Non-nutritive sweeteners: consumer awareness, consumption and inclusion in food and beverage products in South Africa

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Supervisor: Dr Ashika Naicker Date: 20/06/2022

Co-supervisor: Mrs Evonne Singh Date: 20/06/2022

Declaration

I, Shakun Naicker, hereby declare that the research work presented in this thesis is my original work and all the materials used are appropriately acknowledged and explicitly referenced. A reference list is attached to the thesis.

I also confirm that the thesis has not been submitted in any of its part or entirety for any degree in any other institution of higher learning internationally or locally.

I therefore give permission that my work be available for replication and/or for re-printing, for inter-library loan, and for the title and abstract of my thesis to be made available to other educational institutions and students that might need it.

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Dedication

To my husband Priven Naicker and adorable son Aarav Naicker, my loving parents Shakilla and Amichand Haribans and finally, my incredible sister Sarika and brother Kuvir Haribans.

“The starting point of all achievement is desire.”

– Napoleon Hill

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- Our son Aarav who has been most sacrificed through this journey, for his flexibility and ability to accommodate me at his young age.
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Abstract

Background: While there are several advantages that have promoted the consumption of non-nutritive sweeteners (NNSs) like aiding weight loss and supporting diabetes management, there are also concerns about potential negative side effects, such as cancer, insulin resistance, and compensatory appetite that overshadow their use. Globally, NNSs has become a steadfast ingredient in the re-formulation of sugar sweetened beverages (SSBs), but more recently there has been a growing inclusion of NNSs in a wide variety of food items making this ingredient widespread across food categories available in South Africa (SA) due to its functional profile. Furthermore, a sugar tax levy was introduced in SA in 2018 as a counter measure to support the strategic health plan to reduce the country's prevalence of noncommunicable diseases (NCDs) broadening the widespread usage of NNSs in food and beverage industry.

Aim: The aim of the study is to investigate consumer awareness and consumption of NNSs in SA. This study further explores the widespread usage of NNSs through a sub-set of food and beverage products in the South African market.

Methodology: The study used exploratory and quantitative methods to gather data for the research through a cross-sectional survey. The NNS consumer survey was administered to South African participants aged 18 years and older, to all races, men, and women. Convenience and snowball sampling methods was used to recruit 385 participants. The NNS consumer survey was adapted and developed from a study that assessed the knowledge and perceptions of NNSs in the (United Kingdom) UK population. At the beginning of the survey, the introductory paragraph described the background and the aim of the survey, a letter of information and ethical approval for the study was also provided. Sequentially, the questions were related to the participants general health, knowledge, and awareness of NNSs. The survey flowed into a regulatory section which give further insight into participants level of knowledge, perception, and trust of NNSs and concluded with a list of beverages, sweeteners and snacks products to determine consumer consumption thereof. The last section was the NNSs product consumption part of the survey where participants were presented with a list of products containing NNSs and were asked to indicate if they consumed these products. The questionnaire design and the reliability of the questionnaire was pilot tested prior to the survey administration among consumers that were excluded from the main study (n=10). The survey was disseminated through social networks, LinkedIn™, Facebook™ and WhatsApp™ and was designed on 2 different survey design platforms: Google Forms and Microsoft Forms. A scientific product database was established to determine the number of products that contain NNSs within specific categories which included snack foods, dairy products, sugar-free chewing gum, candy, sugar-sweetened beverages, energy drinks, diabetic products, and baby foods, found in three major South African retail stores: Checkers, Woolworths and Dis-Chem. The scientific product database also identified the type of NNSs used, singularly and different combination in products and health and wellness claims for all products examined.

Results: The NNSs consumer survey was completed by 388 South African adults nationally. The survey was opened to all provinces in SA, but high participation came from Gauteng 31.4% (n=122), and KwaZulu-Natal 29.6% (n=122), followed closely by 19.8% (n=77) from Western Cape. Women

participants dominated the survey with a weighted 66.5% (n= 258) of the responses, followed by 33.5% (n=130) of the responses received from men. All races participated in the survey with most responses from Black participants (40.2% n=156), followed by Indian/Asian (30.2% n=117), White (18.0% n=70) and Coloured participants (11.6% n=45). Results showed that mainly the younger South African population with 24.2% (n=94) aged 18-24, 27.6% (n= 107) aged 25-34 and 24.7% (n=96) aged between 35-44 took part in the survey. Participants were asked to indicate if they had any NCDs and the prevalence of the common three NCDs noted were high blood pressure 13.1% (n=51), type 2 diabetes 9.3% (n=36), heart disease 5.4% (n=21) and cancer 2.1% (n=8). A large percentage of participants reported no prevalence of NCDs 73.7% (n=286). Participants were then probed to identify from a list of sweeteners that was provided and indicate which sweeteners they heard off. Interestingly, the results indicated that a large proportion of the participants did not hear of NNSs like neotame 94% (n=363), acesulfame-K 92% (n=356), malitol 84% (n=324), stevia 65% (n=253), saccharin 59% (n=227) and sucralose 59% (n=229) however, a significant 61% (n=238) of participants have heard of xylitol, p<.001 and 45% (174) have heard of aspartame. A total of 33.5% (n=130) p<.001 participants indicated that they consumed products labelled “sugar-free” or “diet” either ‘never’, ‘less often than once a week’ or ‘a few times a week’, p<.001. The relevance of this result is that although a significant 33.5% (n=130) p<.001 of participants consumed products labelled ‘sugar-free’ and/or ‘diet’, they may not actually know the ingredient contained in these products that qualifies it is as ‘sugar-free’ and/or ‘diet’ contain. Participants were given a list of products to select from and were requested to state which products they consume that they think may contain NNSs. A significant 68.3% (n=265) (p<.001) of participants indicated that they consumed cool drinks that they think contain NNSs whilst a significant 71.4% (n=277) (p<.001) did not consume cakes and desserts with NNSs, 70.1% (n=272) did not consume tea, coffee and hot beverages with NNSs and 63.7% (n=247) did not consume chewing gum that contain NNSs. Regarding the use of NNSs in everyday routine, a significant 68.3% (n=265) participants reported that they did not knowingly use NNSs in their everyday routine (p<0.001). The results from the survey further indicated that 50.8% (n=197) of participants were aware of health concerns related to the consumption of NNSs which represents just over half of the participants view. The result for these three statements – ‘I think calling them "artificial" makes me sceptical about their safety’(p=0.00), ‘I worry about the effects that non-nutritive sweeteners can have on my body’ (p=0.00), ‘I have concerns about non-nutritive sweeteners and the risk of cancer’ (p=0.00), was significantly agreed with. There was significant agreement on these benefit statements – ‘non-nutritive sweeteners are helpful for someone who wishes to lose weight’ (p=0.00), ‘non-nutritive sweeteners allow for a little indulgence without feelings of guilt’ (p=0.00), ‘non-nutritive sweeteners allow for diet products to be a viable option’ (p=0.00). When participants were probed on trusting information on health and wellness, the results presented that a significant 55.36% (p=0.00) of participants do not trust the information from government health agencies, regulatory bodies and the information coming from the Department of Health (DOH p=0.00). The results also presented that there was a significant agreement (M=3.11) that NNSs are not good for one’s health, (p=.020).

Finally, a list of products consisting of beverages, sweeteners and snack products was provided, and participants were requested to indicate which products they consume. The list of products that was

presented to participants in the survey were a mix of products where some were most likely to contain NNSs and some were not, like smoothies, chocolate bars and cakes. The data presented that a significant 92% (n=356) (<.001) consume hot beverages (tea, coffee, hot chocolate), 76% (n=294) consume fruit juice and concentrates, 55% (n=213) said yes to milkshake and 54% (n=208) consume diet cool drink. Interestingly, 68.3% (n=265) of participants that said no to knowingly using NNSs in their everyday routine said yes to consuming beverages that may contain NNSs. Of these 68.3% (n=265), 77.2% (n=95) consume fruit juice and concentrates, iced tea, 73.2% (n=90) consume diet cool drinks, 64.2 % (n=79) consume flavoured sparkling water, 55.3% (n=66) consume milkshakes, 53.7% (n=66) consume energy drinks and 40.7% (n=50) consume protein drinks. Participants also indicated their passion for snacking when they were asked to indicate which snacks they consumed. A significant 81% (n=351) consume crisps, 85% (n=330) consume biscuits/rusks, 87% (n=339) consume chocolate bars, 82% consume (n=320) cakes and 82% (n=319) consume ice-creams.

A scientific product database consisting of 419 products that contain NNSs was established. These ranged from snack food, dairy, confectionary, SSBs, energy drinks and diabetic products. The data presented that the highest product category containing NNSs were snacks which made up 45% (n=186) and this was followed by the SSBs category with 21% (n=91) that contained NNSs. The snack food category was made up of the following subcategories: desserts 30% (n=55), crisps 26% (n=48), biscuits 23% (n=43), cereal 9.6% (n=18), sauces 6% (n=12), energy bars 4% (n=7), frozen snacks 1% (n=2) and popcorn 0.53% (n=1). From the NNSs and consumer survey, the results demonstrated that snacks were the highest and most popular consumed products with 81% (n=315) consuming just crisps. From the 419 products that were examined, 65% (n=273) products contained a combination of NNSs used to formulate the product and 34% (n=146) products consisted of single NNS. An interesting outcome that was noted here was that sucralose was most common in formulations where it was found in 38% (n=55) products followed by sorbitol in 16% (n=24) and stevia in 16% (n=23) of the products. Data presented that xylitol was not used individually in products examined.

Conclusion: The outcome of this research has highlighted key consumer insights, presenting sound data that brings to light the current consumer position on the topic of NNSs and its broad use in products in SA. The data highlighted the education gap confirming the initial assumption that there is a high probability that many South African consumers are consuming NNSs without being aware of it. This research has created so many opportunities to improve consumer knowledge and investigate if there is a need to enforce stricter formulating measures with NNSs based on the evidence obtained through the NNSs survey and the scientific product database. These findings should be used to challenge manufacturers, the governmental guardians within the Department of Health and regulators in SA to guide consumer knowledge, awareness, perception and trust. There is a much bigger responsibility and significant role to play in protecting, sustaining, and investing in consumer health and wellbeing, with a priority to focus on consumer education.

Contents

List of Abbreviations

Ace-K	Acesulfame-potassium
ADA	American Diabetes Association
ADI	Acceptable Daily Allowance
AHA	American Heart Association
ANOVA	Analysis of Variance
BDA	British Dietetic Association
CAGR	Compound Annual Growth Rate
CCK	Cholecystokinin
CGCSA	Consumer Goods Council South Africa
CHDs	Congenital Heart Defects
COVID	Coronavirus Disease
CSPI	Center for Science in the Public Interest
CVD	Cardiovascular Disease
DoH	Department of Health
EC	European Council
EECs	Enteroendocrine Cells
FAO	Food and Agriculture Organisation
FDA	Food and Drug Association
GI	Gastrointestinal
GMP	Good Manufacturing Practices
GLP-1	Glucagon-Like Peptide-1
GPCRs	G Protein-Coupled Receptors
GRAS	Generally Recognised as Safe
GSFA	General Standard for Food Additives
HFCS	High Fructose Corn Syrup
HPL	Health Promotion Levy
ISA	International Sweetener Association
Kg	Kilogram
KMO	Kaiser-Meyer-Olkin

Mg	Milligram
NCDs	Non-Communicable Diseases
NNSs	Non-nutritive Sweeteners
NOAEL	No Observed Adverse Effect Level
NTP	Nalt Toxicological Programme
PKU	Phenylketonuria
PYY	Peptide YY
ROS	Reactive Oxygen Species
SA	South Africa
SANHANES	South African National Health and Nutrition Examination Survey
SCFAs	Short-chain Fatty Acids
SPSS®	Statistical Package for Social Sciences
SSBs	Sugar Sweetened Beverages
T1R	Taste 1 Receptor
T2DM	Type 2 Diabetes Mellitus
T2R	Taste 2 Receptor
TRCs	Taste Receptor Cells
UK	United Kingdom
USD	United States Dollars
WHO	World Health Organisation

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Chapter 1
INTRODUCTION

1.1 Introduction

The first chapter will provide a synopsis of the research study, outlining the importance of the study, the problem statement, aim, objectives, assumptions, study parameters and the structure of the thesis.

1.2 Importance of the study

The use of non-nutritive sweeteners (NNSs) in one's diet is often associated with advantages like aiding weight loss and supporting diabetes management (Lohner *et al.* 2020: 7). There is a growing concern globally about health and quality of life which has encouraged consumers to make informed decisions around the consumption of food high in sugar, salt or fat (Lohner *et al.* 2020: 8). This caused many consumers to reduce sugar intake and turn to NNSs for a reduced kilojoule and practically calorie-free alternative to sucrose, making NNSs and products containing NNSs extremely popular globally (Lohner *et al.* 2020: 8). NNSs was commonly used in beverages around the world but more recently there has been a growing inclusion of NNSs in a wide variety of food items and is no longer limited to beverages (Sylvetsky and Rother 2018: 635). Non-nutritive sweeteners are now widespread in a variety of foods including condiments, reduced-Kilojoule desserts and yoghurts, cereals, and snack foods. Gardner *et al.* (2012: 509) describes that NNSs, is commonly known as low-calorie, artificial, noncaloric sweeteners or intense sweeteners because of its heighten sweetness per gram in comparison to caloric sweeteners such as sucrose, corn syrup, and fruit juice concentrates. Non-nutritive sweeteners have been encouraged for the ability to decrease the consumption of sugar, aid weight loss, and regulate blood glucose levels (Gardner *et al.* 2012: 510). In parallel, NNSs have also been under scrutiny for its harmful side effects, such as cancer, insulin resistance, and compensatory appetite (Swithers and Davidson 2008: 161; Tandel 2011: 236). According to Markus *et al.* (2020: 5480), the implementation of the Health Promotion Levy (HPL) in South Africa (SA) correlates with an increased use of sweeteners in the food and beverage industry. The HPL was introduced in the form of a sugar tax law which will be discussed in detail in chapter 2. Non-nutritive sweeteners have not only become widespread in the re-formulation of sugar-sweetened beverages (SSBs) but are now commonly used in several food items available to consumers in South African stores. Non-nutritive sweeteners are known for its functional role as a sugar replacement in that sugar can be replaced or significantly reduced without altering taste. Manufacturers have therefore taken full advantage of the opportunity to formulate with NNSs and realise the financial cost-saving benefit of formulating with NNSs instead of sugar. This cost-saving benefit is also realised by consumers purchasing SSBs that are sugar-free. In SA, manufacturers had the perfect reason to explore formulating with NNSs when sugar tax became a new law for the beverage industry, forcing manufacturers to reduce or replace sugar in SSBs (Markus *et al.* 2020: 5480). More about this will be discussed in chapter 2.

Falbe (2020: 1) asserts that SSB intake is projected to likely contribute to 184,000 global deaths annually from obesity, obesity-related cancers, diabetes, and cardiovascular disease. Falbe (2020: 1)

further states that SSBs also influenced weight gain in children and adults. Singh *et al.* (2015: 15) agree that consumption of SSBs worldwide has become a burden on health, elaborating that more people are consuming high sugar beverages, which include diet or reduced sugar which still maintains its high sweetness intensity. This resulted in lower-calorie replacements becoming broadly available with many products now comprising of NNSs, like acesulfame potassium (acesulfame-K), aspartame, saccharin, and sucralose. While NNSs are chemically diverse compounds, these are all sweet-tasting and contribute no or few calories. Sylvetsky *et al.* (2014: para 2. line 5) express concern that it is unclear whether substitution of sugar with NNSs can ameliorate weight gain; more on this topic will be explained in Chapter 2. However, Bellisle and Drewnowski (2007: 691) are of the view that even though NNSs are sweeter than natural sugar, it contains no kilojoules and encourage its use to control weight and obesity. Interestingly, whilst Lohner *et al.* (2020: 10) state that NNSs may be an excellent tool to reduce sugar intake, manage blood glucose levels, and reduce overall energy intake, it is equally important to maintain a healthy diet, eat correct portion sizes, include a variety of nutrient-dense foods in a diet and conduct regular physical activity.

Ronquest-Ross, Vink and Sigge (2015: 1) highlight that, the South African diet has changed significantly over the past two decades, shifting from a traditional diet based of grains, legumes, vegetables, and fruit, to a western diet centered on energy-dense, nutrient-poor processed foods and beverages resulting in increased added sugar and salt. This has led to an increasing prevalence of overweight and obesity among South Africans (Ronquest-Ross, Vink and Sigge 2015: 1). Harmse (2019: para 2. line 1) explains that, in SA the average person consumes at least 24 teaspoons of sugar daily, which is twice as much as the World Health Organisation guidelines for daily sugar intake (World Health Organisation 2015: 4). According to Statistics South Africa (2021: 1) a concerning 7% of the population aged between 21-79 years old, has type 2 diabetes, this is equivalent to 3.85 million people. A counter-measure to improve health outcomes of South Africans is the HPL on sugary beverages which is aimed to reduce obesity (South African Department of Treasury 2018: para 6. line 3). The HPL on SSBs was a catalyst, forcing the beverage industry to manage the reduction of sugar quantity and adding a combination of commonly used NNSs in cooldrinks (acesulfame-K aspartame, sucralose) to still achieve desired taste. To reiterate this point, Markus *et al.* (2020: 5480) concur that governments are establishing regulations that compel consumers to reduce their consumption of sugar while, simultaneously causing the food and beverage industry to include NNSs in their products. Based on this approach from the food and beverage industry, the reason for this study is to investigate consumer awareness and consumption of NNSs in South Africa. This study further explores the widespread usage of NNSs through a sub-set of food and beverage products in the South African market.

1.3 Problem statement

Non-nutritive sweetener usage in the food and beverage industry is well known and documented. Non-nutritive sweeteners have not only become a steadfast ingredient in the re-formulation of SSBs, but its use is also becoming more widespread across food categories available in SA. Thus, consumers may be directly impacted by unwittingly consuming multiple sweeteners containing items per day; this

creates an impetus to probe consumer perception and knowledge of NNSs and to establish if consumers read ingredient labels to establish if products contain NNSs, prior to purchasing products.

Research indicates that the amplified use of NNSs in the food and beverage sector is a massive global trend and recently, SA has adopted this trend with the intention to curb the level of diabetes and obesity among South Africans (South African Department of Treasury 2018: para 6. line 3). Lohner *et al.* (2020: 5) reiterate that, overall NNSs are likely to lower the intake of energy and carbohydrate, hence the preference to sugar. Furthermore, Lohner *et al.* (2020: 5) encourage that when consumption is controlled, it can become a beneficial approach for individuals looking to control their kilojoule intake and support weight management. Due to prolific research detailing the pros and cons of the inclusion of sweeteners in food and beverage products, controversy continues to surround the use of NNSs with sugar substitutes being criticised for its long-term effect on health (Shwide-Slavin, Swift and Ross 2012: 104).

Strawbridge (2020: 1) has argued that NNSs have become “an ingredient of concern over time”. For example, Strawbridge stresses that while studies leading to Food and Drug Administration (FDA) approval have ruled out the risk of cancer, these studies were conducted using far smaller amounts of diet cooldrinks than the 0.68mg a day, consumed by many people who drank diet cooldrinks (Strawbridge 2020: 1). Strawbridge (2020: 1) expanded his argument, to underscore that the long-term effect of such large doses of chemicals is yet to be established. Alongside this, it must be remembered that all NNSs are not created equal. According to the The United States Food and Drug Administration (2018: para 1. line 3), aspartame, acesulfame-K, neotame, saccharin, and sucralose are regulated as food additives and therefore had to first be approved as safe under the conditions of intended use. However, Lohner *et al.* (2020: 7) argue that these findings were overlooked after extensive review. Ever since, there have been no greater or long-standing human studies to further link NNSs and cancer. Some consumers are concerned about the inclusion of NNSs in food and beverage products and the lack of conclusive trials to prove their safety (Sharma *et al.* 2016: 237). This concern is magnified when consumers may unknowingly consume NNSs in multiple food and beverage in a day, creating a need for research to establish the SA consumer perception and awareness of NNSs, the widespread use of NNSs in food and beverage products, the composition of NNSs used in food and beverage products, and how sweeteners are regulated in SA.

1.4 Aim of the study

The aim of the study is to investigate consumer awareness and consumption of NNSs in South Africa. This study further explores the widespread usage of NNSs through a sub-set of food and beverage products in the South African market.

1.5 Objectives

- To determine the level of knowledge, awareness, and perception of South African consumers on NNSs in products they consume through a NNS consumer survey.
- To determine the consumption of beverages, sweeteners and snacks products through the NNS consumer survey.
- To establish a scientific product database detailing a breakdown of NNSs in a sample of packaged products available in retail outlets in SA through product label analysis.

1.6 Assumptions

The following assumption was made:

- There may be consumers (adults and children) who knowingly and unknowingly consume products containing NNSs.
- Participants answered the survey truthfully.

1.7 Study parameters

- The study was limited to SA's current position on NNSs in food and beverage products.
- The online survey was limited to the participation of South Africans living in SA who are 18 years and over and who have access to a device to participate in the survey.
- The NNS food frequency consumption survey was limited to 385 South African consumers.
- The product label analysis for this study was limited to snacks, SSBs, energy drinks, dairy, gum, candy, diabetic food, and baby food available at three major retailers: Checkers, Woolworths and Dis-Chem.

1.8 Outline of the research study

The outline of the study, as indicated below, was developed together with the research supervisors.

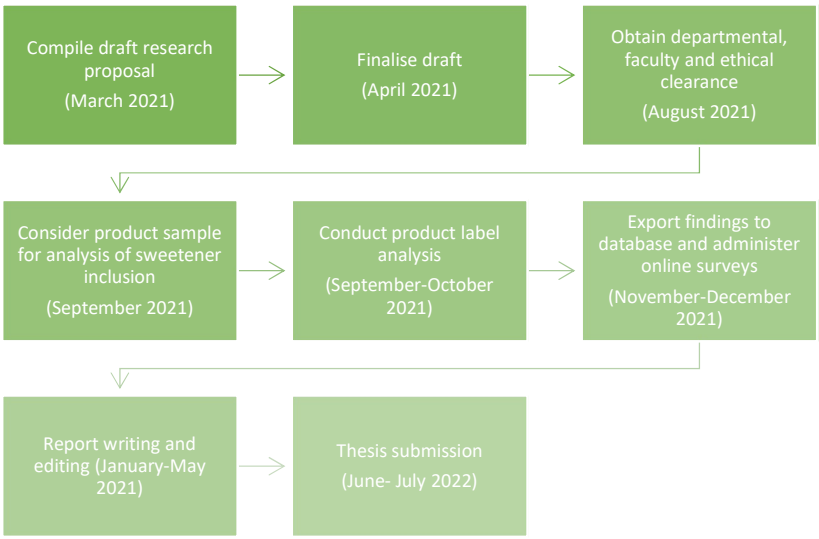


Figure 1.1 Outline of the research study

1.9 Definition of terms

Consumer: a person who makes daily purchase decisions for buying a product, brand or service for their needs and wants (Kotler and Keller 2021: 29).

Diabetes: is described as a chronic, metabolic disease distinguished by raised blood glucose levels (or blood sugar), which over time leads to serious damage to the heart, blood vessels, eyes, kidneys and nerves (World Health Organisation 2021a: para 1. line 1).

Energy-dense: the amount of energy (kilojoules) per gram of food (British Nutrition Foundation 2018: para 1. line 1).

Ingredient label analysis: the detailed study or examination of a packaged food label that describes a list of the ingredients that make up the product we are researching, using, or consuming (Martini and Menozzi 2021: 268).

Manufacturer: is a business or company which embarks on wide scale production of goods to sell (Collins English Dictionary 2021a: 1).

Reformulate: to originate or prepare something again (Oxford Reference 2021: 1).

Regulations: are rules made by a government or other authority in order to control the way something is done, or the way people behave (Collins English Dictionary 2021b: 1).

Non-nutritive sweeteners: these are synthetic compounds that intensify sweetness, consisting of few to no calories when compared to white sugar (Marcus 2013: 149).

Overweight: the term overweight is used to explain when a person has a body mass index (BMI) greater than or equal to 25 kg/m^2 (World Health Organisation 2021b: para 2. line 2).

Obesity: obesity is the term used when measuring BMI, which describes the weight in kilograms divided by the square of the height in metres (kg/m^2). A BMI over 25 kg/m^2 is explained as overweight, and a BMI of over 30 kg/m^2 is described as obese (World Health Organisation 2021b: para 2. line 3).

Sugar-sweetened beverages: are sweetened liquids with various forms of added sugars with a slight nutritional value (Allcott, Lockwood and Taubinsky 2019: 204; Malik and Hu 2019: 2).

1.10 Structure of thesis

Chapter 1: Introduction

- Aims, objectives and context of the research.

Chapter 2: Literature Review

- Detail about the topic using analysis from current/previous studies.

Chapter 3: Methodology

- Research methods to be used in the study.

Chapter 4: Results and Discussion

- Presentation of findings, discussion, and depiction of results.

Chapter 5: Conclusion and Recommendations

- Deductions made on results, shortcomings, and suggestions for further research into topic.

1.11 Conclusion

Chapter 1 has outlined the purpose and importance of the study. It is becoming more evident that NNSs are being promoted as a healthier alternative to sucrose through its widespread usage in the food and beverage industry. Therefore, the primary goal of this study is to establish through the research the reasons that underpin why NNSs are becoming a popular alternative to sucrose in several products and to investigate if consumers in SA are equipped with the right level of awareness that allows them to make informed decisions when consuming NNSs. While doing this, literature will be reviewed to determine the health concerns and benefits associated with their use. A review of the related literature is presented in the next chapter.

1.12 Referencing style

The referencing style used in this thesis is according to the Durban University of Technology (DUT) Harvard style referencing guidelines (Mitha, Naidoo and Thomas 2017).

Chapter 2
LITERATURE REVIEW

2.1 Introduction

This chapter provides an overview of the literature sources that were reviewed to understand and investigate the research topic. It comprises of a systematic, in-depth analysis into NNSs, its widespread use in the food and beverage industry and explores knowledge and awareness of the South African consumer on NNSs.

2.2 Overview on sweeteners

Globally the burden of obesity and diabetes has had a direct influence on the inclusion of NNSs in product reformulation. In chapter 1 it has been explained that NNS are favourable as sugar substitutes because of its intense sweetening effects without or limited kilojoules to the diet (Gardner *et al.* 2012: 509). Myers, Passaro and Hedrick (2018: 334) describe that, very small amounts of NNSs have intense sweet taste. Wal, Pal and Wal (2019: 1595) define a sweetener as, a food additive, which mimics the effect of sugar on taste receptors, and are therefore called sugar substitutes which are either natural or synthetic. Synthetic sugar substitutes are commonly referred to as artificial sweeteners, low calorie sweeteners or non-nutritive sweeteners (Wal, Pal and Wal 2019: 1595). For the purpose of this study, non-nutritive sweeteners (NNSs) will be used throughout the thesis. In this section, details of the various sweetener types and its chemical make-up will be unpacked.

Walbolt and Koh (2020: 114) explain that extensive evidence exists to show how consumption NNSs has increased among obese individuals and diabetics. Obesity and diabetes have become a global public health issue and governments have placed pressure onto manufacturers to reduce sugar levels in particular SSBs products by forcing them to use NNSs in their product formulations. The trend analysis and forecast of non-nutritive sugar market conducted by Persistence Market Research (2017: para 2. line 1) describes the global trend of changing lifestyle patterns and busy schedules of consumers, to reflect a concomitant increase of lifestyle diseases such as diabetes, obesity, and high blood pressure. The trend analysis and forecast continues to reveal how consumers are becoming increasingly concerned over obesity and awareness of the effect of added sugar in food products, thus fuelling the demand for NNSs globally. Farhat, Dewison and Stevenson (2021: 444) substantiate that, the increasing consumption of NNSs is linked to consumers who are wanting to lower kilojoule intake and the risk of obesity and type 2 diabetes.

2.3 Sugar substitutes

There are four other types of sugar substitutes which are presented in Figure 2.1, these are separated by their origin as follows:

- Non-nutritive sweeteners
- Sugar alcohols
- Natural sweeteners
- Novel sweeteners

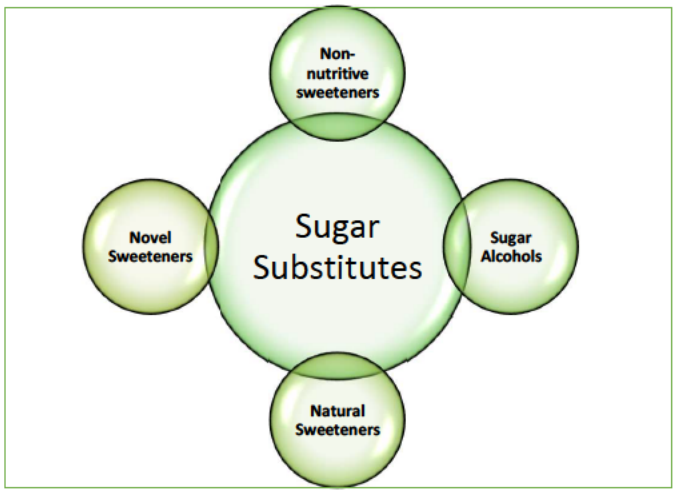


Figure 2.1 Types of sugar substitutes available for consumption (Wal, Pal and Wal 2019: 1595)

2.3.1 Non-nutritive sweeteners

Non-nutritive sweeteners have intense sweetness in small quantities (Gardner *et al.* 2012: 509). These are chemically synthesised, and therefore referred to as "artificial". These will be discussed in detail in Table 2.1.

- Aspartame
- Sucralose
- Neotame
- Acesulfame-K
- Saccharin
- Cyclamate
- Thaumatin

2.3.2 Sugar alcohols

According to Harbolic (2020: 1) nutritive sugar alternatives like sugar and sugar alcohols when consumed, provide calories. Sugar alcohols or polyols, contain fewer calories than sugar. Sugar provides 4 kcal/gram, and sugar alcohols provide an average of 2 kcal/gram (range from 1.5 kcal/gram to 3 kcal/gram) (Harbolic 2020: 1). According to Grembecka (2015: 241) contrary to its name, sugar alcohols are neither sugars nor alcohols. These are carbohydrates with structures that only resemble sugar and alcohol (Grembecka 2015: 242). Polyols are also naturally present in fruit and some vegetables such as mushroom in very small quantities. Grembecka (2015: 243) goes on to explain unlike NNSs, polyols are often combined with other sweeteners because they are not very sweet on its

own. Polyols play a role in product texture, preservation, and filling, holding moisture and cooling sensation in the mouth (Grembecka 2015: 244).

Sugar alcohols or polyols commonly found in foods are:

- Mannitol
- Xylitol
- Sorbitol
- Erythritol
- Isomalt
- Lactitol
- Maltitol

These will be further described in detail in Table 2.1.

2.4 Natural sweeteners

These are found in nature, occurring naturally in fruits. Priya, Gupta and Srikanth (2011: 2034) explain that natural sweeteners carry a nutrition value and are non-carcinogenic as compared to synthetic sweeteners (Priya, Gupta and Srikanth (2011: 2034). Wal, Pal and Wal (2019: 1595) describe that, these have extreme sweetening powers per gram and are low in kilojoules and are thermostable as well. Some important ones are honey, liquorice and thaumatin.

2.4.1 Honey

Neacsu and Madar (2014: 64) simply state that honey is made by bees from the nectar of flowers, is a ready-made sweetener that contains traces of nutrients. To typically describe the composition of honey, Priya, Gupta and Srikanth (2011: 2035) indicate that the composition of honey is made up of 17.7% moisture, 76.4% total sugars, 0.18% ash, and 0.08% total acid (as formic acid). Honey can be used as a sweetening agent in food or in preparations of creams, sauces and candies. Honey also functions as a preservative confirms Neacsu and Madar (2014: 64).

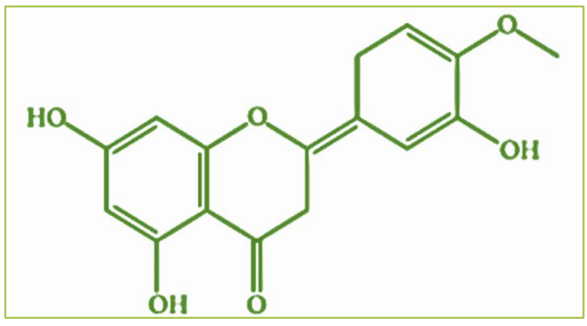


Figure 2.2 Honey chemical structure (Neacsu and Madar 2014: 64)

2.4.2 Liquorice

El-Lahot *et al.* (2017: 127) define that the origination of liquorice is from a liquorice root of a small leguminous shrub, Glycyrrhiza glabra L. which was first discovered in Europe and Central Asia. El-Lahot *et al.* (2017: 128) confirm that Glycyrrhizin is between 50-100 times sweeter than sucrose and has a gentle onset of sweetness followed by a lingering liquorice-like aftertaste. It has a sweet woody flavour. Priya, Gupta and Srikanth (2011: 2035) reiterate that because of its sweet taste, Glycyrrhizin is used worldwide as a natural sweetener and flavouring additive. It is commonly used in toffee and candy (Priya, Gupta and Srikanth 2011: 2035).

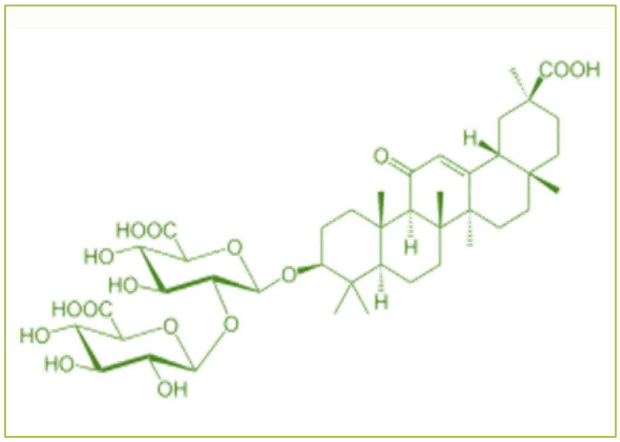


Figure 2.1 Glycyrrhizin chemical structure (El-Lahot *et al.* 2017: 127)

2.4.3 Thaumatin

Yebra-Biurrun (2005: 562) confirms the origin of Thaumatococcus daniellii to Africa (the indigenous West African Katemfe fruit). Thaumatin is a natural form of protein that has an intensely sweet taste and is therefore commonly used as a sweetener. It is at least 3000 times as sweet as sucrose. It provides 4 cal/gm. In West Africa, it is traditionally used for sweetening bread, wines, and sour food state (Yebra-Biurrun 2005: 562). Since the mid-1990s, the food and confectionery industry uses it as sweetener and flavour enhancer (Yebra-Biurrun 2005: 562).

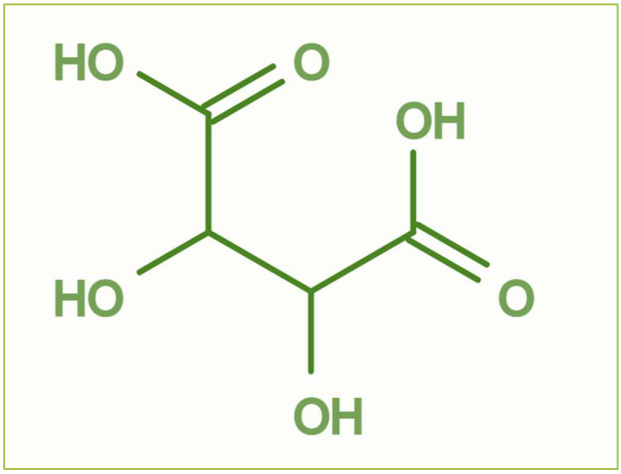


Figure 2.2 Thaumatin chemical structure (Yebra-Biurrun 2005: 565)

2.5 Novel sweeteners

Novel sweeteners are known as natural sweeteners because these are also derived from nature explain Priya, Gupta and Srikanth (2011: 2036). According to research by Persistence Market Research (2017: para 3. line 1), novel sweeteners have become extremely popular in the food and beverage industry growing its market share significantly over recent years. Interestingly, Persistence Market Research (2017: para 14. line 11) goes on to project that, stevia extract will be one of the top selling novel products by year 2026. To put the novel sweetener growth spurt into context, below is a good visual that has been presented by Persistence Market Research (2017: para 2. line 3) putting the rapid growth of novel sweeteners into perspective for us. According to the research done by Persistence Market Research (2017: para 6. line 3) a compound annual growth rate (CAGR) is projected to reach 5.2% growth by year 2026. More about stevia will be discussed in section 2.7.4.

Figure 2.3 Indicating the predicted CARG of novel sweeteners market (Persistence Market Research 2017: para 2. line 3)

Examples of novel sweeteners will be discussed below.

2.5.1 Stevia

Originates from the leaves of the Stevia rebaudiana plant in South America and cultivated in Japan (Priya, Gupta and Srikanth (2011: 2036). Well-Known as “sweet leaf” and is therefore positioned as the safest natural sweetener (Priya, Gupta and Srikanth 2011: 2036). Stevia was confirmed Generally Recognised as Safe (GRAS) in 2008. Seen as a healthier natural alternative to sugar and is 200 – 300 times sweeter than sugar (Priya, Gupta and Srikanth 2011: 2036). Stevia has been widely used as a sweetener for many years (Herbst 2021: 1). Stevia has become increasingly popular and largely used in baking, beverages, cereals, dairy, dressings, sauces, frozen foods, processed fruits, vegetables and snacks. It is heat stable and enhances sweet flavours. It is also used as a packet sweetener in tea/coffee beverages (Herbst 2021: 1).

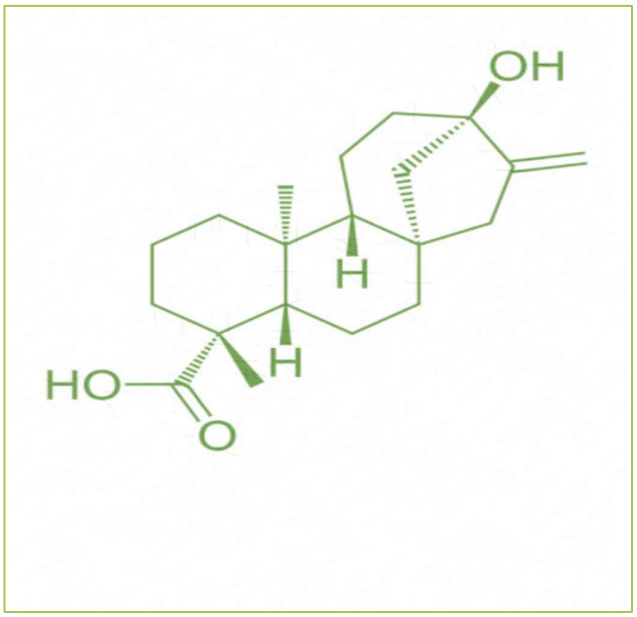


Figure 2.4 Stevia chemical structure (Priya, Gupta and Srikanth 2011: 2036)

2.5.2 Tagatose

According to Levin (2002: 23) tagatose is naturally found in traces in fruits, cacao, and dairy products. Tagatose can crystallise just like sugar, is therefore commonly used in confectionery products, such as chocolate, hard-boiled candies, fondant, fudge, and caramel. It could also be used as a sugar alternative in ice cream, soft drinks, and breakfast cereals. It provides 1.5 kcal/gm. De Gruyter (2009:1) describes that, chemically tagatose is (3S, 4S, 5R)-1, 3, 4, 5, 6-Pentahydroxy-hexane-2-one as shown in figure 2.3. Levin (2002: 24) first discovered tagatose and introduced it as a sweetener in 1988 (Levin 2002: 24).

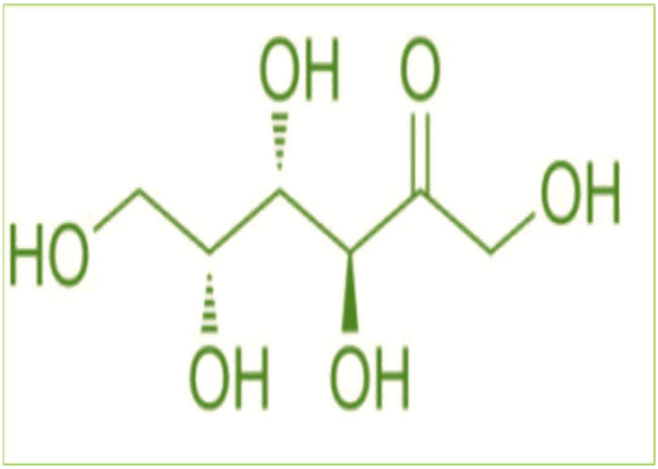


Figure 2.5 Tagatose chemical structure (The United States Food and Drug Administration 2018)

2.5.3 Trehalose

Elbein *et al.* (2003: 17) confirm that, trehalose is a sweetener that is found across a variety of organisms, including bacteria, yeast, fungi, insects, invertebrates, and lower and higher plants, where it may serve as a source of energy and carbon. Elbein *et al.* (2003: 17) describe that, chemically it is (2R,3S,4S,5R,6R)-2-(Hydroxymethyl)-6- [(2R, 3R, 4S, 5S, 6R)-3, 4, 5-trihydroxy-6-(hydroxymethyl)oxan-2-yl]oxyoxane-3,4,5-triol as shown in figure 2.7. According to Wal, Pal and Wal (2019: 1595), trehalose was first discovered in 1832, from an ergot of rye. Trehalose is known to extend shelf life and prevent food from drying out. It is popularly used in food, cosmetics and medicated products (Priya, Gupta and Srikanth 2011: 2036).

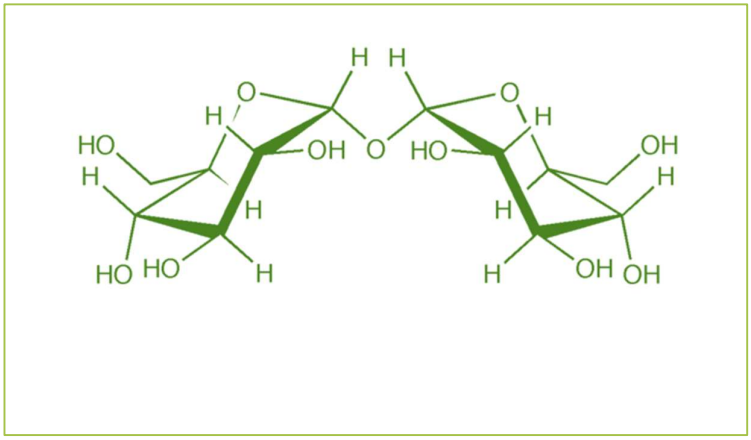
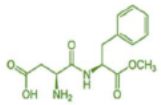
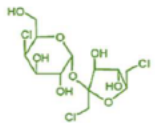
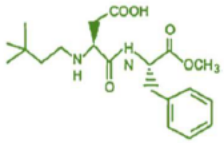
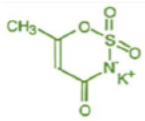
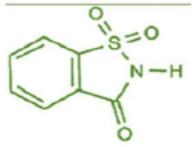
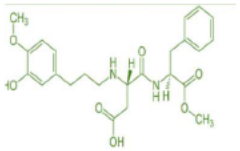
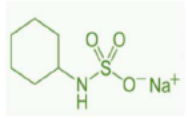


Figure 2.6 Trehalose chemical structure (Elbein *et al.* 2003: 20)

Table 2.1 provides a comparative view of NNSs by definition, year of approval by the FDA, chemical structure, brand names, characteristics, relative sweetness to sucrose, Kcal/g, and acceptable daily intake (ADI) and uses. Table 2.2 outlines the nutritive sweeteners by type, characteristics ADI.

Table 2.1 Non-nutritive sweetener comparison (Yebra-Biurrun 2005: 566; PUBCHEM National Library of Medicine (NIH) 2006; The United States Food and Drug Administration 2018: 1; Periyasamy 2019: 120)

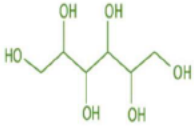
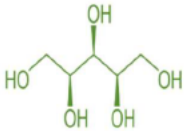
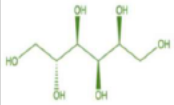
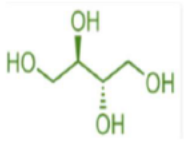
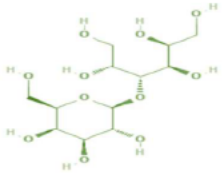
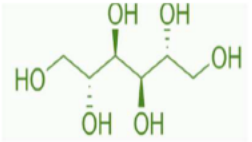
	Aspartame	Sucralose	Neotame	Acesulfame-K	Saccharin	Advantame	Cyclamate
Definition	Artificial sweetener made up of aspartic acid and phenylalanine	A sweetener resulting from the replacement of 3 hydroxyl groups with 3 chlorine atoms on the sugar molecule	Dipeptide methyl ester made up from aspartic acids and phenylalanine	A sweetener combined with an organic acid and potassium	Artificial sweetener in structures of sodium or calcium saccharin	Artificial sweetener created from 3-step method	Artificial sweetener discovered in 1937
Year of approval by FDA	1981	1998	2002	1988	Prior to 1958. Reapproved in 2000	2014	1982
Chemical Structure	 (Yebra-Biurrun 2005: 566)	 (Yebra-Biurrun 2005: 566)	(Yebra-Biurrun 2005: 566) 	 (Yebra-Biurrun 2005: 566)	 (Yebra-Biurrun 2005: 566)	 (Yebra-Biurrun 2005: 566)	 (Yebra-Biurrun 2005: 566)

	Aspartame	Sucralose	Neotame	Acesulfame-K	Saccharin	Advantame	Cyclamate
Brand Names	NutraSweet®, Equal®, others	Splenda®	Common sweetener used in food and snack products	Sunett®, Sweet One®	Sweet'N Low®, Sweet Twin, Sugar Twin®, Necta Sweet®	Used as an ingredient in food and beverage products	SugarTwin Sucaryl
Characteristics	Tends to have loss of sweetness when exposed to high temperatures	Known for its high heat stability during cooking and baking	Known for its high heat stability during cooking and baking	Known for its high heat stability during cooking and baking Tends to have a metallic aftertaste	Known for its high heat stability during cooking and baking Tends to have a metallic aftertaste	Known for its high heat stability during cooking and baking. Very high sweetness intensity. Taste is similar to sugar but sweeter	Can withstand high temperatures but cannot add volume and improves taste when used in combination than by itself.
Relative sweetness compared to sucrose*	180x	600x	7000 – 13000x	200x	300x	20000x	30x
Kcal/g	4	0	0	0	0	0	0
ADI (mg/kg/d) **	50	5	18mg/NA	15	5	1970 mg/day	50
Uses	Packet sweetener in tea/coffee, beverages. Often used in snack food and SSBs. Not used for cooking and baking	Packet sweetener in tea/coffee, beverages, baking, frozen dessert, candy, SSBs, cough drops, and mints	Packet sweetener in tea/coffee, beverages, SSBs, bakery products, jams, chewing gum, tinned fruit, candy, dessert toppings, salad dressings	Packet sweetener in tea/coffee, beverages, chewing gum, Ice-cream, fruit juices, gelatines	Carrier for flavour, used in baking, SSBs, chewing gum, frozen dessert, jams, puddings, gelatines, stewed fruit	Carrier for flavour, used in baking, SSBs, chewing gum, frozen dessert, jams, puddings, gelatines, stewed fruit	Packet sweetener in tea/coffee, beverages, Sugar confectionary

*Relative sweetness as compared to sucrose (table sugar). 1= reference value which is the sweetness of sucrose.
** ADI = Acceptable Daily Intake

*** Other non-nutritive low-calorie sweeteners (Alitame, Thaumatin, Neohesteridine, and Glycyrrhizin) are not yet approved as both sweeteners and as GRAS in the US.

Table 2.2 Nutritive sweeteners: Polyols (Elbein *et al.* 2003: 23; The United States Food and Drug Administration 2018: 1; Wal, Pal and Wal 2019: 1598)

Type	Mannitol	Xylitol	Sorbitol	Erythritol	Lactitol	Maltitol
Definition	An alcohol described as hexose obtained from seaweed	An intermediate product of carbohydrate metabolism from xylan-containing plants	Obtained through hydrogenation of glucose and fructose with nickel catalyst, also obtained from hexose alcohol	A tetrose alcohol formed from cultivating yeast-like fungi on glucose	Lactitol, also known as 4-β-D-galactopyranosyl-D-glucitol, is a sugar alcohol derived from lactose	Maltitol (formed by reducing maltose) is about 80% as sweet as sucrose
Year of approval by FDA	1986	1983	GRAS 1982	GRAS 2001	GRAS 1989	GRAS 1984
Chemical Structure	 (Wal, Pal and Wal 2019)	 (Wal, Pal and Wal 2019)	 (Wal, Pal and Wal 2019)	 (Wal, Pal and Wal 2019)	 (Wal, Pal and Wal 2019)	 (Wal, Pal and Wal 2019)
Brand Names	Used as ingredient in food products	XyloSweet	Used as ingredient in food products	Zerose	Used as ingredient in food products	Used as ingredient in food products
Characteristics	Can withstand high temperatures, melting at extreme	Highest sweetness intensity of all	Can withstand high temperatures and	Extremely soluble in water. Non-hygroscopic	Heat stable, extremely soluble, known for low to no calories therefore applicable	Completely disperses in product.

	temperatures. Known as Non-hygroscopic (resistant to moisture)	alcohols, which disperses rapidly. Has a cooling mouthfeel	highly soluble. No browning benefit and is humectant in nature. (moisture retainer)	(resistant to moisture).	for a variety of low-calorie, low-fat and/or sugar-free products.	Has a cooling mouthfeel.
Type	**Mannitol**	**Xylitol**	**Sorbitol**	**Erythritol**	**Lactitol**	**Maltitol**
Relative sweetness compared to sucrose*	0.5 - 0.7x	1x	0.5 - 0.7x	0.6 - 0.8x	0.3-0.4x	0.9x
Kcal/g	1.6	2.4	2.6	0.2	1.9	2.1
ADI (mg/kg/d)**	Not specified	Not specified	Not specified	Not specified	Not Specified	Not Specified

*Relative sweetness as compared to sucrose (table sugar). 1= reference value which is the sweetness of sucrose

** ADI = Acceptable Daily Intake

2.6 Functionality of sucrose vs. sweeteners in formulations

There are no significant differences between how sucrose and sweeteners function in recipes. Sweeteners is widespread in use as it suits the functionality role of sucrose. One thing to note is that when formulating recipes with sweeteners the performance of this ingredient and the end quality of the product may differ to that of the sucrose ingredient baking (Kansas Value Added Foods Lab 2018: para 3. line 3; Woodbury, Lust and Mauer 2021: 687). These differences are illustrated in the Table 2.3 describing the functionality differences between sucrose and sweetener role in baking.

Table 2.3 Functionality difference in sucrose and sweeteners in baking (Kansas Value Added Foods Lab 2018: para 3. line 3; Woodbury, Lust and Mauer 2021: 687)

Sucrose	Sweeteners
Initiates Maillard reaction	Appearance may be affected e.g., less Maillard browning
Sucrose controls water activity within a wide range of foods and products which is inherently safer from microbiological spoilage.	Water activity must be closely managed when using sugar replacements, NNSs cannot achieve this on its own, it is recommended to use polyols to play a role in reducing microbial spoilage.

2.7 International legislation and labelling requirements for the use of sweeteners in foodstuff

In many countries around the world, governments regulate the use of NNSs and globally, NNSs are regulated under the grouping 'food additives'. Markus *et al.* (2020: 5480) explain that governments are creating regulations to assist consumers to reduce their sugar intake. The safety and use of food additives are heavily regulated across the world. The United States Food and Drug Administration (2014: para 3. line 1) states that, a high intensity sweetener is regulated as a food additive, unless its use as a sweetener is generally recognised as safe. In some cases, countries have adopted global guidelines in designing country specific regulations for food additives. 'The FDA regulates all sweeteners that are sold or used in prepared foods in the United States' (The United States Food and Drug Administration (2014: para 4. line 1). The FDA has set an ADI. This is the amount a person can safely consume each day over a lifetime. Most people eat far less than the ADI (The United States Food and Drug Administration (2014: para 9. line 4).

Ibrahim (2015: 1) reassures that, before approving any NNSs safe for human consumption, NNSs go through a stringent safety assessment in tests with humans and animals to ensure they meet the safety requirements for consumption by consumers, including pregnant women and children. Liauchonak *et al.* (2019: 644) explain that, currently the FDA has approved the use of acesulfame-potassium (Acesulfame-K), aspartame, neotame, saccharin, sucralose, and stevia.

In the meantime, Ibrahim (2015: 88) justifies that, the United States, continues to assess scientific information on the safety of these approved high intensity sweeteners in food, beverages and other products. Should new evidence suggest that a product containing an approved low-calorie high intensity

sweetener is unsafe, the FDA is responsible to review such evidence and to take proper action. Referring to a new report publicised by the International Sweeteners Association (ISA), Durrell (2020: para 1. line 2) justifies that, there is an extensive body of robust scientific evidence indicating that NNSs are safe and can be part of broader strategies to reduce sugar intake. However, regulations are still an area of controversy and a potential point of concern with room for improvement.

2.7.1 Codex Alimentarius

Commonly known as Codex by the food and beverage manufacturing industry has significantly shaped the regulatory world and formed a global foundation for safe use of additives in food. The General Standard for Food Additives: Codex Stan 192-1995 is a standard that guides the food and beverage industry globally on acceptable use of additives in food, overall guiding the limits of use and labelling practices (Food and Agriculture Organisation 1985: para 1. line 1). Codex standards use science as a basis for its food laws and guides the regulation for food safety and safe trade of products in countries all over the world (Food and Agriculture Organisation 1985: para 1. line 1). Countries have the freedom to mould regulations, meaning that Codex standards can be used as a guideline to form its regulation which can be stricter or adopt exact Codex recommendations. This varies from country to country and is often determined by country health strategies and plans. Codex describes its commission as the central part of the Joint FAO/WHO Food Standards Programme and was established by FAO and WHO to safe guard consumer health and ensure fair practices in food trade since 1963 (Food and Agriculture Organisation 1985: para 1. line 1).

2.7.2 Global approved sweetener list and the birth of E-numbers

By now it is known that nutritive and non-nutritive sweeteners are allowed globally, approved by WHO, FDA, FOA and Codex. An example of how Europe adopted the Codex additive standard will be shared here to give insights of how the Codex standards is applied differently from country to country. According to Regulation (EC) No 1333/2008 of the European Parliament and of the Council of 16 December 2008 on food additives, sweeteners are also classified under the grouping of additives and have been given an e-number identity (Parliament and the Council of the European Union 2008: 3). E in E-numbers stands for Europe followed by numbers as depicted in the table below. These numbers are codes used for food additives in accordance with EU directive and can appear in the ingredient labelling for use of food additives in a product independently without listing the name of the sweetener dictated by the Regulation (EC) No 1333/2008 of the European Parliament and of the Council of 16 December 2008. E-numbers are commonly used in ingredient declarations to assist the manufacturer with legal text space constraints. Table 2.4 shows the list of approved sweeteners with E-number codes that is permitted in labelling.

Table 2.4 List of the approved sweeteners classified by the E-number code that is permitted in labelling (Parliament and the Council of the European Union 2008)

E- Number	Sweetener
E420	Sorbitol & Sorbitol syrup
E421	Mannitol
E950	Acesulfame-K
E951	Aspartame
E952	Cyclamic acid and its Na and Ca salts
E953	Lsomalt
E954	Saccharin and its Na, K and Ca salts
E955	Sucralose
E957	Thaumatin
E959	Neohesperidine DC
E960	Steviol glycoside
E961	Neotame
E962	Salt of aspartame-acesulfame-K
E964	Polyglycitol syrup
E965	Maltitol & Maltitol syrup
E966	Lactitol
E967	Xylitol
E968	Erythritol
E969	Advantame

2.7.3 Sweetener regulation in South Africa

In SA, the Department of Health (DOH) has established a legislation for sweeteners titled Regulations for the use of Sweeteners in Foodstuffs under R146 section 15 (1) of the Foodstuffs, Cosmetics and Disinfectants Act,1972 (Act 54 of 1972) Regulations Relating To The Labelling And Advertising Of Foodstuffs. The South African regulations are aligned with "Codex" and comply with mandatory Codex requirements. To reiterate this is another example of how Codex principles were adopted. Essentially, countries may have the freedom to regulate sweeteners within guidelines provided by Codex, meaning there could be a need to introduce a stricter guideline in a country. This is based on a country's discretion resulting in a stricter requirement or control. The legislation dictates the approved sweeteners for use and the limits applicable for manufacturing of food and beverage products. The R146 Regulation on the labelling of food published in 2010 also covers the basic labelling requirements for foodstuffs in SA. This regulation falls under the Foodstuffs, Cosmetics and Disinfectants Act,1972 (Act 54 of 1972). Table 2.5 displays sweetener limits legally allowed in foodstuffs in SA.

Table 2.5 Sweetener limits legally allowed in food products and the permitted doses in mg/kg (Food and Agriculture Organisation 1985)

Sweetener	NNSs in Dairy Desserts (mg/kg)	NNSs in Ice cream (mg/kg)	NNSs in Cocoa & Chocolate Products (mg/kg)	NNSs in Hard Candy (mg/kg)	NNSs in Chewing gum (mg/kg)	NNSs in Baked Goods (mg/kg)	NNSs as a Tabletop Sweetener (mg/kg)	NNSs in Sauces (mg/kg)	NNSs in Soft Drink (mg/kg)
Acesulfame-K	350	800	500	500	5000	1000	GMP	1000	600
Aspartame	1000	1000	3000	3000	10000	1700	GMP	350	600
Cyclamate	250	250	500	500	3000	1600	GMP	Not stated	350
Saccharin	100	100	500	500	2500	170	GMP	160	300
Steviol Glycosides	330	270	Not stated	700	3500	Not stated	GMP	Not stated	200
Sucralose	400	320	800	1800	5000	700	GMP	450	300

The sweetener regulation dictates, a few mandatory requirements to bear in mind when manufacturers label product containing NNSs. The label also allows for consumers to review the list of ingredients in the product and determine whether those ingredients will be suitable for their consumption.

Certain NNSs use require additional warning labels. Example, the word “aspartame” in the list of ingredients must have an asterisk; and state it contains “Contains phenylalanine” The legislation also regulates labelling principles and stipulates how labels should appear. Below are two labelling examples that indicates a warning label, use of E-numbers instead of the name of the NNSs used as well as listing the name of NNSs without E-numbers. These examples are of product labels available in SA:

Example A: The product label in this example lists the name of the NNSs used and its E-number. This example also shows the mandatory *warning label for aspartame.

Potatoes, vegetable oil (palm fruit and/or maize germ or sunflower seed) with antioxidant (TBHQ), corn flour, salt, acidity regulators (E262, E330, E296), vegetable powders (onion, garlic) (irradiated), sugar, MSG [flavour enhancer (E621)], flavourings, spices (irradiated), hydrolysed vegetable protein, anticaking agent (E551), flavour enhancers (E631, E627), colourants (E110, E172), aspartame* [non-nutritive sweetener (E951)].

*Contains phenylalanine.

Example B: The label in this example only lists the e-number of the NNSs blend used and not the name of the NNSs itself. This impacts the way consumers interact with labelling information and influences their familiarity with NNSs.

Ingredients: Cow's Milk and/or Recombined milk, sugar, fruit (6%), Stabilisers (plant based) (E415; E1422), Buttermilk powder (Cow's milk), Whey powder (Cow's milk), Preservatives (Potassium Sorbate (E202), Pimaricin (E235), Vitamins (Biotin, Folic Acid, Nicotinamide, Pantothenic Acid, Vitamin A, B1, B6, B12, D, E), Flavourings, Acidity regulator (E331), Colourants (E104, E110), **Non-Nutritive Sweetener blend (E 952, E 950)**, Yoghurt Culture.

2.7.4 Stevia in South Africa

Stevia has become an increasingly popular sugar alternative for both consumers and manufacturers. According to an article by the Cancer Association, stevia is positioned and marketed to consumers as the "natural, healthy" replacement to sugar, this was eventually approved for use in SA with a 'promulgation (10 September 2012) of the new sweetener regulations under Regulation R733, Regulations Relating to the Use of Sweeteners in Foodstuffs (Herbst 2021: para 13. line 11) (South Africa 2012). Stevia was declared GRAS in the United States in December 2008 and has gained a 10% share of the sugars and sweeteners market in the United States (Herbst 2021: para 15. line 11). In SA, Regulation R733, regulations relating to the use of sweeteners in foodstuffs, allows the use of extracts of stevia rebaudiana, in line with Codex standards, in food and beverages (South Africa 2012) dictating that steviol glycosides must only be used to a 'maximum level of 330mg/kg' (South Africa 2012). According to Persistence Market Research (2017: 1) SA has been working on extensively cultivating stevia from 2017 in frost-free areas especially in KwaZulu-Natal for sustainable supply to the food and beverage industry. South African regulation does not allow for stevia to be defined as a "natural ingredient" due to processing steps stevia undergoes before it can be used as a sweetener. Below is an excerpt from Regulations Relating to the Use of Sweeteners in Foodstuff published under Government Notice in No. R. 3128 (20 December 1991) guiding the use for "natural" description which was repealed and replaced by Regulation R733, Regulations Relating to the Use of Sweeteners in Foodstuffs in 2012.

Misleading descriptions

(a) The "natural" or "nature's" or any other word suggesting that a processed product or its ingredients or an ingredient thereof are totally unprocessed, shall not be used on the label of a foodstuff in the following instances except for honey as described in the Codex Alimentarius Standard, CODEX STAN 12 – 1981, Rev. 1 (1987) and any subsequent revisions and the Agricultural Product Standards Act, 1990 (Act No. 119 of 1990),

as part of the name in relation to a processed foodstuff and shall not be used to qualify the name or trade name thereof;

to describe a foodstuff which contains any ingredient not present in the natural form of such foodstuff or if any ingredient present in the natural form thereof has been removed therefrom; or

to describe the ingredients of a mixed, compounded or blended foodstuff, unless all the ingredients occurred naturally or have not been processed.

Figure 2.7 Misleading descriptions for product labels in the Government Notice in No. R3128 (South Africa 1991)

2.7.5 Food manufacturing and the regulatory landscape

It is also important to understand the role of regulators and how they fit into the compliance. The South African Department of Health set out rules on how food regulation is to be enforced. Large food and beverage industries and retailers in SA invest a large amount of money to enforce these rules by being part of industry associations like the Consumer Goods Council South Africa (CGCSA). The CGCSA plays a fundamental role between government and industry (The Consumer Goods Council of South Africa 2022: para 1. line 2). Regulators have a big responsibility to monitor manufactures and measure compliance through audits at a frequency agreed upon between the manufacturer and regulators (South African Health Products Regulatory Authority 2022). This involves contractual obligations to the government and end users, and other legal and regulatory requirements (The Consumer Goods Council of South Africa 2022: para 1. line 3). Regulators have the right to impose penalties for non-compliance to mandatory requirements. In SA, the regulation for sweeteners is currently under review Government Notice No. R. 3128 (20 December 1991). A review occurs when regulators identify the need to improve and implement more effective control measures. This then means that there will be opportunity for regulators to heighten control measures, and close out gaps identified in the current regulations. This research intends to highlight consumer concerns associated with the use of sweeteners in the food and beverage industry in SA and can be used to guide future regulatory decisions in SA.

2.8 The Global rise of non-nutritive sweeteners

Non-nutritive sweeteners have existed for several years and have become increasingly popular in packaged products in recent years. Walbolt and Koh (2020: 114) describe the growth of the global market for NNSs, growing 5.1% annually between 2008 and 2015. Simultaneously, the use of

sweeteners has come under scrutiny as consumers assert stronger interests in their health and the foods they consume. A report issued by Golberg (2020: para 10. line 11) reveals that, the use of artificial and low- and no-calorie sweeteners in food and beverages has surged more than 300 percent in the last five years. Sylvetsky and Rother (2018: 3) express concern that, of late, NNSs predominantly existed in 'beverages' (e.g., diet cooldrinks) and in 'sweetener packets' (e.g., Equal™, Sweet N Low™, Splenda™), but today they are broadly used in a number of products like condiments, reduced-calorie desserts and yoghurts, cereals, and snack foods. Similarly, Dunford *et al.* (2018: 257) describe how, consumer awareness towards improved health and decreased sugar intake has become significantly greater than before which resulted in a wide-ranging availability of food products containing NNSs. Today, NNSs is also a trendy preference for consumers who diet, healthy or are diabetic. Lohner *et al.* (2020: 7) motivate that, sweeteners are frequently consumed as a sugar replacement for its low kilojoule benefit which can control weight and obesity. Globally, many countries are facing increasing challenges with non-communicable diseases (NCDs). Alsunni (2020: 775) describes that the recent surge in the use of sweeteners is a result of the global spread of obesity. Alsunni (2020: 776) goes on to describe that of lately the surge in mortality cases linked to obesity gave rise to 'low-calorie products' and 'low-calorie diets' to hit the markets, making it easily accessible for consumers. Carissa *et al.* (2019: 1098) also agrees that NNSs have become progressively available in food supply in recent time, expressing concern that young children and adolescents are consuming NNSs in food and beverage products. It is widely understood that of the many contributing factors, a diet high in sugar and fat is partially the cause to heighten obesity and related health issues such as type 2 diabetes mellitus (T2DM), cardiovascular disease (CVD), hypertension, and certain cancers. As a result of the many negative health conditions associated with the intake of excessive sugar, there has been an upsurge in the consumption of NNSs as an alternative. Consumption of NNSs containing foods has increased among people of all ages, with 28% of the total population reporting intake (Shankar, Ahuja and Sriram 2013: 9). Dunford *et al.* (2018: 257) explain that many studies conducted to date, showcase the widespread use of NNSs in the food and beverage industry globally especially higher income countries like United States, Australia, New Zealand, and Mexico where there has been an increased number of consumers who are looking to reduce their sugar intake.

Lohner *et al.* (2020: 7) express that, low and now non-calorie sweeteners are not a magic bullet, but they are excellent tools to help reduce sugar intake, manage blood glucose levels, and reduce overall energy intake. Sylvetsky *et al.* (2014: 1) agrees that, while NNSs are chemically diverse compounds, these are all sweet-tasting and contribute no or few calories. Carissa *et al.* (2019: 1099) pose a different view and justify that, researchers have been able to scientifically show that sugar-sweetened foods and beverages contribute to weight gain in children and adults, experts continue to debate whether feeding products containing NNSs to infants and children should be allowed or not. Due to the absence of strong scientific evidence to disprove or back their safety, Carissa *et al.* (2019: 1099) warn that intake of NNSs consumed by all ages should be monitored. This view is also supported by Lohner *et al.* (2020: 1), by stating that, there has been little research on the negative health outcomes arising from prolonged consumption of large amounts of NNSs over long periods, and even less focusing specifically on people

with diabetes. Carissa *et al.* (2019: 1099) further debate that, a known barrier to a deep understanding of the health effects of NNSs is the difficulty in quantifying the amount of NNSs consumed at the individual level. In Codex regulation for labelling Codex (4.2.3.3 Codex Regulation) which regulates the use of sweeteners, it was mentioned that producers must narrate when products are formulated with sweeteners, but the amount of sweetener the product contains is not required to be declared by the producer making it difficult to estimate the average amount of NNSs being consumed by any person per day, argues Carissa *et al.* (2019: 1100).

2.9 The widespread use of non-nutritive sweeteners in the food and beverage industry

In SA, the widespread use of NNSs in packaged food is becoming very common, like global trends where NNSs was found mainly in beverages, it is now found in several snack food products available on the market. A report from Mordor Intelligence (2021: 1) describes how big the sweetener market has become over time. According to the report, the global food sweetener market was valued at 'USD 85.92 billion' in 2020 and is projected to witness a 'CAGR of 2.49%' during the forecast period (2021-2026) (Mordor Intelligence 2021: 1). In recent years, South Africans have adopted food trends that are westernised and have moved away from traditional foods. To confirm this, Ronquest-Ross, Vink and Sigge (2015: 1) voice concern that, over the past two decades, the diets of South Africans have shifted rapidly from a traditional based diet of grains, legumes, vegetables, and fruit to a western based diet of energy-dense, nutrient-poor processed foods and beverages with increased sugar and salt. This has resulted in an increasing prevalence of overweight and obesity among South Africans confirm Ronquest-Ross, Vink and Sigge (2015: 1). According to a report by Mordor Intelligence (2021: 1) South African market research indicates that the intake of cool drinks, and other sweetened carbonated beverages, and fruit drinks with added sugar have increased dramatically, especially among the youth, whereas the intake of milk has declined. The intake of beverages has changed dramatically over the past few decades, coinciding with an increased prevalence of obesity in the country. Furthermore, Ronquest-Ross, Vink and Sigge (2015: 9) also share findings that South Africans have shown a modified change related to the intake of food and beverages since 1994. The outcome of this change has led to a diet higher in kilojoules, sugar and fats through frequent consumption of SSBs, processed foods and snacks, increased meat consumption, decrease in fruit and vegetables consumption, increased usage of NNSs and decrease in exercise (Ronquest-Ross, Vink and Sigge 2015: 1). Furthermore, cool drinks, sauces, dressings, and condiments, sweet and savoury snacks, meat, and fats and oils were the biggest factors that influence the change in food consumption patterns (Ronquest-Ross, Vink and Sigge 2015: 1). Convenience, health, nutrition, and indulgence were the primary levers for the weighty consumption of packaged foods and beverages. Furthermore, Cecchetto *et al.* (2021: 160) describes the global crisis surrounding the current Coronavirus Disease (COVID-19) pandemic with the combination of stress, anxiety, and depression due to this unprecedented situation had an impact on eating behaviours, causing many to comfort eat and reward themselves with increased consumption of packaged snacks and beverages. Cecchetto *et al.* (2021: 161) confirm through a study that 365 Italian residents increased emotional eating due to high levels of depression, anxiety, quality of personal relationships, and quality of life, while the increase of binging was predicted by higher stress during COVID. In SA a study looking into the impact of the COVID-19 pandemic on food consumption

habits, food purchasing behaviours, and food security status among South Africans reported that a significant 36.8% (n=187) reported that their eating habits during the COVID-19 pandemic period worsened and this was trailed by 34.6% (n=176) who reported they did not have any changes to their eating habits during this period (Naicker *et al.* 2021: 134). Furthermore, the study reported that, 31.5% (n= 160) of participants made no changes to the total meals consumed a day, while 25% (n=127) participants reported that they added one or more snacks between meals, and 17.5% (n=89) skipped one or more meals during the pandemic (p<.005) (Naicker *et al.* 2021: 134). Taking these shifts in food consumption into consideration, Ronquest-Ross, Vink and Sigge (2015: 9) substantiate that this leads consumers to increased fat, sugar, and salt intake and in turn, a potentially crippling effect on public health overall.

According to Statistics South Africa (2021: 1), diabetes is prevalent among 7% of the South African population equating to 3.85 million people, aged between 21-79 years old. This number however does not take into consideration prediabetes and those undiagnosed. (Statistics South Africa 2021: 1) confirms that one in every three South Africans are prediabetic, which is cause for concern. A counter measure to improve health outcomes of South Africans is the Health Promotion Levy (HPL) on sugary beverages which is aimed to reduce obesity (South African Department of Treasury 2018: 1). A report from (Mordor Intelligence 2021: 1) describes that, the introduced sugar duty was also a factor that pressured manufacturers to increase sweetener usage to reduce sugar content, and in turn, the calorie content, without compromising the taste of the final product.

2.10 Cost of sweeteners vs. sucrose in South Africa

Before launching into the cost discussion of sweeteners vs sucrose, it is important to understand the growth of sweeteners in SA which could also put its widespread use in the food and beverage industry into perspective. Here are some key highlights surrounding the growth trends in the sweetener market in SA. According to an article written by Muhummed Kadwa, it was confirmed that the demand for sugar dropped significantly in SA when the HPL was implemented (Kadwa 2022: para 13. line 11). Kadwa elaborates that this was due to reformulation initiatives in the SSBs sector in SA which largely resulted in the use of NNSs to replace sugar (Kadwa 2022: para 13. line 13). According to SaFacts Co (2022: para 2. line 1) the cost of sucrose at the end of December 2020 in respect of 2020/2021 was declared at R4 992.56 per ton which is approximately R15.27 per kg. In Table 2.6 the cost of sweetener equivalence to sucrose will be presented.

Table 2.6 Cost of sweeteners vs sugar (Sunley 2021; South African Sugar Association 2022)

Sweetener	Sweetener Typical Cost R/kg	Intensity x Sugar	g per 1kg Sugar Equivalent	Cost R/kg Sugar Equivalent
Acesulfame-K	17	200	5g	0.85
Aspartame	280	200	5g	1.40

Cyclamate	42	25	40g	1.68
Saccharin	125	450	2.2g	0.28
Stevia	1500	250	4g	6.00
Sucralose	1500	600	1.67g	2.51

In Table 2.6, it is illustrated that the cost of sweeteners is significantly lower than that compared to sucrose except for stevia. It can also be seen that due to the high intensity sweetness of NNSs, smaller quantities resulting in grams are used as a sugar equivalent, thus positioning NNSs as cheaper.

Figure 2.10 which depicts the revenue generated in SA in the sweetener market and the growth of the sweetener market in SA will be discussed.

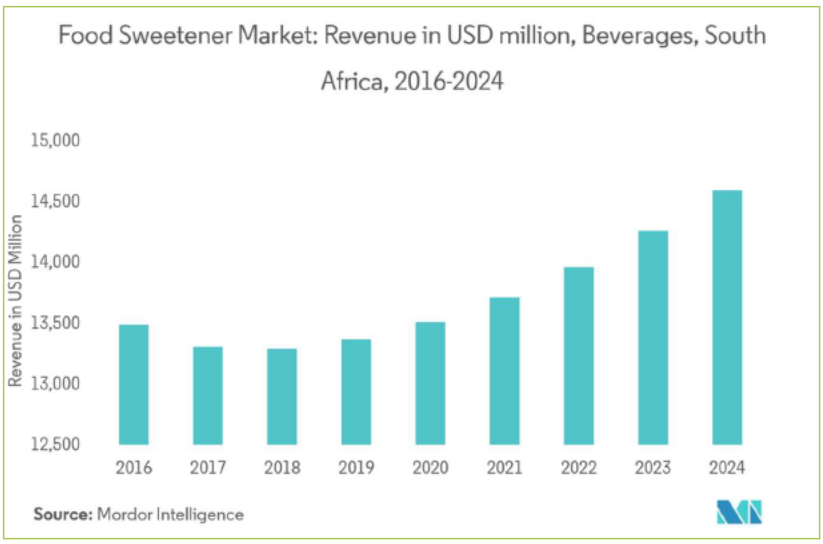


Figure 2.8 Projects the trajectory of the food sweetener market revenue (beverages) in South Africa from 2016 to 2024 (Mordor Intelligence 2021)

Figure 2.10 quantifies the increasing shift from sugar to sweeteners in SA. According to (Statistics South Africa 2021: 1), SA has the largest sweetener market in Africa holding around 15% of the African market. The option of using NNSs in manufacturing of food and beverage products has become the trend in the manufacturing industry because NNSs supports the drive for reduced sugar content, reduced calorie, lower product costs but still achieving the desired taste and quality of the product.

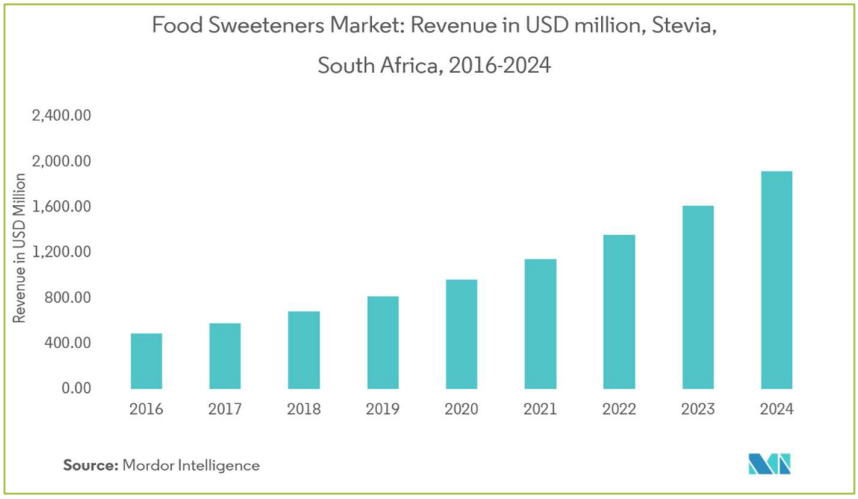


Figure 2.9 Projects the trajectory of the food sweetener market, particularly stevia in South Africa from 2016 into 2024 (Tate and Lyle 2017; Mordor Intelligence 2021)

Figure 2.11 indicates that yearly, stevia presents a steady growth despite being priced higher than all other sweeteners. This result could be related to how stevia is positioned against other sweeteners. Consumers see stevia as a natural sugar alternative coming from the stevia leaf. Some manufacturers refer to their sweeteners as "natural" even though these are processed or refined. Stevia is just one example of a sweetener referred to as ‘natural’ but exposed to several processing steps before it can be used. This is not explained to consumers, so they are not aware that stevia is not used in its natural form.

2.11 Consumers

2.11.1 Consumer’s knowledge and perception of non-nutritive sweeteners

Consumers who use NNSs have expressed concern around its use. Farhat, Dewison and Stevenson (2021: 444) state that although NNSs are popular sugar substitutes, concerns regarding its use have been raised by the public. Professional body endorsements worldwide, have also expressed that consumers remain sceptical of the safety of NNSs (The United States Food and Drug Administration 2018: para 3. line 1). Farhat, Dewison and Stevenson (2021: 444) indicate that, a representative study conducted by Mintel in a sample of Americans, presented that 64% illustrated that they were worried about the safety of “artificial” sweeteners while the other 36% were unsure about the safety of sweeteners. The report from Mordor Intelligence (2021: 1) confirms that, even with higher consumption rates of sweeteners globally, consumers do not want to consume artificial ingredients and controversy surrounding the possible health effects of artificial sweeteners are hindering the market. Similar to findings by Dunford *et al.* (2018: 257), in SA, there has been increased interest among consumers on the topic of sugar reduction. This worked as a benefit for manufacturers as they needed to manage costs and compliance, in the wake of the HPL, which has led to wider availability of food products containing NNSs Dunford *et al.* (2018: 257). This trend has been observed globally where manufacturers have ramped up the inclusion of NNSs in product formulations to meet consumers’ growing desire to manage and reduce kilojoule intake while simultaneously helping

to manage rising ingredient costs. Dunford *et al.* (2018: 257) expresses concern in that, the degree to which NNSs are used by manufacturers to sweeten products are unidentified. Ibrahim (2015: 88) posits that, due to consumer awareness and concern associated with weight management, this was a key lever for NNSs to be used as sugar alternative in consumer diets which made the use of NNSs in the production of carbonated diet cool drinks and low-calorie foods popular globally.

Due to varying education levels in South Africa, Statistics South Africa (2021: 1) indicated that, education inflation recorded its lowest annual rate in three decades compared to last year's rise which was at 6.4%. Taking education levels of South African consumers into consideration here, there is a high level of concern that many South Africans may not be aware of sweeteners or know about these ingredients of concern. There is a high probability that many South African consumers may be consuming NNSs without being aware of it. Another concern to highlight here, is if one is not aware that one is consuming NNSs, it would be impossible for one to know how much is being consumed in a day, a week or month. There is insufficient evidence to indicate how knowledgeable and aware the South African consumer are on the topic of NNSs. This opens various channels of concern around child and adult consumption frequency and daily consumption levels. For example, a person could start the day with a yoghurt or cereal bar, followed by a diet cool drink together with a bag of crisps and later in the day, eat candy or may even chew gum as well as consume a few cups of beverage sweetened with NNSs. This example highlights that a person could be collectively consuming a high quantity of NNSs daily and thus be very different to the ADI for artificial sweeteners as regulated by The United States Food and Drug Administration (2018: 1) reflected in Table 2.1 and 2.2.

Shankar, Ahuja and Sriram (2013: 9) confirm that, there isn't always enough information available to consumers about NNSs. The fragments of information provided to consumers are often contrary and dependent on the intention of the body, industry, or agency sharing the information. While the FDA and most available industry-funded studies sanction the safety of NNSs, there is a limited conclusive substantiated research to dissuade or support the use of NNSs. Shankar, Ahuja and Sriram (2013: 9) advocate those consumers using NNSs must be guarded.

Research suggests that globally, there is a knowledge gap among consumers concerning the use of NNSs states Carissa *et al.* (2019: 1098). It was assumed that the level of literacy among consumers in a first world country in comparison to that of consumers in a third world country, including the level of awareness and knowledge of NNSs would be higher. Farhat, Dewison and Stevenson (2021: 444) describe a study that, was done among consumers in the United Kingdom (UK) that intended to examine knowledge, benefits and safety perceptions of NNSs. This survey was distributed online, through social media platforms and UK universities and was completed by 1589 participants aged 18 years and older (Farhat, Dewison and Stevenson

2021: 444). Results revealed that a significant proportion of the study sample perceived the safety and usage of NNSs to be concerning and the results on knowledge in regulations was also lacking in the study sample. Moreover, the 'artificial' characteristics of NNSs prompted the study population to reject instead of accepting NNSs. Farhat, Dewison and Stevenson (2021: 444) explained that the survey report presented that due to the undesirable perception of NNSs, the results presented that the consumption levels of NNSs were low ($p<0.001$). Farhat, Dewison and Stevenson (2021: 444) go on to state that, a report from the American Diabetes Association (ADA) indicate that American consumers have concerns about NNSs. From these studies that have been highlighted here, it can be assumed that, not all consumers are aware of the potential benefits or concerns associated with the use of NNSs. In SA, it is yet to be established how aware consumers are about the NNSs, and its inclusion in food and beverage products NNSs, as well as whether consumers read product labels.

Farhat, Dewison and Stevenson (2021: 444) confirmed that consumer education on the topic of NNSs resulted in the acceptance of NNSs converted negative perception and attitude associated with concerns and risks to seeing more of the benefits with consuming NNSs. The consequence of this outcome presented here recommends that education through trusted health and government organisations is not only well received, but also helps consumers make informed decisions, ensuring the information is presented by well trained and informed health experts on the topic of NNSs, state Farhat, Dewison and Stevenson (2021: 444). This then reflects a significant investment towards educating various role players. Due to the described relationship between saccharin, aspartame and sucralose and cancer risk in animals, the public is very cautious about the use of NNSs, even though these studies were not replicated in humans. Cohen *et al.* (1991: 1551) agrees that there is a strong link between saccharin and the risk of cancer and this has been argued since 1970. Cohen *et al.* (1991: 1551) state that the studies carried out on rodents presented very concerning observations when rodents that were given high doses of saccharin displayed a high risk of developing bladder cancer. Cohen *et al.* (1991: 1551) justifies that, when epidemiological studies were conducted in humans, there was evidence of bladder cancer risk that was observed but the results lacked consistency. This argument is further supported by Reuber (1978: 173) stating that no evident studies exist that can convincingly link saccharin to cancer in humans and for this reason it was removed from the U.S. National Toxicology Program's Report on Carcinogens in year 2000 (Reuber 1978: 173). In the wake of these unfolding, Harbolic (2020: para 1. line 3) states that between 1999 and 2004, more than 6000 new products containing NNSs were launched into the US market. Harbolic (2020: para 1. line 1) points out that, sweeteners are found in so many products now that people can be consuming them without even knowing it. This draws attention to the fact that, NNSs were an ingredient of interest even before the sugar taxes were introduced by countries, and this status dramatically increased low calorie claims in new product launches post the sugar tax. This sustains concern that the widespread inclusion of sweeteners in

products and the possibility that consumers may be unaware of just how much NNSs they are consuming daily (Harbolic 2020: para 1. line 2).

With the proliferation of information on the net, the need for transparency and the time for experts to come together to jointly collaborate on dissemination of facts is key to creating sustained relationships built on trust. Scientists and experts should be working together in a systems approach towards providing clear, factual data with replicable clinical trial results to avoid misinformation, or information overload and confusion. One of the key reasons of this research, is to assess the knowledge and perception of the South African consumer on NNSs.

2.11.2 Manufacturers in the food and beverage industry

Globally, manufacturers have adapted recipes in the food and beverage industry to meet consumer need for reduced kilojoule and reduced sugar beverages with a shift towards healthier packaged food options. SSBs manufacturers in SA responded, when the sugar tax law was implemented in 2018. Formulas were adapted to reduce sucrose and a combination of NNSs were added to maintain desired sweet taste. Harbolic (2020: para 10. line 13) describes that, the use of NNSs began with the need for cost reduction and continued with the need for calorie reduction. Adding to the list of NNSs accolades, Wal, Pal and Wal (2019: 1595) have indicated that product with NNSs have a longer shelf life. The beverage industry is one of the largest users of NNSs worldwide, followed by foods, tabletop sweeteners, personal care products (such as toothpaste), and pharmaceuticals (Ibrahim 2015: 88). Manufacturers are constantly facing pressure to innovate healthier food options and obtain sound consumer and market insights for product innovation that will deliver healthier products low in nutrients like sugar, fat, kilojoule, sodium and carbohydrates. Chattopadhyay, Raychaudhuri and Chakraborty (2014: 611) describe that, today the major goal of diabetes management is control of blood glucose. Consumers have a free choice of food and beverage products. They must choose the right food and beverage to comply with dietary recommendations, at the same time, the food and beverage industry can contribute effectively to this product need by providing adapted product options to satisfy consumer needs.

Globally, the food and beverage industry are using several forms of alternative sweeteners, which have made it possible to offer consumers the sweet taste without the calories. Harbolic (2020: para 5. line 3) explains that many people prefer a specific sweetener without realising that numerous products now contain combinations of nutritive and/or NNSs.
The following are key advantages for these sweetener blends:

- **Taste:** The major limitation to the use of saccharin is its bitter aftertaste. Combining saccharin with other sweeteners helps alleviate this problem (Harbolic 2020: 1).
- **Cost:** Using combinations of NNSs can result in a sweeter taste with less sweeteners, saving companies money (Harbolic 2020: 1). Ibrahim (2015: 1) adds that, a wide variety of low-calorie sweeteners are available for use in foods which expands the capability

to develop reduced-calorie products that meet consumer needs and desires. In addition, blending some low-calorie sweeteners in foods and beverages may also act synergistically to produce the desired level of sweetness with smaller amounts of each sweetener and the resulting taste offers a better fit with consumer expectations of a sweetness profile similar to that of sugar. Tandel (2011: 236) state that, the food and beverage industry is increasingly replacing sugar or high fructose corn syrup with artificial sweeteners in a range of products which traditionally contained sugar. NNSs cost the food industry only a fraction of the cost of natural sweeteners despite the extremely high profit margins for manufacturers of artificial sweeteners explains Tandel (2011: 236). The cost of manufacturing artificial sweeteners versus farming and milling of sugar cane/beet, is significantly cheaper and requires less resources. According to the sugar and sweetener price guide (Statistics South Africa 2021) and world market prices between 2012 and 2013 which gives a good indication of the current situation today, sweeteners cost 4% or less than sugar. High fructose corn syrup (HFCS both 42 and 55) are the cheapest sweeteners on the market, at about half the price of sugar, is also widely used as a sugar alternative in the food industry. For these obvious reasons, this represents a huge saving to the food manufacturer but at the cost of it having a very negative consumer uptake.

- **Flexibility:** The ability to combine non-nutritive and nutritive sweeteners can offer consumers low-calorie choices, along with the zero-calorie ones (Harbolic 2020: 1).

Due to intense promotion of NNSs by manufacturers and positioning of NNSs as healthier alternative to sugar has caused misuse (Harbolic 2020: 1). On the other hand, Ibrahim (2015: 1) elaborates, that the benefits of NNSs for manufacturers are - the wide range stability of pH and temperature for these high intensive sweeteners that allow its application in products that require long shelf life, at room temperature. Ibrahim (2015: 88) reiterates that there are several additional advantages for the application of highly intensive sweetener in foods, beverages, candies, chewing gums and other products.

Liauchonak *et al.* (2019: 644) explains that there has been a significant demand for NNSs in the beverage industry, but this demand has now also increased in the food and snack industry making NNSs a sugar replacement in baking, confectionary, and ice cream. This builds an opportunity for food and beverage manufacturers to acknowledge the critical role NNSs has in the lives of consumers, so they have a big responsibility to stay on top of scientific changes to sweeteners and the impact this could have on health, formulation and demand (Liauchonak *et al.* (2019: 644). Research shows that manufacturers worldwide are pressured, to strike a balance with creative cost-effective product formulations that contain reduced sugar and healthier options in line with consumer demand while simultaneously staying away from NNSs that some consumers remain sceptical about.

2.12 Advantages and disadvantages of consuming non-nutritive sweeteners

NNSs have been widely researched by many scientists and worldwide, research shows that scientists are divided in their views on the safety of NNSs. There are many conflicting arguments around the advantages and disadvantages associated with human health and the consumption of NNSs. In other words, sweeteners are known for both pros and cons. A potentially increased risk for cancer is a starting point for many debates around the safety of NNSs.

In one of the most recent studies conducted by Debras *et al.* (2022: 11), the data illustrated that from a large-scale population-based cohort study, there was a positive link to suggest association between higher intake of artificial sweeteners (especially aspartame and acesulfame-K) and overall cancer risk. There were 102,865 adults who participated from the French population-based cohort NutriNet-Sante´ (2009–2021) (median follow-up time = 7.8 years). The method used to obtain this data through dietary intakes and consumption of sweeteners that was done by repeated 24-hour dietary records including brand names of industrial products explain Debras *et al.* (2022: 11). Debras *et al.* (2022: 11) further elaborated that more specifically, results illustrated that aspartame intake was associated with increased breast and obesity-related cancers (Debras *et al.* 2022: 11). Results illustrated that higher cancer risks were observed for aspartame (HR = 1.15 [95% CI 1.03 to 1.28], P = 0.002) and acesulfame-K (HR = 1.13 [95% CI 1.01 to 1.26], P = 0.007) (Debras et al. 2022: 11). Increased risks were observed for breast cancer (HR = 1.22 [95% CI 1.01 to 1.48], P = 0.036, for aspartame) and obesity-related cancers (HR = 1.13 [95% CI 1.00 to 1.28], P = 0.036, for total artificial sweeteners, and HR = 1.15 [95% CI 1.01 to 1.32], P = 0.026, for aspartame). In this study it was also observed that the intake of NNSs was higher among the younger male and female participants than the older ones. Debras *et al.* (2022: 11) conclude by saying that these observations provide important and novel insights for the ongoing re-evaluation of food additive sweeteners by the European Food Safety Authority and other health agencies globally.

Data from a different study by Lohner *et al.* (2020: 1) shares insight on studies that indicated that NNSs consumption might lead to weight gain instead of the expected weight loss which explains why, in people with diabetes this could lead to the worsening of glycaemic control, blood pressure, and lipid profile. While there are several advantages that have been associated with sweeteners like aiding weight loss and supporting diabetes management, there are also concerns that overshadow their use. Sylvetsky *et al.* (2014: 1) expressed similar concern that, it currently remained unclear whether substitution of caloric sugars with NNSs can ameliorate weight gain. Additionally, Tandel (2011: 236) and Swithers and Davidson (2008: 161) agree that, low-Kilojoule intense sweeteners have been promoted for their potential to reduce added sugar consumption, facilitate weight loss, and control blood glucose levels, however, these sweeteners have also been investigated for their potential negative side effects, such as cancer, insulin resistance, and compensatory appetite state (Swithers and Davidson 2008: 161; Tandel 2011: 236). (Shwide-Slavin, Swift and Ross 2012: 104) confirm that, controversy continues to surround the use of NNSs among consumers. In saying this, sugar substitutes have been criticised for its long-term effect on health. Several studies suggest that there may be harmful side

effects caused using sweeteners over time. Tandel (2011: 236) agrees that there is some ongoing controversy over whether NNSs usage poses health risks.

The World Health Organisation (1987: 11) reassures that, the legislation governing the safety and evaluation of food additives and contaminants in the present publication referred to as "Principles for the Safety Assessment of Food Additives and Contaminants in Food" which was developed for safety evaluation of food additives and contaminants. In this legislation, the stages of safety and testing are described. World Health Organisation (1987: 11) guides the legislation to address the qualification for studies and the process that must be adhered to when studies are being conducted. The World Health Organisation (1987: 11) shared that, for some evaluation of food additives, the assessment has often been difficult to make. Here are some of the shortcomings of past studies, that have not met the criteria for a qualifying study:

- Tests were of short duration, conducted with a very small number of animals at inappropriate dose levels, and without adequate clinical, haematological, chemical, or histopathological examinations have frequently been encountered among the data submitted for evaluation (World Health Organisation 1987: 11).
- Tests of this sort cannot be regarded as having permanent validity; with the passing of time, these would need to be supplemented by studies carried out in full accordance with the recommendations set out in the report of the WHO Scientific Group on Procedures for Investigating Intentional and Unintentional Food Additives (World Health Organisation 1987: 11).

In this section, studies that have been conducted by scientists will be discussed, and will outline both advantages and disadvantages on the use and safety of NNSs. Chattopadhyay, Raychaudhuri and Chakraborty (2014: 611) expressed concern associated with aspartame and cancer. A study was conducted by Nalt Toxicological Programme (NTP) in 2 strains of transgenic mice, and the results presented that when either male or female mice was subjected to aspartame there was an increased risk to cancer (Soffritti *et al.* 2016: 7). Based on research reviews and recommendations from governments and advisory bodies such as European Commissions Scientific Committee on Food and joint FAO/WHO expert committee on food additives, aspartame was deemed safe for human consumption by more than ninety countries worldwide. With this result on hand, Chattopadhyay, Raychaudhuri and Chakraborty (2014: 611) elaborate that, the public feels that this still does not provide the reassurance with regards to the safety of NNSs and effect on health. Tandel (2011: 236) shares a similar view, stating that, besides the benefits linked to NNSs, animal studies have convincingly proven that artificial sweeteners cause weight gain, brain tumours, bladder cancer and many other health hazards. Health-related side effects including carcinogenicity are also noted in humans (Tandel (2011: 236). Many studies have been carried out on these substances with conclusions ranging from “safe under all conditions” to “unsafe at any dose”. Farhat, Dewison and Stevenson (2021: 444) advocate that extensive safety evaluation corroborated the safety of NNSs, and several organisation’s such as the American Heart Association (AHA), the American Diabetes Association (ADA) and the British

Dietetic Association (BDA) issued statements advocating their safety. Tandel (2011: 236) reports on a study done in 2005 by the University of Texas Health Science Centre at San Antonio showing that, rather than promoting weight loss, the use of diet drinks was a marker for increasing weight gain and obesity. Those who consumed diet cooldrink were more likely to gain weight than those who consumed naturally sweetened cooldrinks. Tandel (2011: 236) elaborated that, animal studies have convincingly proven that artificial sweeteners cause body weight gain. A sweet taste induces an insulin response, which causes blood sugar to be stored in tissues, but because blood sugar does not increase with NNSs, there is hypoglycemia and increased food intake. In the experiment, after a while, rats given artificial sweetener have steadily increased caloric intake, increased body weight, and increased adiposity. Chattopadhyay, Raychaudhuri and Chakraborty (2014: 611) assert that, the FDA tried to ban saccharin in 1977 because animal studies had showed that it caused cancer in rats (mainly bladder cancer). Many studies have since been performed on saccharin. No study has ever shown a clear causal relationship between saccharin consumption and health risks in human at normal doses. On the other hand, Sharma *et al.* (2016: 237) shared a different angle on sweeteners stating that, there is nothing in our diet that we can consume without a cost. Sharma *et al.* (2016: 237) argued that, eliminating the daily use of sweeteners is an uphill task, instead they advocated for the use of precautionary labelling especially for high-risk individuals such as pregnant and lactating women, and individuals suffering from diabetes, migraine, epilepsy patients, and children. Sharma *et al.* (2016: 237) caution that, children are especially important because they have a higher food and beverage intake per kilogram of their body weight. A paediatric epidemiological study has found a positive correlation between intake of NNSs-containing beverage and weight gain; however, conclusive data are still lacking. Sharma *et al.* (2016: 237) continue to drive the argument that, a Danish study done on 59,334 pregnant women found that the intake of artificially sweetened beverage was associated with an increased risk of preterm delivery. Pregnant women have been cautioned about consuming NNSs through the labelling requirements of products containing NNSs. Pregnant women and the consumption of NNSs has been a hot topic and remains a global hot topic in the regulatory world today.

A contradicting view from Liauchonak *et al.* (2019: 644) reveals that, when a Norwegian pregnancy cohort study was conducted that involved sucrose sweetened beverages, the results presented an increased risk of congenital heart defects (CHDs) in offspring, whereas fruit juices, cordial beverages, and artificial sweeteners presented no evidence to CHD. In other words, the research indicates that sucrose posed a risk while artificial sweeteners didn't. Findings from the study described by Liauchonak *et al.* (2019: 644) indicate that, there have not been many studies that support this result. Again, the contradictory views on studies make it extremely difficult for scientist to reach consensus on the use and safety of NNSs.

Sharing a different view on the advantages of using NNSs, Ibrahim (2015: 1) asserts that, high intensive sweeteners, assist people in losing weight, avoiding obesity diseases and other health issues associated with high caloric intake by replacing common sugars in foods and beverages with non-nutritive, zero calorie high intensive sweeteners, without changing people's diet habits and taste.

Contrary to this view, Bellisle and Drewnowski (2007: 691) share a conflicting view that, there are recurring arguments that high intensity sweeteners increase appetite for sweet foods, promote overeating, and may even lead to weight gain. A similar view from Mooradian, Smith and Tokuda (2017: 8) affirms that, commonly used non-caloric artificial sweeteners may have an unfavourable effect on health including glucose intolerance and failure to cause weight reduction. The debate on whether artificial sweeteners support weight loss or cause weight gain is still a controversial topic among scientific worldwide. These inconclusive studies result in mounting mistrust and concerns from the public about the use of sweeteners in food and beverage products.

There are also some arguments that highlight that people have been using sweeteners for a number of years and have not reported any illnesses or health related issues that could have been related to the consumption of sweeteners. Shankar, Ahuja and Sriram (2013: 9) state that, when using any new ingredient, it is important to monitor for symptoms related to allergies or intolerance, which may occur even when very small amounts are consumed. It is highly unlikely that US consumers will exceed the ADI established for NNSs state Shankar, Ahuja and Sriram (2013: 9). As these products have been on the market for decades, with consumption patterns on the rise and no reported adverse health problems affecting large numbers of people, their continued popularity and increased use are to be expected, explain Shankar, Ahuja and Sriram (2013: 9).

More than one sweetener that has come under fire for adverse health effects. While Ibrahim (2015: 88) talks to the advantages of NNSs and states that, NNSs are in high demands due to its multiple advantages including assisting people in losing weight or avoiding obesity and assisting diabetics to control their blood sugar level. Whitehouse, Boullata and McCauley (2008: 1) shared a different view and argue that, since the discovery of NNSs, the safety of artificial sweeteners has been controversial. Artificial sweeteners provide the sweetness of sugar without the calories. Whitehouse, Boullata and McCauley (2008: 1) mention that, more individuals of all ages are choosing to use these products. However, scientists disagree about the relationships between sweeteners and lymphomas, leukaemia, cancers of the bladder and brain, chronic fatigue syndrome, Parkinson's disease, Alzheimer's disease, multiple sclerosis, autism, and systemic lupus. Recently, these substances have received increased attention due to their effects on glucose regulation concludes, Whitehouse, Boullata and McCauley (2008: 1). An opposed view is shared by Larsen (2012: 3) stating that, based on the large number of toxicological studies that are requested for the safety evaluation of food additives, a no observed adverse effect level (NOAEL) is identified for the most sensitive effect in the most sensitive animal species. Larsen (2012: 3) continues to state that, oral benefits have been associated with the use of NNSs and what this means is that NNSs can prevent fermentation which reduces the potential for dental plaque and decay.

Grylls (2020: 1) confirms that, the world’s most widely used NNSs, aspartame, has been previously linked to adverse health effects by numerous studies but the International Sweeteners Association (ISA) still supports aspartame use and its safety today. The United States Food and Drug Administration

(2018: 1) states that, scientists have reviewed scientific data regarding the safety of aspartame in food and concluded that it is safe for the general population under certain conditions. Labels of aspartame-containing foods and beverages must include a statement that informs individuals with phenylketonuria (PKU) that the product contains phenylalanine. Wal, Pal and Wal (2019: 1595) agreed that one of the most important advantages of aspartame is that people who have diabetes or are on a low-calorie diet, still get to enjoy a variety of desserts that are low in fat and calories but are still pleasurable. Saccharin was also studied intensely to evaluate its safety for human consumption. Sharma *et al.* (2016: 237) expressed concern that the research conducted may be failing us. With two sides battling over the safety of these sweeteners, it's imperative that we get the answers from “gold standard" research studies with: independent, randomised, double-blinded, placebo-controlled studies.

Results of more recent studies conducted by the Centre for Science Interest (CSPI) brought sucralose under scrutiny. According to the CSPI report in 2013, sucralose was downgraded from “safe” to “caution” after the Ramazzini Institute presented the then-unpublished findings of the study at a conference Center for Science in the Public Interest (2016: 1). Using a sensitive experimental design, this study evaluated the carcinogenic effect of sucralose in mice. This powerful study found a significant dose-related increased incidence of males bearing malignant tumours ($p<0.05$) and a significant dose-related increased incidence ($p<0.01$) of hematopoietic neoplasias in males, at the dose levels of 2,000 ppm ($p< 0.01$) and 16,000 ppm ($p<0.01$) (Center for Science in the Public Interest 2016: 1).

Scientists should be trusted to procure replicable evidence that speaks to the benefits or concerns associated with the inclusion of sweeteners in one’s diet but in this case, scientists are struggling to find replicable results. This resulted in consumers all over the world having a fair share of doubt on the safety and use of sweeteners in products.

2.13 Physiological effect of non-nutritive sweeteners

As highlighted earlier in the chapter, globally, the rising trend in obesity and diabetes have made NNSs an extremely popular go to product because of its low caloric value. Walbolt and Koh (2020: 115) agree that, despite NNSs widespread usage and how popular they have become, their intended benefits are yet to be validated. In this chapter several disadvantages of the use of NNSs have been highlighted but to reiterate that some evidence suggests that NNSs relate to metabolic disease, particularly obesity states Walbolt and Koh (2020: 115). The role of NNSs in metabolic syndrome focuses on three potential mechanisms: how NNSs interact with gustatory cells or sweet taste receptors, how NNSs interfere with gut microbiota structure and how NNSs interfere with discovered reactions to sweetness. These three mechanisms are depicted in Figure 2.8.

Currently, it remains unclear whether substitution of caloric sugars with NNSs can ameliorate weight gain (Sylvetsky *et al.* 2014: 1). Furthermore, to support the uncertainty Walbolt and Koh (2020: 115) agree that, research has brought the efficacy of using NNSs to improve or prevent metabolic diseases into scrutiny. Since NNSs have zero to very minor caloric load, they won’t contribute directly to obesity,

but instead may influence metabolic processes believes Walbolt and Koh (2020: 115). Research has uncovered multiple mechanisms that may play roles in how NNSs could trigger metabolic disease and interestingly a comprehensive review was done by Sylvetsky and Rother (2018: 635) evaluating the effect of NNSs on metabolism, weight, and obesity-related NCDs. Here the biological mechanisms that may explain NNSs impact will also be discussed through the study conducted by Sylvetsky and Rother (2018: 635).

Sylvetsky and Rother (2018: 635) unpack some of the proposed mechanisms linking NNSs to weight and health outcomes to the associations between NNSs consumption, body weight, and health conditions including type 2 diabetes, cardiovascular disease, and non-alcoholic fatty liver disease. Sylvetsky and Rother (2018: 635) go on to elaborate that, while results in cellular and rodent models indicate harmful impact of NNSs on metabolic health, majority of the human randomized controlled trials show marginal benefits of NNSs use on body weight, with little data available on other metabolic conclusions.

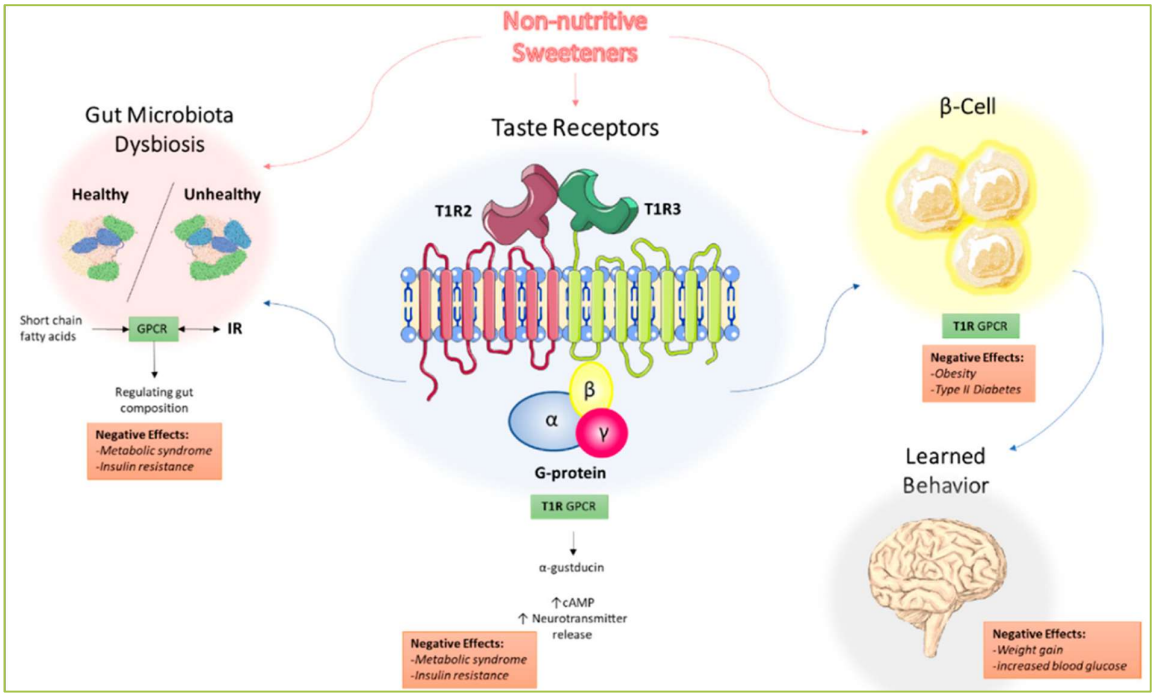


Figure 2.10 Physiological effect of non-nutritive sweeteners (Liauchonak *et al*. 2019: 644)

Figure 2.12 as described by Liauchonak *et al.* (2019: 644) depicts, the anticipated underlying mechanism effects of NNSs on the occurrence of metabolic syndrome. NNSs interacts with the T1R family of sweet-taste receptors through associated G protein α-gustducin, which results in increased intracellular cAMP levels and increased neurotransmitter release. Through the associated G protein-coupled receptors (GPCRs) signalling, this may explain how NNSs can contribute to metabolic syndrome and insulin resistance. NNSs also interfere with gut microbiota composition, with short-chain

fatty acids (SCFAs) from dietary intake acting as ligands for GPCRs in the gastrointestinal tract, regulating NNSs permeability and gut microbiota composition. Additionally, NNSs are connected to insulin and various hormone secretion, which eventually effects studied behaviour and reaction to sweetness state Liauchonak *et al.* (2019: 644).

2.13.1 The gut sweet taste receptors and the impact of non-nutritive sweeteners on hormone secretion

It is interesting to learn the role NNSs plays when interacting with sweet taste receptors. Liauchonak *et al.* (2019: 644) describes how, the sensitivity of the sweet taste starts at time of the type 2 taste receptor cells (TRCs) gathered in taste buds on the tongue that are GPCRs. Liauchonak *et al.* (2019: 644) confirms that, there are two classifications of GPCRs that have been distinguished: the taste 1 receptor (T1R) and taste 2 receptor (T2R) families. Within the T1R family, the T1R2 and T1R3 established plays a role in forming heterodimers that perform as sweet-taste receptors. Sylvetsky and Rother (2018: 638) build on explaining how sweet taste receptor initiation on taste buds targets the release of neurotransmitters to transport the sweetness message to the brain, initiation of sweet taste receptors extra-orally exerts different downstream effects, only some of which are presently understood. The study was also able to connect sweet taste receptors to the disturbance between sweetness and calories, alterations in gut microbiota and overall effect on the change in taste preference states Sylvetsky and Rother (2018: 638). Liauchonak *et al.* (2019: 644) agree that sweet-taste receptors have also been found throughout the gastrointestinal (GI) tract, in the biliary tract, and the respiratory tract, suggesting that NNSs have additional effects in the body and may not be the inert compounds that they were once thought to be. Liauchonak *et al.* (2019: 644) elaborate that, these studies have shown that ligand binding to sweet taste receptors on enteroendocrine cells (EECs) in part, affects hormone secretion. In particular, the use of a sweet-taste inhibitor decreased glucagon-like peptide-1 (GLP-1) and peptide YY (PYY) secretion by L cells, without affecting cholecystokinin (CCK) secretion from I cells, which are known to not express sweet-taste receptors. Thus, it appears that this network of sweet taste signalling pathways in the oral cavity and the GI tract mediate the hormonal responses that orchestrate the hunger–satiety cycle. To further support what Liauchonak *et al.* (2019: 644) is stating here, a study conducted at the University of Sydney by researchers in 2016, showed that studies in both animals and humans have suggested that consuming artificial sweeteners can make you feel hungry and to therefore eat more (Cook 2016: 1). Sylvetsky and Rother (2018: 639) is of similar view and describes the disturbance of relationship between sweetness and calories through this study by stating that a sweet taste was indicative of calories and nutrients (e.g., fruit), yet this is not the case for NNSs. It has therefore been hypothesised that the sensation of sweetness without the delivery of calories may result in a disturbance of appetite regulation and impaired metabolic signalling. From the studies discussed earlier, there were conflicting arguments related to whether sweeteners increase appetite or not. Explained clearly here, the sweet taste receptors can affect hunger negatively.

2.14 Effect of non-nutritive sweeteners on gut microbiota composition

Liauchonak *et al.* (2019: 644) explain that, the gut microbiota are made up of millions of bacteria, viruses, and fungi that occur symbiotically within the gut and begins developing at birth. The make-up and purpose of the microbiota differs not only amongst individuals, but also fluctuates throughout an individual's life, influenced by external factors such as environmental stressors, antibiotics and diet. Sylvetsky and Rother (2018: 640) expose that, the experimental evidence for NNSs-induced alterations in gut microbiota in humans is limited. The human study presented that contact with NNSs for one week, linked alterations in the microbiome and glucose metabolism in a small sample, but due to an insufficient control group, it makes these results unreliable. Sylvetsky and Rother (2018: 640) reassure that, further study in this area is warranted, as such findings may have important implications given the emerging role of the gut microbiome in health and disease. Sylvetsky and Rother (2018: 636) conclude that, observational studies where able to show that, NNSs consumption is associated with higher body weight and metabolic syndrome. In contrast, randomised controlled trials demonstrate that NNSs may support weight loss, particularly when used alongside behavioural weight loss support. Additional long-term, well-controlled intervention studies in humans are needed to determine NNSs effects on weight, adiposity, and chronic disease under free-living conditions.

It is thought that diet is responsible for approximately 10% of the influence on intestinal microbiota, a substantial amount when considering the high variability in lifestyle and genetics amongst individuals. Aberrations in the gut microbiota have been associated with the development of insulin resistance, obesity, and metabolic syndrome; however, the details are still in the process of being understood. It has been reported that type 2 diabetes is associated with alterations in microbiota composition (Liauchonak *et al.* 2019: 644). Markus *et al.* (2020: 5480) shed concern that, even though stevia is generally considered safe, emerging scientific evidence has implicated the agent in gut microbial imbalance and yet the mechanism by which stevia extract alters the gut microbiota remains inadequately understood. More research is needed to understand how stevia impacts the gut. Another interesting piece of research presented by Choudhary and Pretorius (2017: 725) describing the effect that aspartame has on gut microbiota. Choudhary and Pretorius (2017: 725) strongly agree that NNSs (including aspartame) may influence gut metabolism by changing the host metabolic phenotype, ultimately affecting the gut microbiota. Changes in the gut microbiota may interfere with the physiological responses that control homeostasis; alter the intestinal environment, thereby triggering inflammatory processes associated with metabolic disorders; or disrupt sweet-taste receptors in the gut that can affect glucose absorptive capacity and glucose homeostasis states Choudhary and Pretorius (2017: 726).

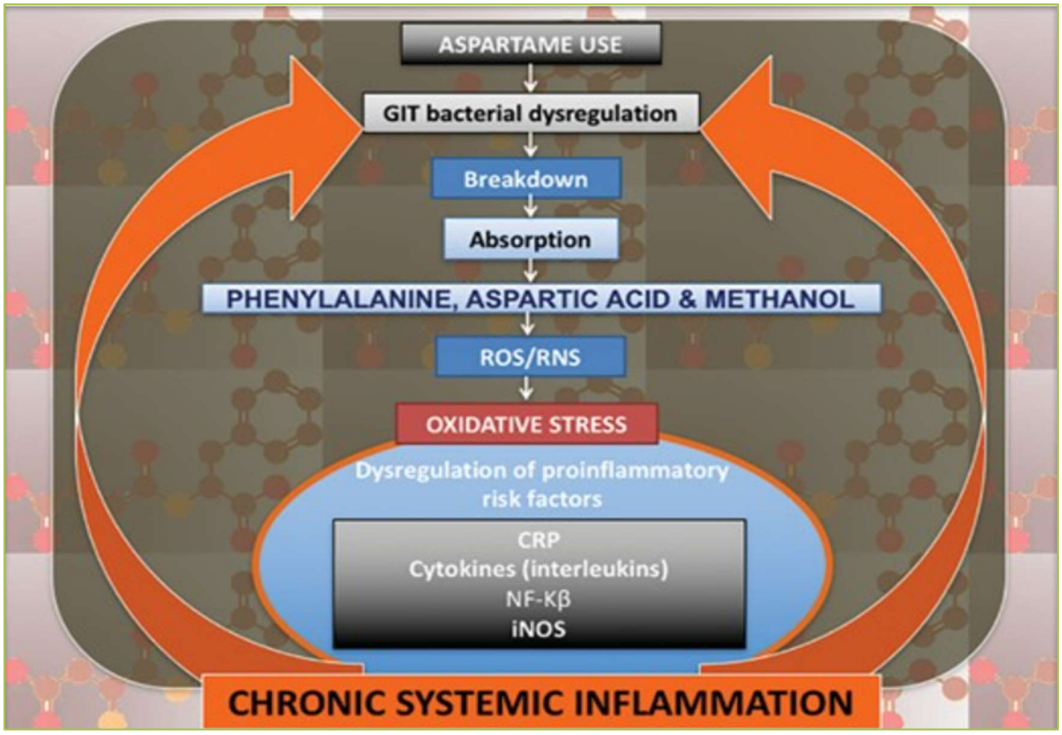


Figure 2.13 Role of aspartame in the development of inflammation in the gastrointestinal intestinal tract (Choudhary and Pretorius 2017: 728)

Figure 2.13 describes how the consumption of aspartame may lead to excess production of reactive nitrogen species (RNS) and reactive oxygen species (ROS), inducing oxidative stress in different cells and tissues. This causes dysregulation of proinflammatory markers, which ultimately leads to chronic systemic inflammation, which in turn causes gut bacterial dysregulation (Choudhary and Pretorius 2017: 728).

2.15 Conclusion

As research indicates, NNSs continues to be a staple in the Western diet (Walbolt and Koh 2020: 115). Nonetheless, the concern around safety of consuming NNSs is still a very controversial topic (Liauchonak *et al.* 2019: 644). It is evident in the research that has been shared here that, there is a high probability that many consumers globally are consuming NNSs through a variety of packaged foods and beverages, and they may not even be aware of this. In 2004, WHO had recommended that nutritional labelling was one of the strategies to assist the public in making healthier food choice. However, Van der Merwe *et al.* (2013: 650) reported that South African consumers selectively read nutrition information on food labels. It was also stated in this chapter, that regardless of the level of education in first world countries vs the level of education in third world countries, the consumer perception and knowledge on sweetener use and its safety were very similar, in that consumers are not very aware NNSs, and some consumers may be reluctant to consume them.

The purpose of this chapter was to argue some of the conflicting views associated with the use and safety of sweeteners and highlight why sweeteners have become an ingredient of concern. It also aimed to show how sweeteners have become so widespread globally; it is no longer limited to beverages, but its use has been ramped up in foods as well. Due to manufacturers turning to inclusion of sweeteners in food and drink, it is filtering into an ever-increasing number of products today. The overall impact on whether the daily intake limits for sweeteners are being exceed or not, is not established at this stage. Harbolic (2020: 1) strongly argues that acceptable daily intakes have been set for each non-nutritive sweetener for a reason; and should not be ingested in unlimited quantities. Choudhary and Pretorius (2017: 730) reminds scientists that the subject of artificial sweeteners has generated extensive research but much about it is yet to be fully explored to make the correct conclusions and eliminate doubt that surrounds its use. This chapter also highlighted the link between NNSs and metabolic diseases and this to remains unclear. At this stage, it is difficult for scientists to ascertain whether NNSs consumption has beneficial or adverse effects on health outcomes.

This chapter further highlighted that there is a big role for regulators to play in the regulating and monitoring of the use of sweeteners in food and beverage products in South Africa. Hargous *et al.* (2020: 1) reiterate that, although one of the main strategies used by the food industry to reduce the content of added sugars in packaged foods and beverages, is via inclusion of NNSs in food and beverage products, the continuous monitoring of NNSs consumption is essential. While the amount of NNSs used in food and beverage formulations is regulated by the maximum permitted level as stipulated in the GRAS of the Codex Alimentarius Commission, the current widespread use could mean that consumers may unknowingly consume many items that contain NNSs making it an ingredient of concern in terms of exceeding the ADI and long-term health outcomes. Hence, the necessity to probe into consumer perception and knowledge levels to determine if consumers are aware of the inclusion of NNSs in the products they consume. The next chapter will deal with research design and methodology of the study.

Chapter 3
METHODOLOGY

3.1 Introduction

This chapter will underpin the research design and methodology for the study. The study design, study population, sample selection, measurement instruments and, lastly, ethical considerations and reduction of bias will be explained in detail.

3.2 Study design

This study investigated consumer awareness and consumption of products that contain NNSs in South Africa. This study further explored the widespread usage of NNSs through a sub-set of food and beverage products in the South African market. The study used exploratory and quantitative methods to gather data for the research through a cross-sectional survey. The study design will be described here in detail.

3.2.1 Cross-sectional study

According to experts Olsen and St George (2004: 7) a cross-sectional study design includes a selection of either the entire population or a subset of individuals who participate in a study. In this study the mechanics was the NNSs consumer survey that was used to obtain data from individuals and the development of the scientific product database for a sub-set food and beverage products that contain NNSs. Levin (2006: 25) states that the advantages of a cross-sectional study is that it is inexpensive, takes a minimum amount of time to execute and allows for the data obtained from the study to be assessed for potential risks. It is extremely useful and commonly used as a public tool (Levin 2006: 25). There are some disadvantages of the cross-sectional study as this type of study only provides a snapshot of a situation for a specific time frame and this could produce different results to another time frame (Levin 2006: 25). It is also challenging to make casual inference and results could be under-represented resulting in prevalence-incidence bias (also called Neyman bias), depending on the type of study (Levin 2006: 25).

3.3 Aim and objectives of the study

The study aimed to investigate consumer awareness and consumption of NNSs in South Africa. This study further explores the widespread usage of NNSs through a sub-set of food and beverage products in the South African market. As indicated previously, NNSs, have become increasingly popular and are used in several packaged food products and are no longer limited to SSBs. While the permissible level of NNSs included in food and beverage formulations is regulated by the maximum permitted level as stipulated by the General Standard for Food Additives (GSFA) of the Codex Alimentarius Commission, the current inclusion of NNSs across a growing number of food and beverage products would mean that consumers may unknowingly consume several products that contain NNSs; making it an ingredient of concern in terms of long-term health impact.

This study had three objectives. First, this study investigated the level of knowledge, awareness, and perception of South African consumers on NNSs in products they consume through a consumer survey.

Second, the study determined the consumption of beverages, sweeteners and snacks products through the NNS consumer survey. Third, the study established a scientific product database detailing a breakdown of NNSs in a sub-set sample of packaged products available in retail outlets in SA through product label analysis. The scientific database was ongoing throughout the research process. Figure 3.1. illustrates the phased approach applied in this research study.

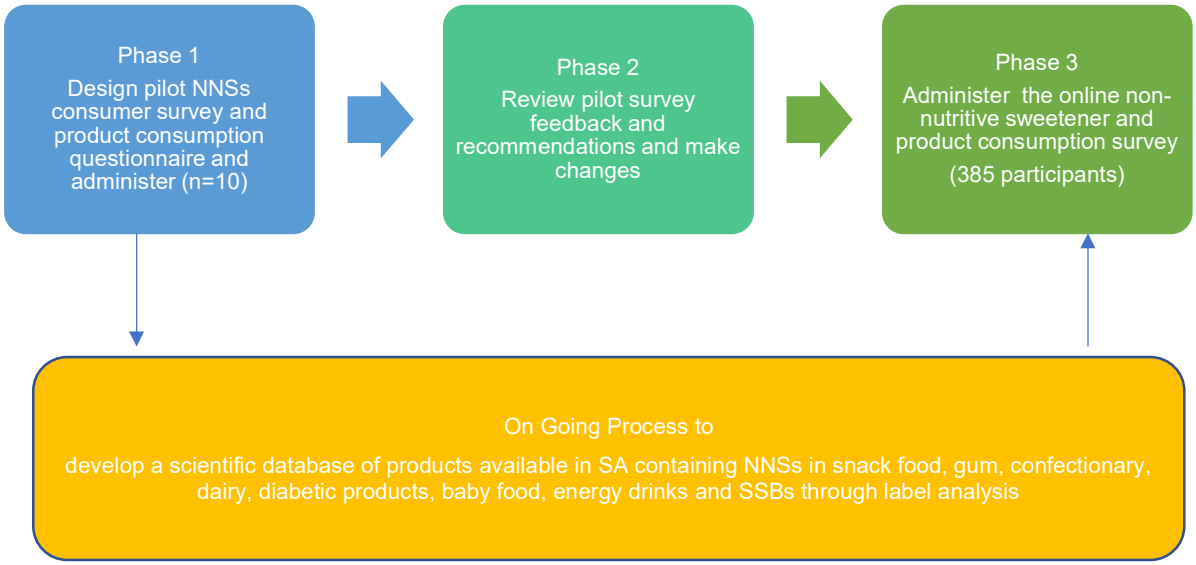


Figure 3.1 A flowchart illustrating the phased approach process used in this research study to achieve the targeted objectives

3.4 Study population and sample size calculation for the non-nutritive sweetener consumer survey

3.4.1 Study population eligibility criteria and sample size

The sample inclusion criteria were as follows:

- South African adults, ≥18 years
- Men and women
- All races

3.4.2 Sample size calculation

The sample size for a consumer survey with a population size of +1,000.00 with a 95% confidence level, 5% margin of error is calculated at 385 (Taherdoost 2017: 238). Given that the South African population size is 60,742,921 million (Worldometer 2019), the sample size for the NNSs consumer survey was set at 385. Convenience and snowball sampling methods were used to recruit 385 participants which will be explained in greater detail under section 3.6.

3.5 Study method and materials

This section details the study method and measurement instruments used in this study

3.5.1 Non-nutritive sweetener consumer survey

The NNSs consumer survey (Appendix E) investigated consumers knowledge, perception, and consumption of NNSs in SA through the online mode. The survey was adapted and designed to obtain key information from participants to provide valuable data for the research study. It was also developed on the foundation of a study that was used to gain data on the knowledge and perceptions of NNSs in the UK population by researchers Farhat, Dewison and Stevenson (2021: 444). The survey consisted of sections which will be further unpacked here. At the beginning of the survey, the introductory paragraph described the background and the aim of the survey, a letter of information and ethical approval for the study was also provided.

The first section included demographic information of the participants; gender, age group, race, location, and level of education. Sequentially, the next set of questions were related to the participants general health, knowledge, and awareness of NNSs. The survey flowed into a regulatory section which gave further insight into participants level of knowledge, perception, and trust of NNSs. The last section was the NNSs product consumption part of the survey where participants were presented with a list of beverages, sweeteners and snacks products and were asked to select if they consumed these products. The consumption questionnaire was a validated tool, from Myers, Passaro and Hedrick (2018: 11), adapted to the South African context.

Some of these adaptions included language which was adapted to suit the SA consumer and simplified to make the survey more relatable by using terms and descriptions that were familiar to participants. For example, in the NNSs consumer survey: SA provinces were listed, level of education status was adapted to the South African context, ethnicity, and SA government information about DOH and description of applicable regulations were also adapted. In addition, product names familiar to South Africans, i.e., diet cool drink instead of diet soda was used in the consumer survey.
The survey access was available on two different survey platforms to enable online access for participants convenience, preference and ease of use:

- Google Forms
- Microsoft Forms

3.5.2 Pilot study

The NNS consumer survey was piloted prior to administering the survey among participants, these participants were excluded from the main study (n=10). Participants identified to participate in the pilot study were students and work associates. Email addresses were obtained through the staff intranet at Mars Consumer Products Africa and the department of Food and Nutrition at the DUT. These participants were included in a blind carbon copy email with a link to participate in the pilot survey (Appendix C). A brief introduction on the purpose of the pilot study, letter of information and consent was shared. The pilot version of the survey included questions at the end to determine usability, ease of comprehension, as well as routing and sequencing of questions. Reliability of the questionnaire,

ensures consistent measurements of the questions used in a survey instrument to elicit the same results each time it is asked in the same situation on repeated occasions (Wright and Marsden (2010: 407). In this study, we did not re-test reliability for test stability over time as pilot participants were experienced in the food and beverage industry and academia. Feedback from the pilot study advised finalisation of the questionnaire before implementation. Recommendations for improvement from the pilot survey were:

- Write all acronyms in full so that all participants clearly understand its meaning, for example, DoH – Department of Health.
- One participant suggested that examples of commonly known NNSs found in beverages to be provided upfront, example, Coke Zero has Aspartame. Instead, food and beverage products that contain NNSs were listed to help the participant identify these without singling out a specific product.
- An interesting comment was received for an improved regulation on NNSs, to promote transparency and communication to consumers, on the risk factors associated with the NNSs.

All recommendations and comments from the pilot survey were considered and adapted where possible to enhance clarity and flow, without effecting the objectives of the study.

3.6 Recruitment of participants for online non-nutritive sweeteners survey

Convenience and snowball sampling methods were used to recruit 385 participants (South Africa adults, ≥18 years, men and women of all races) for the NNSs consumer survey. The final survey was disseminated through social networks, LinkedIn™, Facebook™ and WhatsApp™ (Appendix E). The expected time to complete the survey was projected at 15 minutes, and the survey was open for five months. The public was involved in the dissemination of the survey in their networks through snowball sampling technique which allowed anyone who was willing to participate in this survey. These methods will be discussed under point 3.6.1 and 3.6.2 in detail. The platforms chosen were constantly monitored for responses and a regular reminder through daily updates on the status prompt user of LinkedIn™, Facebook™ and WhatsApp™ to take the survey. These platforms were open to public viewing and participants were requested to share this survey link within their networks which supported the recruitment of more participants. Furthermore, the Consumer Goods Council South Africa was approached to support the recruitment of participants due to its large influence and industry member stakeholders in SA. All members were encouraged to participate. A comment was also left on the social page of Foodies SA which recruited participants from this pool of users. Mars Consumer Products SA who played a big role in disseminating the survey via email to all associates based in Durban, Johannesburg, and Cape Town. Participants shared the survey to their networks to extend the pool within their own community WhatsApp™ groups like neighbourhood watch and school parent groups. Smaller work communities in various provinces participated in the survey and recruited others to participate through word of mouth and social network. To support a steady pace of obtaining responses, two field workers were also recruited to fast track the administration of the NNSs survey in different

provinces. This effort not only ensured the NNSs survey reached all provinces but also obtained a demographic representative sample of participants from all provinces.

3.6.1 Convenience sampling

Convenience sampling involves selecting participants because that are often readily and easily available. Typically, convenience sampling tends to be a favoured sampling technique as it is inexpensive, and an easy option compared to other sampling techniques (Taherdoost 2017: 23). Convenience sampling often helps to overcome many of the limitations associated with research. For example, using friends or family as part of sample is easier than targeting unknown individuals (Taherdoost 2017: 23).

3.6.2 Snowball sampling method

Snowball sampling is known as a non-random sampling method that uses a few cases to help encourage other cases to take part in the study (Taherdoost 2017: 23). The advantage is that it effectively increases the sample size, has easy execution and is inexpensive. The disadvantage is that this method is applied in small populations that are difficult to access due to their closed nature, e.g., secret societies and inaccessible professions (Taherdoost 2017: 23) but this did not apply to this research study.

3.7 Non-nutritive sweeteners food and beverage database in the South African market

The scientific database was established to determine the number of products that contain NNSs within specific categories which included snack foods, dairy products, sugar-free chewing gum, candy, sugar-sweetened beverages, energy drinks, diabetic products and baby foods found in three major South African retail stores: Checkers, Woolworths and Dis-Chem. This study aimed to identify food and beverage products that were formulated with NNSs in the South African market. The database development was a desktop study that involved the scientific and regulatory analysis of product labels through a combined use of online and in person collection of label data. The database is a point of reference for several products containing NNSs, that were examined during this phase of the study. It was limited to the following categories: snack foods, dairy products, sugar-free chewing gum, candy, SSBs, energy drinks, diabetic products and baby foods, found in three major South African retail stores: Checkers, Woolworths and Dis-Chem. This study was limited to these product categories because NNSs is commonly found in these foods and the reason for including baby food into the scope was for the associated concern of including NNSs in baby food. These three retailers because the label analysis needed to cover a wide range of products for the duration of the research. If more retailers and categories were added, it would have been difficult to manage the timeline and the accuracy of this step in the research. The selection of major SA retailers was limited to Checkers and Woolworths as these outlets have a significant market share in SA, Dis-Chem was included for its unique product offerings. Each retailer represents a very different shopping experience for consumers and is positioned very differently from one another. Checkers is positioned as affordable to most of its shoppers and is trusted

for its convenience of having 'your favourites in one place' (Checkers 2022: 1). Checkers has larger stores with a wide selection of quality products, often at competitive prices (Checkers 2022: 1). Woolworths on the other hand is positioned as a trendy, much smaller retail store that prioritises quality, health and nutrition. Woolworths took quality to the next level when they were the first retailer in SA to introduce a 'sell by date' on food packaging (Woolworths 2022: 1). Consumers shopping at Woolworths bond with the quality and luxury of their food products and not the cost, therefore targeting a very niche consumer market. Woolworths has its private label food and beverage products which is retailed along with limited alternate brands, this combination offering of in-house and competitor brands offers consumers a desirable but limited product range when compared to Checkers. Dis-Chem brings a different dimension to the research and was chosen for its popular position on pharmaceutical, healthcare products and wellness (Dis-Chem 2022: 1). Focusing mainly on family personal care, baby care, health, and wellness products, it includes a niche health food range, diabetic friendly food range, meal supplements and shakes targeting consumers who look for these products specifically. Consumers shopping at Dis-Chem are shopping for very specific food items within the range mentioned. These retailers are available nationally, are well known, well located and easily accessible. Data was captured and exported onto a database with a detailed breakdown of NNSs found in the sample of packaged foods within the highlighted categories. The label analysis explored whether products made, health and wellness claims that justified the inclusion of sweeteners according to the sweetener regulation guideline for use of sweeteners in foodstuff (South Africa 1991). Regulation R146 was also applied to guide the label examination which regulates the labelling requirements known as Regulation for Foodstuffs, Cosmetics and Disinfectants Act (23 February 2007).

The scientific analysis indicated:

- The type of sweetener used,
- If a combination of sweeteners and polyols were used,
- If sugar was also included in the product with sweeteners,
- Variation in sweetener labelling from product to product,
- If sugar-free or diabetic friendly claims were made.

This data was quality checked through a sub-sample for every 15th label, by trained researchers over a five-month period. This was an independent check for duplications or incomplete data and was verified by the appointed research assistants. Online data collection involved retrieving product label data through an online medium e.g., accessing retailers online shopping websites for Checkers, Woolworths and Dis-Chem, the food or beverage manufacturers websites and health and wellness advertising websites. This resulted in an assessment of online product specifications, product technical data sheets or otherwise commonly known as product descriptions that were available online at the time of research. Additionally, in person store visits was also done by trained researchers, which included the physical examination of product labels within the assigned categories, the data was captured and transferred onto the scientific product database.

3.8 Statistical Analysis

The statistical Package for Social Sciences (SPSS®) version 25IBM Corp, Armonk, NY, USA) was used as an instrument for the analysis. Descriptive statistics were used to define the proportion of responses for each question. Statistical significance was accepted as $p < 0.05$. All online survey results were transferred automatically to excel, and the data was then analysed. Descriptive statistics including means and standard deviations, were applied. Chi-square goodness-of-fit-test, which is a univariate test, was used on a categorical variable to test whether any of the response options were selected significantly more/less often that the others. Under the null hypothesis, it was assumed that all responses are equally selected. A binomial test was used to measure whether a significant proportion of participants selected one of a possible two responses. One sample t-test was applied and confirmed whether a mean score was significantly different from a scalar value. Independent samples t-test compared two independent groups of cases. ANOVA: A test that compares more than two independent groups of cases was also applied. The data was analysed and interpretated into numerical and binomial tables and graphs which will be presented in Chapter 4.

3.9 Validity

Researchers Heale and Twycross (2015: 66), describe that, validity in research refers to the level of accuracy obtained through a study, so tools are able to measure what it is intended to measure. Heale and Twycross (2015: 67) go on to state that, reliability in research refers to the consistency in measure and both are equally important for the success of accurate research communication. Each phase of this study was validated through various methods to ensure that the data is accurate and reliable. The validation of tools, steps, execution, and method used for validation will be discussed next.

3.9.1 Pilot study tool validation

The method used to validate the pilot study tool included content and construct validity tests. The measure was the pilot study, and this tool was used to determine the suitability of the NNSs consumer survey. The reason for applying the content validity test was to ensure that the pilot study was a validation step to check that the survey was fully representative of what it aimed to measure before it was disseminated as the main study. First, to understand what a construct validity test is followed by a discussion on why this type of validity was applied. Heale and Twycross (2015: 66) describe the construct validity test as a tool that measures the accuracy and intention of what the research wants to achieve ahead of the application. The pilot study was conducted for this exact reason, it was performed to ensure that the NNSs survey and product consumption questionnaire tool was going to evaluate what it was intended to research. The statistician also assessed the chronical flow of the survey to ensure the acceptable order, the questions were also evaluated to ensure that these were not ambiguous or confusing for the participant, to ensure that it would speak to the objectives of the study, before it could be finalised for the main study.

3.9.2 Non-nutritive sweetener consumer survey tool and validation

The NNSs consumer survey tool was developed on the basis of a construct validity test to ensure that this tool will allow the research to achieve what was intended. This was achieved by constructing the NNSs consumer survey according to a very similar validated questionnaire that was trialed and tested in a study by researchers Farhat, Dewison and Stevenson (2021: 444). Researchers Farhat, Dewison and Stevenson (2021: 444) embarked on a very similar study on NNSs in the United Kingdom, measuring consumer knowledge and perception of NNSs. This was therefore the basis on which the NNSs survey and product consumption questionnaire was designed. Questions were very similar to the validated tool and the flow of the survey followed suit.

3.9.3 Scientific product database tool and validation

The scientific product database tool was established in the study to showcase the range of several products that contain NNSs in the South African market. For the validation of the products documented in the scientific database, there was an in-person validation conducted for every 15th product. The data collection involved a physical examination of product labels by researchers at the retailer. Research workers were recruited and trained. An overview on the research topic, the scope of research isolated to selected retailers and product categories for analysis were defined. Emphasis was placed on the examination of the ingredient declaration and product claims for the selected product categories. The data collection was a pivotal component of this research study exhibiting rich data that was gathered to enable this study and to answer questions and evaluate the outcome which will be unpacked in Chapter 4.

3.10 Reduction of bias

This research evaluated the phases in the research study that could have introduced bias and the following steps were taken to mitigate bias.

- Pilot study: the NNS consumer survey was tested on a sample population who was impartial to the study. As presented in table 3.1, the pilot study was used as a tool to test the understanding and flow of the NNSs consumer survey by ten participants who were then excluded from further participation in the survey.
- In-store label analysis: this was conducted by impartial researchers who were recruited and trained to collect data from products within the product categories instore, independently as presented in table 3.1. The exercise expanded over three major retailers in SA, representing different brands of products available in each store.
- NNSs database: label accuracy was validated by trained researchers for every 15th product captured in the database.

- Data analysis: an impartial statistician was appointed, who then extracted the data directly to the instrumentation platforms for analysis.
- An online survey form: was designed to accept only one response from a participant and was closed after 385 responses were received.
- Data quality of the NNSs consumer survey and database: all results captured on MS Excel tool was validated. The supervisor and statistician played a role in ensuring accuracy and reliability of data obtained during this research. The supervisor actively guided the research topic ensuring that a wide scope of journal articles, reviews and citations were applied in this research and that the research was true and well presented by conducting regular reviews.

3.11 Ethical consideration

The research study obtained full ethical approval from the Institutional Research Ethics Committee (IREC) (Ethics Clearance Number: 136/21) (Appendix D). This study applied non-invasive methods. Participants were provided with a letter of information (Appendix A) and informed consent was attained through a checkbox at the start of the online survey (Appendix B). Participation in the online questionnaire was entirely voluntary and anonymous with the option to withdraw at any time from the survey. The survey had no identifying values that linked information to the participant such as name, email address or IP address. Electronic data was password protected and will be deleted after the retention period of 5 years.

3.12 Conclusion

This chapter unpacked the individual components in the research design and methodology used in this study. These components were further unpacked in this chapter ensuring that the instrumentation, methods, and process followed were ethically, academically, and scientifically sound. In chapter 4, the results of the study will be presented and discussed.

Chapter 4
RESULTS AND DISCUSSION

4.1 Introduction

In this chapter, the results of the NNSs consumer survey and NNSs scientific product database are presented in the form of graphs, figures, and tables and discussed.

4.2 Overview

The NNSs consumer survey was designed and administered to obtain data on consumer knowledge, awareness, and perception from South African consumers and NNSs product consumption. This data obtained through the study is essential for identification of gaps in consumer knowledge or understanding the consumer level of awareness and NNSs consumption through food and beverage products. The data from the NNSs consumer survey will be used to draw comparisons and similarities to some of the global studies narrated in chapter 2. The use of NNSs in the South African food and beverage industry, will be illustrated and discussed through the results of the scientific database of products that contain NNSs.

4.3 Consumer survey

4.3.1 Demographics

Table 4.1 describes the demographic information of the study participants for the NNSs consumer survey.

Table 4.1 Demographic information of study participants for the non-nutritive sweeteners consumer survey (n=388)

Category	Description	% (n)
Gender	Women	66.5 (258)
	Men	33.5 (130)
Age (years)	18-24	24.2 (94)
	25-34	27.6 (107)
	35-44	24.7 (96)
	45-54	14.9 (58)
	55-64	5.7 (22)
	65-74	2.3 (9)
	+75	0.5 (2)
Race	White	18.0 (70)
	Indian/Asian	30.2 (117)
	Black	40.2 (156)
	Coloured	11.6 (45)
Province	Eastern Cape	10.3 (40)

Category	Description	% (n)
	Free State	3.1 (12)
	Gauteng	31.4 (122)
	KwaZulu-Natal	29.6 (115)
	Limpopo	1.8 (7)
	Mpumalanga	1.5 (6)
	North-West	0.5 (2)
	Northern Cape	0.8 (3)
	Western Cape	19.8 (77)
Education	No formal education	4.6 (18)
	Primary school	2.1 (8)
	High school	16.2 (63)
	Tertiary	77.1 (299)

A total of 388 South African adults participated in the NNSs consumer survey, nationally. Women participants dominated the survey with a weighted 66.5% (n= 258) of the responses, followed by 33.5% (n=130) of the responses received from men. Budree, Fietkiewicz and Lins (2019: 320) also explain that women were more active than men on social media with Facebook at one stage being dominated by higher female usage. Looking into research on whether gender influences online survey, data reveals that women participation is often higher than men. According to an online survey study conducted at a large state university in south-eastern USA, where the survey received responses from 278 participants, the data presented that woman were the minority but yielded a higher response rate by 36% (Smith 2008: 9). According to the latest data on gender shopping trends from NielsenIQ (2019: para 2, line 1), 71% of women shop for groceries, 81% of women enjoy doing grocery shopping (NielsenIQ 2019: para 2, line 2). This then positions why women would want to know more about health and wellbeing as protectors of their family, which could have resulted in more women taking this survey due to the nature of the topic and its association to food, health, and wellbeing.

All races participated in the survey with most responses from Black participants (40.2% n=156), followed by Indian/Asian (30.2% n=117), White (18.0% n=70) and Coloured participants (11.6% n=45). Every effort was made to obtain a demographic representative sample; however, a larger sample of Indian participants was obtained due to the researcher's networks. Results show that younger South African population with 24.2% (n=94) aged 18-24, 27.6% (n= 107) aged 25-34 and 24.7% (n=96) aged between 35-44 that took part in the survey. It can be assumed from this result that the young are more prone or able to easily access and interact with social media than the older participants aged between 65-74, where a low 2.3% (n=9) of the responses were received. According to a study conducted by Budree, Fietkiewicz and Lins (2019: 318), social media is gaining traction and is fast growing in SA. To justify here how popular social media is among the young SA population, Budree, Fietkiewicz and Lins (2019: 319), elaborate that from the increase in SA users, the majority are between the ages of 20 and 29 years old. This could then explain why the responses received from the younger age group was

higher than that of the older aged population. Furthermore, Budree, Fietkiewicz and Lins (2019: 320) state that senior citizens above the age of 60 represent 7% of users. This 7% is made up of the aged who are open to trying new things. The survey was opened to all provinces in SA, but high participation came from Gauteng 31.4% (n=122), and KwaZulu-Natal 29.6% (n=122), followed closely by 19.8% (n=77) from Western Cape. The level of education also varied between participants with higher participation, 77.1% (n=299) of participants having a tertiary education, 16.2% (n=63) with high school education, 2.1% (n=8) with primary school education and 4.6% (n=18) with no formal education. Given that 4.6% participants had no formal education can attest to the power of life-long learning through other modes. The extrapolated data on education is a mixed basket showing the projected inconsistencies of education as anticipated.

4.3.2 Prevalence of non-communicable diseases

The NNSs consumer survey also aimed to establish the prevalence of NCDs among participants. Table 4.2 below presents the result of participants in response to the prevalence of NCDs.

Table 4.2 Prevalence of non-communicable disease among study participants

NCDS	% (n)
Type 2 diabetes	9.3 (36)
High blood pressure	13.1 (51)
Heart disease	5.4 (21)
Cancer	2.1 (8)
No NCDs	73.7 (286)

In Table 4.2 the prevalence of the common three NCDs noted were high blood pressure 13.1% (n=51), type 2 diabetes 9.3% (n=36), heart disease 5.4% (n=21) and cancer 2.1% (n=8). A large percentage of participants reported no prevalence of NCDs 73.7% (n=286). High blood pressure, type 2 diabetes and heart disease is among the increasing NCDs in SA. These findings are comparable to results reported in the South African National Health and Nutrition Examination Survey SANHANES where high blood pressure was reported by (20.6% and 12.0%), heart disease (2.9% and 1.5%) and high blood sugar (6.0% and 4.0%) male and female participants, respectively in SA (Shisana *et al.* 2013: 4). However, the 2016 SADHS, reported that 46% of women and 44% of men have hypertension and hypertension increased steadily with age; 84% of women age 65+ have hypertension, compared with 17% of women age 15-24. In addition, 13% of women and 8% of men are diabetic (National Department of Health (NDoH), Statistics South Africa (Stats SA), South African Medical Research Council (SAMRC), and

ICF, 2018). It was also raised in chapter 2, that 7% of the South African population has diabetes (3.85 million people, aged between 21-79 years old) (Harmse 2019: 1). The 73.7% of the participants that reported no prevalence to NCDs in the NNS survey could mean that this was because of the younger age group mainly participated in this survey. Again, this was a similar finding that was presented in the SANHANES survey. According to Shisana *et al.* (2013: 12), NCD prevalence among female and male participants increased with age, however this results must interpreted with caution as this is self-reported and it could slightly different in reality due to undiagnosed hypertension and diabetes mellitus.

4.3.3 Consumer non-nutritive sweetener awareness

Participants were provided a list of different NNSs in the survey and were asked to state which ones they have heard off. Table 4.3 represents participants responses to the different types NNSs they heard of.

Table 4.3 Participant response to different types of non-nutritive sweeteners

Sweeteners	Frequency (%)		n	p-value
	Yes	No		
Saccharin	161 (41)	**227 (59)**	388	.001*
Aspartame	174 (45)	214 (55)	388	.048
Stevia	135 (35)	**253 (65)**	388	<.001*
Neotame	25 (6)	**363 (94)**	388	<.001*
Xylitol	**238 (61)**	150 (39)	388	<.001*
Malitol	64 (16)	**324 (84)**	388	<.001*
Sucralose	159 (41)	**229 (59)**	388	<.001*
Acesulfame-K	32 (8)	**356 (92)**	388	<.001*

* indicates significance at the 95% level

The results presented in Table 4.3 shows that a large proportion of the participants indicated that they did not hear of neotame 94% (n=363), acesulfame-K 92% (n=356), malitol 84% (n=324), stevia 65% (n=253), saccharin 59% (n=227) and sucralose 59% (n=229). This result highlights the consumer awareness gap of NNSs. To unpack the reason behind why this result is a cause for concern, the NNSs that participants have indicated that they have not heard of is very commonly used in the food and beverage industry in SA. Interestingly, while results show that not all sweeteners were commonly heard of, a significant 61% (n=238) of participants have heard of xylitol, p<.001. An explanation behind this

result could be that xylitol is better known due to its common use in gum, candy and in-home baking. Xylitol is also well positioned for its claims and has had a lot of marketing support. It is known for dental claims associating its consumption with healthy teeth linked to reduction of dental caries because it is a high intense sweetener which does not digest to acid by oral microorganisms, resulting in it preventing dental caries (Gupta *et al.* 2013: 3). It is also widely marketed and well positioned as a sugar-free alternative sold as an ingredient in health stores like Dis-Chem, making the product and marketing information easily accessible to consumers. This result typically demonstrates that there is power behind marketing which creates the awareness. It not only creates awareness but also expands consumer knowledge.

Aspartame was the second highest known NNS that was heard of by 45% (n=174) of the participants. This could be related to the fact that aspartame is commonly used in SSBs. Aspartame is also well marketed as a sugar alternative. In a most recent study shared in chapter 2, like xylitol, aspartame has received a lot of attention in the media because of its health concerns with long-term consumption and the link to cancer (Debras *et al.* 2022: 11). At one stage aspartame was also banned and later re-introduced into the market as the claims against it being a cause of cancer were not evidently substantiated through research (The United States Food and Drug Administration 2018: 1).

Regarding the education level of participants highlighted in Table 4.1, it is interesting to note, that regardless of level of education where 77.1% of the study participants had tertiary education, there is still a high number of participants who did not hear of various NNSs in the SA market.

Figure 4.1 presents the results on how often participants consumed products labelled ‘sugar-free’ or ‘diet’ and how often they knowingly consumed products containing NNSs.

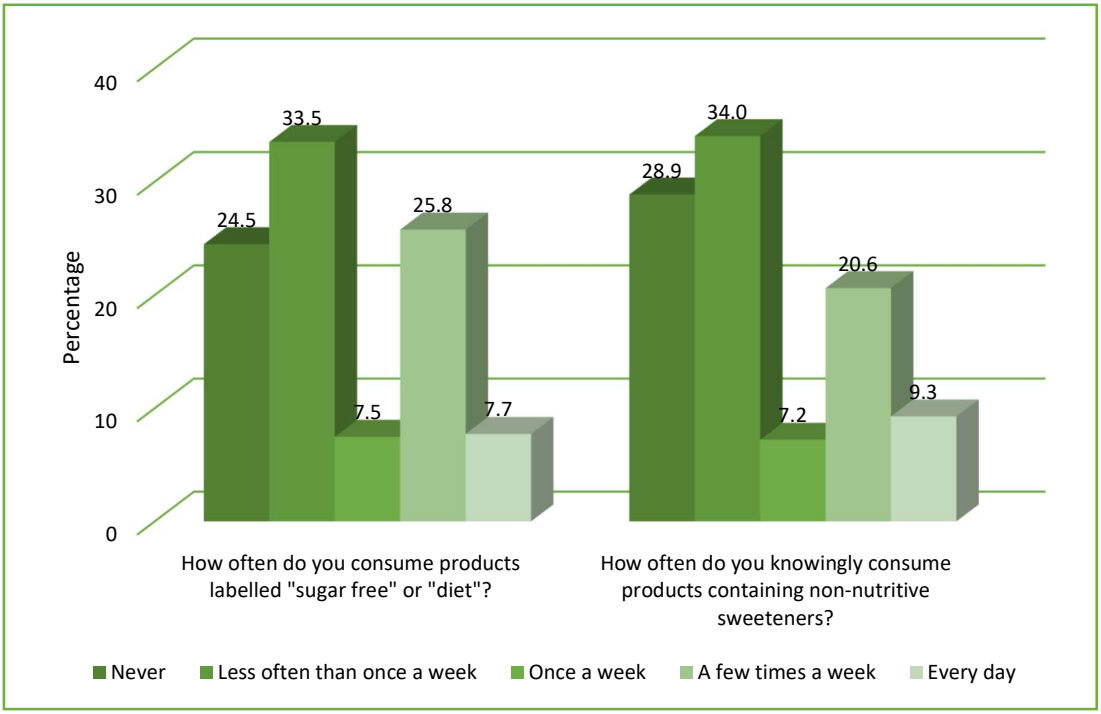


Figure 4.1 Consumption of 'sugar-free' or 'diet' products and frequency of knowingly consuming products containing non-nutritive sweeteners

Regarding the frequency of consuming products that are labelled ‘sugar-free’ or ‘diet’ products, 33.5% (n=130) participants consumed it less often than once a week, 25.8 % (n=100) consumed NNSs a few times a week, 7.5% (n=29) consumed NNSs once a week and 7.7% (n=30) consumed NNSs every day. The chi-square goodness-of-fit test was used to test if any response option was significantly more than others. A significant number of participants indicated that they consumed products labelled “sugar-free” or “diet” either ‘never’ ‘less often than once a week’ or ‘a few times a week’, p<.001. The relevance of this result is that although a significant number of participants consumed products labelled ‘sugar-free’ and/or ‘diet’, they may not actually know what these products contain. According to a study that was conducted to assess the impact of sugar related claims on health and whether this had an influence on consumers, Prada *et al.* (2021: 3) explains that the study data presented that, consumers are attracted to sugar related claims such as ‘sugar-free’ and ‘reduced sugar’ which is influencing buying behaviour, however ‘sugar-free’ or ‘diet’ products are formulated with the inclusion of NNSs. So, while the results show that sugar-free’ or ‘diet’ products are consumed, and consumers knowingly consume NNS, consumers showed poor familiarity in identifying the type NNSs they consume as highlighted in Table 4.3 which could be because ingredient labels are not read by many consumers.

Regarding participants frequency of knowingly consuming products with NNSs, 34%(n=132) consumed NNSs less often than once a week, 28.9% (n=112) never consumed NNSs and 20.6% (n=80) consumed NNSs few times a week. It is difficult to confirm from these results if consumers are truly aware of products that contain NNS as results earlier demonstrated that a significant proportion had not heard

of most NNSs. The chi-square goodness-of-fit test was also used here to test if any response option was significantly more than others. A significant number of participants indicated that they consume products that contain NNSs 'less often than once a week' or 'a few times a week', p<.001. To further interpret the results of those that said 'never' to knowingly consuming products containing NNSs, through further analysis, it was established that these very same participants said 'yes' to consuming products that contain NNSs.

Participants were given a list of products to select from and was asked to state which products they consume that they think may contain NNSs which is presented in Table 4.4.

Table 4.4 Products study participants consume which they think may contain non-nutritive sweeteners

Products	Frequency (%)		n	p-value
	Yes	No		
Cool drinks	**265 (68.3)**	123 (31.7)	388	.000
Cakes and desserts	111 (28.6%)	**277 (71.4)**	388	.000
Tea, coffee and hot beverages	116 (29.9%)	**272 (70.1)**	388	.000
Chewing gum	141 (36.3%)	**247 (63.7)**	388	.000

In Table 4.4, a significant 68.3% (n=265) participants indicated that they consumed cooldrinks that they think contain NNSs. Interestingly, a significant 71.4% (n=277) p.000 said no to consuming cakes and desserts that could contain NNSs, 70.1% (n=272) reported that they do not consume tea, coffee and hot beverages with NNSs and 63.7 % (n=247) reported that do not consume chewing gum that contain NNSs. It could be interpreted through the data presented here that participants are aware that SSBs contain NNSs. This result could be the case of the education around the HPL that was introduced as a counter measure to improve health outcomes in SA. The sugar tax levy was introduced in SA to support the reduction of sugar consumption as a measure to reduce NCDs in the country (South African Department of Treasury 2018: 1). This topic gained traction in the media supported by health campaigns and consumer education from platforms like HEALA and Priceless SA who pushed the movement to introduce the sugar tax levy in SA (Heala 2021: para 1, line 2). Campaigns centered around diabetes and HPL, driven by HEALA, a coalition of civil society organisations in SA, advocates to educate communities and officials about health and wellness (Heala 2021: para 1, line 2). Since the introduction of the sugar tax levy there has also been a cost benefit for consumers by incentivising sugar-free or diet beverages so they are cheaper than those that are not (Prada *et al.* 2021: 1). Manufacturers in the SSB industry were forced to reduce sugar which resulted in reformulation of SSBs in SA. SSBs have been re-formulated to include NNSs and the cost saving was also passed onto the consumer (South African Department of Treasury 2018: 1). It is a concern that a significant 63.7% (n=247) do not think that chewing gum contains NNSs. This again proves that participants are not very knowledgeable of

ingredients in products they consume. To substantiate why this is a concern, it must be mentioned here that a typical gum formulation includes a combination of sweeteners regardless of it being 'sugar-free' or not (Prada *et al.* 2021: 3).

Continuing the topic of participant knowledge, the next question in the survey probed participants to state whether they knowingly used NNSs in their daily routine.

Table 4.5 Participants usage of non-nutritive sweeteners in daily routine

Do you knowingly use NNSs in your everyday routine?	% (n)
Yes	31.7 (123)
No	**68.3 (265)**

A significant 68.3% (n=265) $p<0.001$ participants reported that they did not knowingly use NNSs in their everyday routine (Table 4.5). Firstly, this result not only indicates that participants have confirmed that they do not use NNSs knowingly which could mean that they may consume these without knowledge. Secondly, this result presented here represents more than half of the study population saying no to using NNS in their daily routine which raises the topic of concern again in this study. On the topic of participant knowledge, the trend being picked up in the data demonstrates that participants lack knowledge on NNSs. It could also mean that participants do not read product labels or investigate ingredients being consumed. It can be assumed that participants are therefore not familiar with NNSs. This result deepens the urgent need to introduce simple education measures for consumer knowledge in SA.

4.3.4 Consumer reasons for the consumption of non-nutritive sweeteners

In this section of the survey, consumers were required to indicate the reason why they consumed products containing NNSs where 1 indicated no influence and 5 indicated a very large influence from a list of reasons that was provided.

Figure 4.2 Reasons for consuming products containing non-nutritive sweeteners

In Figure 4.2, the most selected reason by participants for consuming products containing NNSs was 'they are ingredients in foods I consume' and the least selected reason was 'pleasant taste'. Interpreting the results of those participants who confirmed the reason they consume NNSs is because it is found in the foods and beverages that they consume; these participants have recognised that NNSs do exist in the products they consume. They almost seem to suggest that they do not have a choice if they wish to consume those products that they enjoy. Importantly, this result also shows that participants indicated that the taste of NNSs or the reason that it could be healthier than sugar had no influence on consumption. Also, NNSs being low in kilojoules/calorie was also not a reason that had a very large influence on consumption. What can be concluded from this result is that the only reason that influenced participant consumption of NNSs is because it is in foods and drinks that is consumed. Now the other reason for the increased use of NNSs in product formulation and why consumers could be consuming them in products more often is also due to the rising pressure that manufactures face to reduce sugar, reduce kilojoules and formulate healthier products low in nutrients like sugar, fats, sodium and carbohydrates. The most recent introduction of the sugar tax law in SA on the SSBs sector forced manufacturers to turn to NNSs to replace sugar in re-formulations. An added advantage for manufacturers was identified through a cost saving benefit to formulate using NSSs than sucrose. This allowed the industry to pass on the cost saving benefit to consumers. SSBs for example that are classified as diet, zero sugar or sugar-free is cheaper than those drinks that contain a higher sugar content. It also gives manufacturers the benefit and flexibility of formulating with NNSs, and nutritive sweeteners know as polyols to achieve the desired taste of the product without using sugar (Harbolic 2020: 1).

4.3.5 Consumer awareness and concerns of non-nutritive sweeteners

The next set of questions in the survey aimed to establish whether participants were aware or had any concerns about the use of NNSs.

Table 4.6 Participants' awareness and concerns about using non-nutritive sweeteners

Questions	Frequency (%)	
	Yes	No
Are you aware of any health concerns related to the consumption of non-nutritive sweeteners?	197 (50.8)	191 (49.2)
Are you concerned about using non-nutritive sweeteners?	191 (49.2)	197 (50.8)
Would you like to know more about non-nutritive sweeteners	**289 (74.5)**	99 (25.5)

The results presented in Table 4.6 indicates that 50.8% (n=197) of participants were aware of health concerns related to the consumption of NNSs which is the representation of just over half of the participants view. The very same result is observed when participants were asked if they had any concerns about using NNSs. A result showing 50.8% (n=197) of the participants responded that they had no concern using NNS. When participants were asked if they would like more information about NNSs, a significant 74.5% (n=289) indicated that they would like to know more about NNSs, $p<.001$. It can be assumed here that participants who voluntarily completed the online survey on NNS, could potentially be interested in the topic than the average consumer. Educating consumers on topics like NNSs empowers them to make informed choices that can influence their health and wellbeing in a positive way. Farhat, Dewison and Stevenson (2021: 444) confirmed that consumer education on the topic of NNSs resulted in the acceptance of NNSs and converted negative perception and attitude associated with concerns and risks to seeing more of the benefits with consuming NNSs. The consequence of this outcome presented here recommends that education through trusted health and government organisations is not only well received, but also help consumers make informed decisions, ensuring the information is presented by well trained and informed health experts on the topic of NNSs (Farhat, Dewison and Stevenson 2021: 445).

4.3.6 Information on health and wellness

The next set of questions in the survey probed participants to gather data on how they got information about health and wellness topics and which platforms they would use for this.

Table 4.7 Platforms used to get information on health and wellness topics

Item	Frequency (%)	
	No	Yes
TV/radio	**349 (89.9)**	39 (10.1)
Twitter	**382 (98.5)**	6 (1.5)
Instagram	**376 (96.9)**	12 (3.1)
Facebook	**359 (92.5)**	29 (7.5)
Scientific reports and research papers	**312 (80.4)**	76 (19.6)
Government health agencies website	**372 (95.9)**	16 (4.1)
Government food regulator's website – e.g., Department of Health	**354 (91.2)**	34 (8.8)
Never looked for information	**244 (62.9)**	144 (37.1)

The results in Table 4.7 indicate that a significant number of participants did not use these platforms for information retrieval. As discussed early in the results, participants were of a younger age group and the substantiation for this was because they were more active on social media in SA vs the older generation. The interesting point about this result is that even the popular platforms like Twitter 98.5% (n=382), Instagram 96.9% (n=376) and Facebook 92.5% (n=359) were not used as a platform for information. Government health agency websites 95.9% (n=372) and Government food regulator's website – e.g., Department of Health 91.2% (n=354) were also not popular platforms used for obtaining information. It could also be that consumers do not trust social media for scientific information hence this result. Surprisingly, 19.6% (n=76) responded positively to using Scientific reports and research papers to get information compared to only 10.1% (n=39) using TV/radio to get information. It is also concerning that 62.9% (n=244) of the participants indicated that they have never looked for information. With regards to social media access and maturity in SA, radio is still one of the depended means of communication in SA. Gavaza and Pearse (2019: 3) reported in 2019 that a study performed on assessing media maturity in SA, found that community radio was still the most effective way to raise awareness about health-related issues due to its wide and significant reach of people. Social media maturity is still very much emerging in SA and still has a long way to go before it reaches maturity.

4.3.7 Consumer attitude towards non-nutritive sweeteners

In the survey, participants were asked to state how strongly they agreed or disagreed to a set of awareness and risk perception statements on NNSs. Table 4.8 presents the participants attitudes towards NNSs.

Table 4.8 Consumer attitude towards non-nutritive sweeteners

Awareness and risk perception statements	n	Mean (SD)	T	df	p-value
I think non-nutritive sweeteners are not natural and therefore harmful	388	.965	.044	387	<.001*
I think calling them "artificial" makes me sceptical about their safety	388	**.000**	5.929	387	<.001*
I think non-nutritive sweeteners are bad for health	388	.257	1.136	387	<.001*
I worry about the effects that non-nutritive sweeteners can have on my body	388	**.000**	5.132	387	<.001*
I have concerns about non-nutritive sweeteners and the risk of cancer	388	**.000**	4.528	387	<.001*
I think that non-nutritive sweeteners can cause people to gain weight	388	.320	-.997	387	<.001*
I think that non-nutritive sweeteners can cause diabetes	388	.513	-.655	387	<.001*
I think that non-nutritive sweeteners can cause allergic reactions	388	.760	.306	387	<.001*
Pregnant women should not consume non-nutritive sweeteners	388	.545	.605	387	<.001*

*indicates significant at the 95% level

To obtain an overall measure for attitude towards NNSs, factor analysis was applied to the 11 items measuring attitudes of NNSs. This is done to determine if there are any underlying latent factors that indicate groupings of these items.

The result for these three statements – 'I think calling them "artificial" makes me sceptical about their safety', 'I worry about the effects that non-nutritive sweeteners can have on my body', 'I have concerns about non-nutritive sweeteners and the risk of cancer', was significantly agreed with. Furthermore, factor analysis with promax rotation was applied to these 11 items. Items one and two were dropped as seen in the table above because their communalities were both below 0.1, and they were not well represented on any factors. One factor was extracted and accounts for 52.95% of the variance in the data. A Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO) of .913 and a significant Bartlett's test indicates that the data was adequate for successful and reliable extraction. Successful extraction was completed in four iterations.

Table 4.9 Factor analysis of attitude towards non-nutritive sweeteners

Awareness and risk perception statements	Factor 1
I think non-nutritive sweeteners are bad for health	.815
I think that non-nutritive sweeteners can cause diabetes	.777
I have concerns about non-nutritive sweeteners and the risk of cancer	.768
I think that non-nutritive sweeteners can cause people to gain weight	.766
I worry about the effects that non-nutritive sweeteners can have on my body	.725
I think non-nutritive sweeteners are not natural and therefore harmful	.693
I think that non-nutritive sweeteners can cause allergic reactions	.681
Pregnant women should not consume non-nutritive sweeteners	.678
I think calling them "artificial" makes me sceptical about their safety	.625

The composite measure for attitude for the results presented in Table 4.9 was formed by calculating the average of the agreement scores included in the factor which was tested for reliability using Cronbach's alpha. An alpha of 0.909 indicates that this composite variable, that measures attitude towards NNSs, is reliable.

To investigate possible scenarios that could explain the reason for the strong agreement in participants towards this statement – 'I think calling them "artificial" makes me sceptical about their safety'. In this result, participants are expressing concern and nervousness about the word 'artificial'. Now, artificial ingredients have gained a lot of negative traction in the media over the years. The pace on this picked up in 2012 when Nestle, one of SA's largest food industry announced the removal of all artificial ingredients in their confectionary portfolio. This was a mainstream for further rise on the topic of artificial ingredients and was well supported by marketing and consumer education by Nestle. Consumers accepted the change as a positive health intervention becoming more aware of the implications around using artificial ingredients. In the early 90's artificial was a common term used to describe sweeteners, its only recently that the term NNSs is being used more commonly. The labelling regulation for foodstuff in SA mandates that the sweeteners must be labelled as non-nutritive sweeteners, followed by the name of the sweetener (South Africa 1991: 57). This could also mean that not many consumers will be able to make the link that NNSs and artificial sweeteners are one and the same thing. Bringing in a piece of literature cited in chapter two to link this finding to a Mintel survey conducted in a representative sample of Americans, the survey found that 64% of participants indicated they were concerned about the safety of "artificial" sweeteners while the remaining 36% were unsure about the safety of sweeteners There was significant agreement for the statement - I worry about the effects that non-nutritive sweeteners can have on my body, alluding to participants expression of concern because they seem to be aware of the negative health issues associated with the use of sweeteners. In SA, there was a great deal of debate about the use of sweeteners, its consumption having both negative and positive effects on the body. As shown in chapter two, scientists are divided on their views on the topic of NNSs

and consumers are aware of the mixed messaging that comes with the consumption of sweeteners. Chattopadhyay, Raychaudhuri and Chakraborty (2014: 611) elaborate that although sweeteners have been deemed safe by the WHO, FAO and FDA, the public feels that this still does not provide the reassurance with regards to the safety of NNSs and effect on health. Tandel (2011: 236) shares a similar view, stating that, besides the benefits linked to NNSs, animal studies have convincingly proven that artificial sweeteners cause weight gain, brain tumours, bladder cancer and many other health hazards.

The significant result and strong agreement to the statement – 'I have concerns about non-nutritive sweeteners and the risk of cancer', participants demonstrated that they are aware of the link to cancer and consumption of NNSs. There have been controversial debates that linked the use of certain NNSs to cancer, which was widely covered in the media, so this could be the reason why consumers have concerns about the consumption of NNSs and cancer. This message stuck with consumers because of its negative connotations. In chapter two, scientists Chattopadhyay, Raychaudhuri and Chakraborty (2014: 611) expressed concern associated with the carcinogenicity studies of aspartame. This study was conducted by Nalt Toxicological Programme (NTP) in 2 strains of transgenic mice, and it was concluded that aspartame exposure was associated with increase in cancer in either male or female mice (Soffritti *et al.* 2016: 7).

A one-sample test was conducted on the attitude variables to confirm if there is significant agreement or disagreement that a negative attitude exists regarding NNSs presented in the table below.

Table 4.10 One-Sample test on consumer attitude towards non-nutritive sweeteners

Test Value = 3						
Measure	**t**	**df**	**Sig. (2-tailed)**	**Mean Difference**	**95% Confidence Interval of the Difference**	
					Lower	**Upper**
Attitude	**2.343**	**387**	**.020**	.10825	.0174	.1991

What can be concluded from the result presented in the table above is that there is significant agreement (M=3.11) that NNSs are not good for one's health, p=.020. To also state here that the result obtained in the survey that presents a significant agreement to the three statements highlighted in this discussion, there is significant difference in attitude or perception towards NNSs across education, f (3, 384) = 4.353, p=.005. Post hoc analysis with Tukey's test indicated that there was significantly more agreement that NNSs are not good for one's health among those with no formal education (M=3.66) than those with a tertiary education (M=3.02), p=.020.

4.3.8 Consumer attitude towards benefits of consuming non-nutritive sweeteners

Participants were presented with five statements that described benefits of using NNSs and had to state in a scale between strongly disagree and strongly agree how they perceived these benefits of NNSs.

Table 4.11 Consumer attitudes towards benefits of consuming non-nutritive sweeteners

Statements	n	Mean (SD)	T	df	p-value
Non-nutritive sweeteners are helpful for someone who wishes to lose weight	388	.119	1.562	387	<.001*
Non-nutritive sweeteners are helpful for someone who has diabetes	388	.000	7.062	387	<.001*
Non-nutritive sweeteners bring more benefit than risks to consumers	388	.889	-.140	387	<.001*
Non-nutritive sweeteners allow for a little indulgence without feelings of guilt	388	.000	4.327	387	<.001*
Non-nutritive sweeteners allow for diet products to be a viable option	388	.000	4.554	387	<.001*

Table 4.11 presents the results showing agreement or disagreement to the statements highlighted on the benefits of consuming NNSs. There was significant agreement on these benefit statements – 'non-nutritive sweeteners are helpful for someone who wishes to lose weight', 'non-nutritive sweeteners allow for a little indulgence without feelings of guilt', 'non-nutritive sweeteners allow for diet products to be a viable option'. Participants genuinely believe that there are benefits linked to the consumption of sweeteners, despite the negative results associated with health concerns that were presented earlier on. Factor analysis with promax rotation was applied to these 5 items. One factor was extracted and accounted for 56.61% of the variance in the data. A Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO) of .840 and a significant Bartlett's test indicated that the data was adequate for successful and reliable extraction. Successful extraction was completed in 6 iterations. It was interesting to see that females (M=3.29) agree significantly more than males (M=3.03) that consuming foods with NNSs has benefits, t (386) = -2.610, p=.009.

Table 4.12 Factor analysis loading for attitude towards benefits of consuming non-nutritive sweeteners

Benefits	Factor 1
Non-nutritive sweeteners allow for diet products to be a viable option	.824
Non-nutritive sweeteners are helpful for someone who has diabetes	.768

Non-nutritive sweeteners bring more benefit than risks to consumers	.751
Non-nutritive sweeteners are helpful for someone who wishes to lose weight	.735
Non-nutritive sweeteners allow for a little indulgence without feelings of guilt	.677

The composite measure for (BENEFITS) was formed by calculating the average of the agreement scores included in the factor and was tested for reliability using Cronbach's alpha. An alpha of 0.865 indicates that this composite variable, that measures benefit of NNSs, is reliable.

4.3.9 Consumer attitude towards trusting information

Participants were also asked to state how strongly they disagreed or agreed to legislative or regulation statements that were presented to them in the survey which aimed to measure trust. The result on trust is presented in Table 4.13.

Table 4.13 Consumer response towards trust

Item	n	Mean (SD)	t	df	p-value
I trust information coming from Government health agencies (such as the DoH)	388	.000	5.334	387	<.001*
I trust information coming from food regulatory authorities (DoH)	388	.000	8.983	387	<.001*
I trust information coming from research/ scientific papers	388	.000	15.280	387	<.001*
I trust information coming from health and wellness blogs	388	.000	6.501	387	<.001*
I trust information coming from social media	388	.000	-5.298	387	<.001*
I trust the regulator's position (DoH) regarding the safety and benefits of Non-nutritive sweeteners	388	.000	7.868	387	<.001*

Table 4.13 presents the result on participants response to trust. The results illustrate that a significant number of participants do not trust the information from government health agencies and regulatory bodies. Factor analysis with promax rotation was applied to these 6 items. Two factors were extracted which account for 55.36% of the variance in the data. A Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO) of .737 and a significant Bartlett's test indicates that the data was adequate for successful and reliable extraction. Rotation converged in three iterations. This result gives great insight into the measure of trust and the source of information participants are comfortable to trust. This creates the opportunity to improve knowledge management and improvement on a topic like NNSs.

Table 4.14 Factor analysis for consumer attitude towards trust

Trust in organisation and trust in social media	Factor	
	1	2
I trust information coming from Government health agencies (such as the DoH)	.889	
I trust information coming from food regulatory authorities (DoH)	.854	
I trust the regulator's position (DOH) regarding the safety and benefits of non-nutritive sweeteners	.679	
I trust information coming from research/ scientific papers	.607	
I trust information coming from health and wellness blogs		.747
I trust information coming from social media		.573

In table 4.14 above, the composite measures (TRUST IN ORGANISATION and TRUST IN SOCIAL MEDIA) formed by calculating the average of the agreement scores included in the factors, were tested for reliability using Cronbach's alpha. An alpha of 0.842 for factor 1 indicates that this composite variable, that measures trust in information from recognised authorities, is reliable. However, alpha for factor 2 (TRUST IN SOCIAL MEDIA) is below the accepted 0.7 threshold and, since the factor is unstable with only two items loading onto it, it will be ignored.

4.3.10 Consumer awareness on regulations

As much as the survey aimed to assess the measure of trust, it also aimed at the same time to measure awareness on regulations. Table 4.15 presents how participants responded to the statements that measured consumer awareness on regulations. Participants were asked to respond to options provided in a rating scale from strongly disagree to strongly agree to the statements presented.

Table 4.15 Consumer response to awareness on regulations

Awareness of regulations	n	Mean (SD)	t	df	p-value
I am not aware of these regulations as I am not motivated enough to look for them	388	.003	2.951	387	<.001*
The aim of the regulatory bodies is to protect consumers' health	388	.000	15.837	387	<.001*

Awareness of regulations	n	Mean (SD)	t	df	p-value
As a result of the regulations, only a safe amount of these sweeteners is found in food and drinks	388	**.000**	7.109	387	<.001*
All non-nutritive sweeteners have been vigorously tested before being allowed onto the market	388	**.000**	6.927	387	<.001*

Table 4.15 illustrates that a significant number of participants strongly agreed to the statements on the awareness of regulations on NNSs. This result confirms that participants lack knowledge in this area and further education is needed on this topic. In a UK study that was narrated in chapter two, results revealed a high-risk perception of NNSs and a lack of knowledge in regulations in nearly half the population sample. Moreover, the artificial attributes of NNSs, further limited consumer acceptance. Farhat, Dewison and Stevenson (2021: 444) explained that from the survey report, the risk perception was significantly linked to a lower consumption of sweeteners ($p < 0.001$) and was affected by gender, occupation, education levels, age and body weight status.

4.3.11 Product consumption of beverages, sweeteners, snacks products

A list of products consisting of beverages, sweeteners and snack products was provided, and participants selected which products they consume. The list of products that was presented to participants in the survey were a mix of products where some were most likely to contain NNSs and some were not likely such as smoothies, chocolate bars and cakes. It is also important to note that there limitations of this self-reported consumption questionnaire as it does not account for frequency of consumption, it only includes yes or no answers and does not investigate how often and how much a product is consumed. More about this is discussed in Chapter 5 under the study limitations.

Table 4.16 Consumption of beverages, sweeteners and snacks products

Products	Frequency (%)		n	p-value
	Yes	No		
Beverages				
Fruit Juice & Concentrates (excluding fresh juice)	**294 (76)**	94 (24)	388	<.001*
Ice-Tea	136 (35)	**252 (65)**	388	<.001*
Diet Cooldrinks	208 (54)	180 (46)	388	

Products	Frequency (%)		n	p-value
	Yes	No		
Flavoured Sparkling Water	195 (50)	193 (50)	388	
Flavoured Carbonated Water	159 (41)	**229 (59)**	388	<.001*
Milkshakes	213 (55)	175 (45)	388	
Energy Drinks	184 (47)	204 (53)	388	
Protein Drinks	132 (34)	**256 (66)**	388	<.001*
Smoothies	208 (54)	180 (46)	388	
Hot Beverages	**356 (92)**	32 (8)	388	<.001*
Sweeteners				
Sweetener Aspartame	113 (29)	**275 (71)**	388	<.001
Sweetener Sucralose	128 (33)	**260 (67)**	388	<.001*
Sweetener Saccharin	107 (28)	**281(72)**	388	<.001*
Sweetener Xylitol	144 (37)	**244 (63)**	388	<.001*
Sweetener Sorbitol	106 (27)	**282 (73)**	388	<.001*
Snacks				
Crisps	**315 (81)**	73 (19)	388	<.001*
Biscuits/Rusks	**330 (85)**	58 (15)	388	<.001*
Chocolate Bars	**339 (87)**	49 (13)	388	<.001*
Energy Bars	182 (47)	206 (53)	388	
Sugar-free Chewing Gum	201 (52)	187 (48)	388	
Sugar-Free Gum Drops, Gummy Worms/Bears	158 (41)	**230 (59)**	388	<.001*
Sugar-Free Chocolate	105 (27)	**283 (73)**	388	<.001*
Cakes	**320 (82)**	68 (18)	388	<.001*

Products	Frequency (%)		n	p-value
	Yes	No		
Ice-creams	**319 (82)**	69 (18)	388	<.001*
Yoghurts - Lite	135 (39)	**253 (61)**	388	<.001*
Yoghurts – Fat Free	152 (39)	**236 (61)**	388	<.001*
Yoghurt – Sugar-Free	143 (37)	**245 (63)**	388	<.001*
Yoghurt – Low Fat	**248 (64)**	140 (36)	388	<.001*
Yoghurt – Full Cream	**218 (56)**	170 (44)	388	<.001*

For the purpose of a consolidated view of products consumed by participants, Table 4.16, presents which beverages, sweeteners, and snacks products participants consume. This question was an enabler research question to establish the link between those participants who indicated that they do not consume NNSs and may consume one or more of the products from this list that could contain NNSs. The results of each category will be discussed now.

4.3.12 Beverage consumption

In table 4.16, the data presents that, a significant 92% (n=356) consumed hot beverages (tea, coffee, hot chocolate), 76% (n=294) consumed fruit juice and concentrates, 55% (n=213) consumed milkshakes and 54% (n=208) consumed diet cooldrink. The data also presented that a significant 66% (n=256) did not consume protein shakes which will be discussed further on. From the data presented, it is interesting that fruit juices and concentrates are consumed more than diet cool drink. To unpack the possible reason why fruit juice and concentrates is consumed more than diet cool drink option could be because of its direct link to the word 'fruit' and how this is positioned in the minds of consumers, well supported through marketing and advertising linked to health and wellness choices for a beverage option, consumers therefore perceive it to be healthier than cooldrink and it is often cheaper (Kadwa 2022: para 13. line 11). Participants indicated through their choices that iced tea, flavoured carbonated water and protein drink shakes were not popular and a significant number of participants did not consume these beverages. Considering that these products do not appeal to all consumers, these products appeal to a very niche consumer market unlike fruit juice, concentrates diet cool drink and hot beverages. South Africans love their tea, coffee which is often accompanied by a snack item and represents a time to socialise as well as tea has its history through colonization which has now become a norm (Maiden 2020: para 1, line 3). Another important point to highlight here is the impact that the sugar tax law that was introduced in 2018 has had on manufacturers in the SSB industry of SA. This

involuntarily compelled the beverage industry to formulate without sugar introducing a wide range of sweeteners into SSBs and this is largely one of the reasons why more beverages now contain NNSs. Markus *et al.* (2020: 5480) concur that governments are establishing regulations that compel consumers to reduce their consumption of sugar while, simultaneously causing the food and beverage industry to include NNSs in their products.

NNSs food and beverage database in the South African market will be discussed.

4.3.13 **Sweetener consumption**

Participants were given a list of sweeteners to choose from and indicate which ones they consumed. In the sweetener section, the results in the table represents that a significant proportion have said no to consuming these sweeteners (aspartame, sucralose, saccharin, xylitol and sorbitol) as a sugar replacement or alternative to sugar. Earlier, on the topic of concern, it was presented through the results that a significant number of participants strongly agreed that they are sceptical about using sweeteners because it is 'artificial'. The result seen here indicates that participants have maintained their stance indicating that sweeteners are not a popular choice which could be for the reason highlighted earlier. This could also mean that participants still very much prefer to consume sugar. On the other hand, earlier it was presented that xylitol was most heard of by a significant 61% (n=238) of participants. As mentioned, the reason for this could be linked to the well positioning of xylitol for its claims. Xylitol is commonly used in products and diabetics are more prone to knowing about xylitol because of marketing and campaigning for its use as a healthier alternative to sugar.

4.3.14 Snack consumption

Participants were given a variety of snack foods which included a mixed basket of products for participants to indicate which ones they consumed. Data proved snacks to be extremely popular in the study population. A significant 81% (n=351) consumed crisps, 85% (n=330) consumed biscuits/rusks, 87% (n=339) consumed chocolate bars, 82% (n=320) consumed cakes and 82% (n=319) consumed ice-creams. Participants demonstrated a preference for snacking. Just looking at the result for snacking could confirm that consumers default to snacking. This could also be related to the food environment and the constant need for convenience foods (Holdsworth and Landais 2019: 513). In SA, it was explained in the research that diets have become more urbanised resulting in higher intake of foods that are high in fats, and energy resulting in the prevalence of obesity (Holdsworth and Landais 2019: 525). Snacking has become a trend and happens when socialising, during cooking or just being stuck in traffic on the drive home from work (Holdsworth and Landais 2019: 525). As presented, sugar-free candy and chocolate product options were not preferred by 59% (n=230) of the participants indicated that they did not consume sugar-free sweets and 73% (n=283) did not consume sugar-free chocolate. The data also presented that 61% (n=253) participants did not consume lite yoghurts, and 61% (n=236) did not consume fat free yoghurts and 63% (n=245) did not consume sugar-free yoghurts. This result shows that lite, fat free or sugar-free options were not popular among participants which shows that snacking doesn't always result in healthier food choices. As Participants indicated that they consumed

low fat and full cream yoghurt more than the other yoghurt options listed. In fact, low fat yoghurt was consumed by 64% (n=248) and full cream yoghurt consumed by 56% (n=218) participants. These results can surely be related to the high consumption level of sugar in SA and to substantiate what Harmse (2019: 1) stated in chapter two explaining that the typical South African consumes 24 teaspoons of sugar daily, more than double of the WHO guidelines for daily intake.

The NNSs consumer survey gave valuable insight of beverages, sweeteners and snacks products that participants consumed which will support the next phase of this study, the scientific database that was developed through label analysis documenting a list of packaged products that contain NNSs.

4.4 Non-nutritive sweetener food and beverage database in the South African market

An important element of this research was to establish a scientific product database that consists of products with NNSs in the South African market. The reason for the incorporation of this element was to be able to showcase the widespread use of NNSs in a sample of packaged products that is available to South Africans at three major retailers: Checkers, Woolworths and Dis-Chem. This involved a detailed label analysis on selected products that were examined to obtain data about ingredients used, particularly examining the label for NNSs also linking these products to any specific health and wellness claims. The product selected for label analysis was within these product categories highlighted below:

- Snack foods
- Dairy products
- Sugar-free chewing gum
- Candy
- Sugar-sweetened beverages
- Energy drinks
- Diabetic products
- Baby foods

A total of 419 products containing NNSs were found (Table 4.19) and available across the three major stores. These ranged from snack food, dairy, confectionary, SSBs, energy drinks and diabetic products.

A detailed breakdown of the categories containing NNS is presented in figure 4.3.

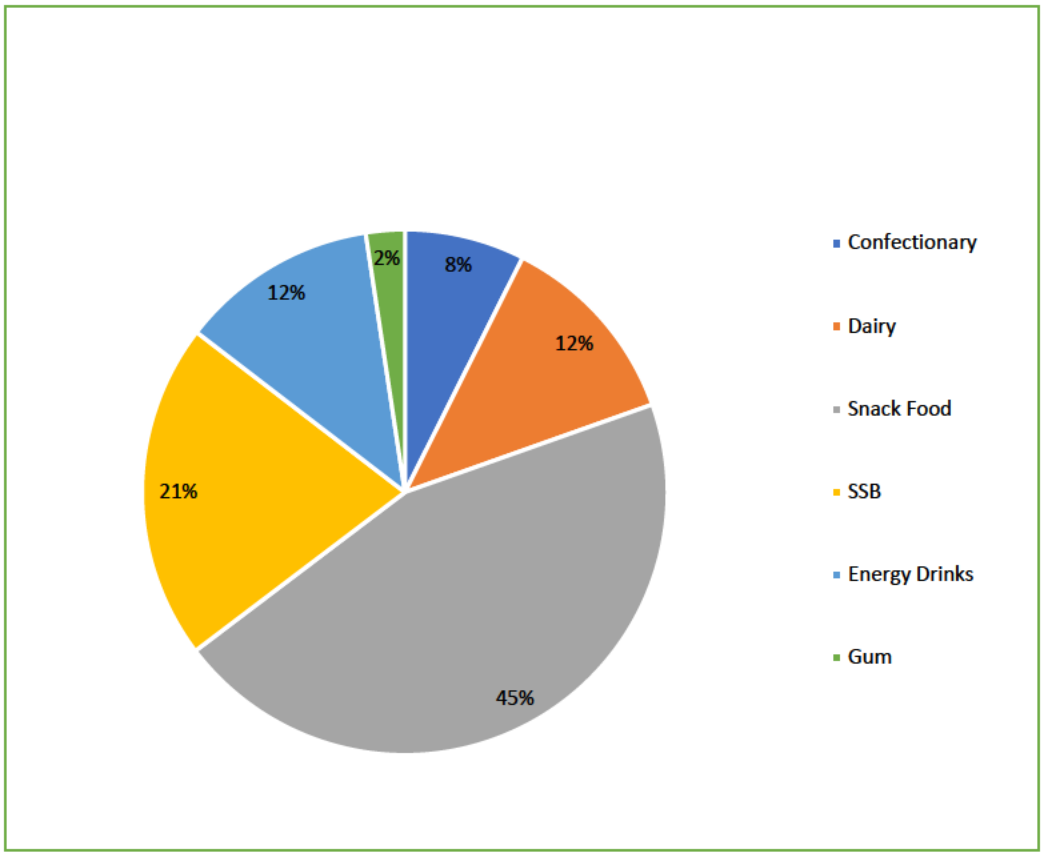


Figure 4.3 Product categories containing non-nutritive sweeteners

Figure 4.3 presents the product categories examined and the percentage of the product within each category that contained NNSs. As anticipated before embarking on this research and well elaborated in chapter two, the use of NNSs has significantly increased in recent years. Substantiating this result here, figure 4.3 confirms how mainstream the use of NNSs has become in the food and beverage industry of SA. The data presented that 45% (n=186) of the 419 products that where examined contained NNSs in the snack category. The SSBs category was the second highest category with NNSs at 21% (n=91). It was also highlighted in chapter two that at one stage, NNSs was limited to just the beverage industry. Here, it can be agreed that through this outcome, NNSs are no longer just limited to the beverage industry in SA, but has also found their way into snacks, desserts, confectionary, dairy items, protein shakes and diabetic friendly solutions. Equally weighted between dairy and energy drinks, 12% (n=52) of these products examined in this subcategory contained NNSs.

As mentioned, the snack category contained the larger number of products with NNSs. To further unpack this finding, figure 4.4 presents the product subcategories within the snack category that was examined that consisted of products with NNSs. This will be discussed now.

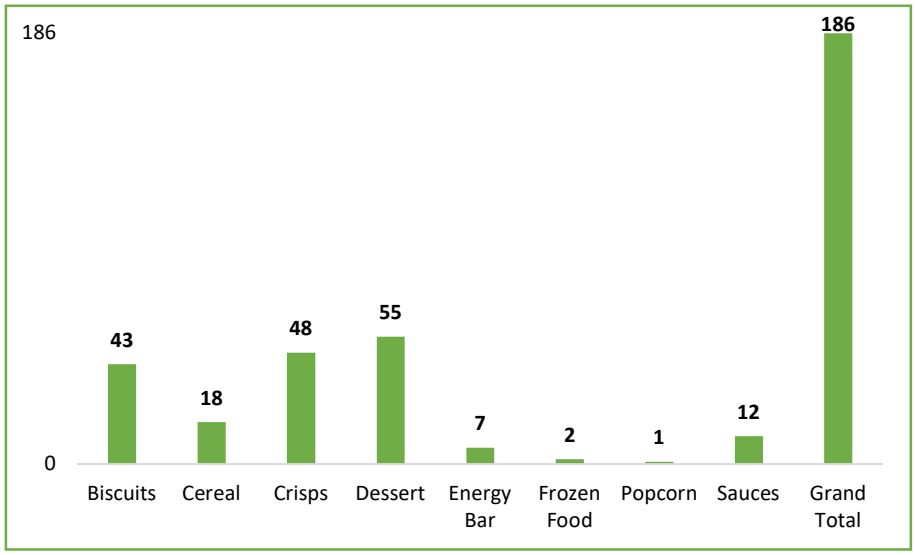


Figure 4.4 Subcategories of product within the snack category examined

Figure 4.4. presents the 45% (n=186) of the subcategories within the snack category that contained NNSs. The snack food category was made up of the following subcategories: desserts 30% (n=55), crisps 26% (n=48), biscuits 23% (n=43), cereal 9.6% (n=18), sauces 6% (n=12), energy bars 4% (n=7), frozen snacks 1% (n=2) and popcorn 0.53% (n=1). From the NNSs and consumer survey, the results illustrated that snacks were the highest and most popular consumed products with 81% (n=315) (table 4.16) consuming just crisps. The survey result confirmed through data obtained on consumption of biscuits/rusks, cakes and chocolate bars that a significant number of participants consumed these items (<.001*).

The scientific product database also presented through the result of the product label analysis for NNSs that products selected by participants do contain NNSs, and in some products more than one NNS is used. This is worrying as consumers do not believe that they are eating NNSs, but this result indicates otherwise. In summary, more than often, sweeteners are used in combination to replace sucrose to reduce sugar but still achieve the desired taste. Common combinations of NNSs acesulfame-K, sucralose, aspartame, stevia exist in numerous products in low doses, it is a disadvantage to consumers who indicated that they have not heard of these sweeteners and may be consuming them in products daily. The table below presents a list of commonly used combination NNSs in manufacturing and the number of times each combination was found in various beverage and snack products and have been listed as they appeared on the products during the label analysis.

Table 4.17 Combination sweeteners used in product formulation in South Africa

Combination of NNSs found in beverages and snack foods	Count of Product
Acesulfame-K, sodium cyclamate	19
Xylitol, sorbitol, aspartame, sweetener mannitol, acesulfame-K, sucralose	1
Acesulfame-K, sucralose	1
Sodium cyclamate, sodium saccharin, acesulfame-K	1
Sucralose, erythritol, steviol glycoside	1
Sucralose, erythritol, steviol glycoside	1
Acesulfame-K, aspartame	2
Acesulfame-K, aspartame	10
Acesulfame-K, sucralose	1
Acesulfame-K, sucralose	5
Aspartame, acesulfame-K & sucralose, xylitol, sorbitol, mannitol	1
Aspartame, acesulfame-K	1
Aspartame, acesulfame-K	20
Aspartame, sodium saccharin	1
Aspartame, sodium saccharin	1
Aspartame, non-nutritive sweetener, sodium saccharin	1
Aspartame, acesulfame-K	4
Aspartame, acesulfame-K	2
Aspartame, acesulfame-K, mannitol, sucralose	1
Aspartame, mannitol, acesulfame-K	1
Aspartame, acesulfame-K, sucralose	1
Aspartame, acesulfame-K	2
Aspartame, acesulfame-K	1
Aspartame, sucralose, acesulfame-K	1
Erythritol, stevia extract	8
Erythritol, sodium cyclamate, acesulfame-K	1
Erythritol, sodium cyclamate, acesulfame-K, maltitol	2
Isomalt and acesulfame potassium	1
Isomaltitol, aspartame, acesulfame-K	1
Maltitol, acesulfame-K	8
Maltitol and acesulfame-K	1
Maltitol, acesulfame-K	6
Maltitol syrup, maltitol	1
Maltitol syrup, isomalt, sucralose	1
Maltitol syrup, mannitol, sucralose	1
Maltitol, lactitol, acesulfame-K	2
Maltitol, sorbitol, acesulfame-K	2
Maltitol, isomalt	1

Combination of NNSs found in beverages and snack foods	Count of Product
Mannitol, maltitol syrup, sucralose, acesulfame-K	1
Acesulfame-K, sucralose	1
Acesulfame-K, sucralose	1
Sodium cyclamate, sodium saccharin	1
Sodium cyclamate, sodium saccharin, acesulfame-K	6
Sodium cyclamate, sodium saccharin, acesulfame-K	2
Sodium saccharin	1
Acesulfame-K, sodium cyclamate	2
Acesulfame-K, sodium cyclamate	6
Acesulfame-K, sodium cyclamate	4
Acesulfame-K, sodium cyclamate, steviol glycosides	1
Acesulfame-K, aspartame	2
Acesulfame-K, aspartame	1
Acesulfame-K, aspartame, sucralose	1
Acesulfame-K, sodium saccharin	1
Acesulfame-K, sucralose	1
Acesulfame-K, sucralose	3
Acesulfame-K, sucralose	1
Aspartame, acesulfame-K	1
Aspartame, acesulfame-K	1
Aspartame, acesulfame-K, sucralose	2
Sodium cyclamate, acesulfame-K	3
Sodium cyclamate, acesulfame-K	1
Sodium cyclamate, acesulfame-K and aspartame	1
Sodium cyclamate, acesulfame-K and aspartame	1
Sodium cyclamate, acesulfame-K and aspartame	1
Sodium cyclamate, acesulfame-K and aspartame	1
Sodium cyclamate, sodium saccharin	1
Sodium cyclamate, sodium saccharin	1
Sodium cyclamate, sodium saccharin, acesulfame-K	2
Sodium cyclamate, sodium saccharin, acesulfame-K	1
Sodium saccharin	2
Sodium saccharin, acesulfame-K	1
Sucralose, acesulfame-K, sodium cyclamate	4
Sucralose, acesulfame-K, sodium cyclamate	1
Sucralose, acesulfame-K	1
Sucralose, acesulfame-K	1
Sucralose, acesulfame-K	8
Sucralose, acesulfame-K	1
Acesulfame-K, aspartame	1
Sodium saccharin, sodium cyclamate, acesulfame-K	1
Nutriose, sucralose	3
Sodium cyclamate, sodium saccharin, acesulfame-K	1
Polydextrose, isomalt, sucralose	5

Combination of NNSs found in beverages and snack foods	Count of Product
Sodium cyclamate, sucralose, sodium saccharin	1
Sodium cyclamate, acesulfame-K, steviol glycosides	7
Sodium cyclamate, aspartame, sodium saccharine	4
Sodium cyclamate, saccharin, acesulfame-K	6
Sodium saccharin, aspartame	1
Sodium saccharin, aspartame	1
Sodium saccharin, aspartame	1
Sodium saccharin, aspartame	1
sodium saccharin, aspartame	4
sorbitol, aspartame	7
Sorbitol, maltitol	5
Sucralose, acesulfame-K	6
Sucralose, acesulfame-K	11
Sucralose, stevia	3
Sucralose, acesulfame-K	1
Acesulfame-K, sodium cyclamate	1
Acesulfame-K, sodium cyclamate	1
Aspartame, acesulfame-K, mannitol	1
Aspartame, Acesulfame-K	1
Aspartame, sodium cyclamate, saccharin	4
Aspartame, saccharin	1
Sucralose, acesulfame-K	1
Xylitol, isomalt, sorbitol, aspartame	2
Xylitol, sorbitol, aspartame, mannitol, acesulfame-K, sucralose	1
Xylitol, sorbitol, aspartame, mannitol, acesulfame-K, sucralose	1
Grand Total	**272**

Table 4.17 highlights that out of the 419 products that were examined, 65% (n=272) products contained a combination of NNSs used to formulate the product. The type of products that use combination NNSs are chewing gum, candy, SSBs, energy drinks, energy bars, yoghurts, yogi sips, milkshakes, crisps, biscuits, desserts, and diabetic friendly products. The reason that manufacturers turn to formulating with combination NNSs is simply not to alter the taste of the product when sugar content is reduced or removed. Ibrahim (2015: 1) elaborates, that the benefits of NNSs for manufacturers are - the wide range stability of pH and temperature for these highly intensive sweeteners that allow its application in products that require long shelf life, at room temperature. It also allows for flexibility in formulating and is a cheaper ingredient than sucrose (Ibrahim 2015: 1). To achieve this, nutritive and NNSs are often combined because of their varying characteristics and functionalities in formulation. All products and its combination use of NNSs have been documented in the scientific product database and will be presented later.

The scientific product database highlighted the most used sweeteners individually, in the food and beverage industry of SA. Table 4.19 below confirms a list of sweeteners that were used in formulations independently.

Table 4.18 List of sweeteners used in formulations individually

Individual Sweetener	
Non-Nutritive Sweetener	**% (n)**
Acesulfame-K	1 (2)
Aspartame	11 (16)
Cyclamic acid	1 (1)
Isolmalt	1 (1)
Maltitol	12 (18)
Saccharine	2 (3)
Sodium Saccharin	2 (3)
Sorbitol	24 (24)
Stevia	23 (24)
Sucralose	38 (55)
Grand Total	**147**

Table 4.18 presents the 35% (n=147) of products that consisted of single NNSs with sucralose being the most used in the products examined, found in 38% (n=55) of the products, followed by sorbitol in 16% (n=24) and stevia in 16% (n=23) of the products. In it interesting to note here from the data that has been presented here that xylitol was not used individually in products examined which could support the conclusion even though xylitol was most heard of, it was used only in a combination and not individually and this could be linked to the earlier discussion about how xylitol is marketed, and its position is well centred in the mind of the consumer. To discuss some of the reasons why sucralose is so common in formulating is that it is such an all-purpose sweetener, it can withstand very high temperatures making it very heat stable and a good substitute to sugar in baking, it is also cheap and can be used in a variety of products a sugar replacement (Kansas Value Added Foods Lab 2018: para 3. line 3; Woodbury, Lust and Mauer 2021: 687). Earlier, a significant 59% (n=229) indicated that they did not hear of sucralose and yet it is the most used sweetener in the food and beverage industry of SA. It was explained in chapter 2 that stevia is becoming increasingly popular due to it being positioned and promoted in SA as a natural sweetener and yet earlier the results indicated that a significant 65% (n=253) did not even hear of stevia. More concern arises as the data talks to the lack of consumer education on the topic of NNSs.

4.5 Health and wellness product claims

It was explained earlier that consumers are drawn to claims that focus on health and wellbeing. Claims usually trigger consumer behaviour and influence their product choices or decisions. Let's consider

those that are diabetic as an example; these consumers may be drawn to products that are diabetic friendly or sugar-free to support their lifestyle and manage reduced sugar and low-calorie intake. Consumers may also read the surface information on packaging and not really read the detail about the ingredients in products. In the scientific product database, products with claims have been documented under a health and wellness column that describes the claim for that product. These claims may be specifically linked to products formulated with NNSs enabling the claim to be possible and appeal to consumers who have a need diet or control sugar intake.

The scientific product database was able to provide valuable information, consisting of the detailed breakdown of 419 packaged products examined in this study. It details NNSs found in the products examined, the store at which these products were found, and presents whether each product had any health claim that supported the use of NNSs like reduced sugar, zero sugar, diabetic friendly or sugar-free. It is also interesting to note that the data presented that 43% (n=179) of the products contained sugar and NNSs while the other 58% (n=240) contained only sweeteners. It can be assumed that the reason for this could be due to specific functional properties of sugar that NNSs lack. It could also be linked to the balancing of the desired sweet taste, so the formulation does not completely irradiate sugar and lastly, there is no need for the product to make claims around sugar-free or diabetic friendly. The full breakdown of the scientific product database consisting of the 419 products examined is presented in table 4.19 as extracted from the product labels.

4.6 Non-nutritive sweeteners food and beverage database

Table 4.19 non-nutritive sweeteners food and beverage database in the South African market

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Checkers, Woolworths	SSB	Fizzy Drink	Coke Light	No	Yes	N/A	Aspartame, Ace K & Sucralose	Yes	Low Kilojoule, No Sugar, Light Taste, contains phenylalanine RDA - 500ml per day
Woolworths	Snack Food	Crisps	Woolworths-Sweet BBQ Puffs	Yes	Yes	Sucralose	N/A	Yes	Always baked, never fried, NO Azo Dye Colourant, No tartrazine. Contains Salt (2nd), Sugar (3rd) and Sucralose. 30 g
Checkers	Snack Food	Crisps	Simba Chakalaka Potato Flavoured Chips	Yes	Yes	Aspartame	N/A	No	Contains Sugar & Aspartame* [non-nutritive sweetener (E951)]. *Contains phenylalanine

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Checkers	Snack Food	Crisps	Fritos Tomato	Yes	Yes	Saccharine	N/A	No	Sodium saccharin [non-nutritive sweetener (E954)]
Checkers, Woolworths	Snack Food	Crisps	Lays Caribbean Onion & Balsamic Vinegar Flavoured Potato Chips	Yes	Yes	Aspartame	N/A	No	Product contains phenylalanine due to type of non-nutritive inclusion. It is the last ingredient on the declaration meaning it is lowest quantity of the formulation, although % inclusion rate unknow. Added Salt
Checkers	Snack Food	Crisps	Doritos 3D Bugles Lime & Sweet Chilli Corn Snack	Yes	Yes	Sucralose	N/A	No	Sucralose is the last ingredient on the declaration meaning it is lowest quantity of the formulation, although % inclusion rate unknow. Added Salt
Checkers	Snack Food	Crisps	Fritos Sweet Chilli	Yes	Yes	Aspartame	N/A	No	Aspartame* [non-nutritive sweetener (E951)], *Contains phenylalanine

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Checkers	Snack Food	Crisps	Fritos BBQ	Yes	Yes	Aspartame	N/A	No	Sodium saccharin [non-nutritive sweetener (E954)]
Checkers	Snack Food	Crisps	Ghost Pops	Yes	Yes	N/A	Sodium saccharin [non-nutritive sweetener (E954)], aspartame* [non-nutritive sweetener (E951)]	No	Sodium saccharin higher ratio than Aspartame *Contains phenylalanine
Checkers	Snack Food	Crisps	N knaks Sweet Chilli	Yes	Yes	N/A	aspartame* [non-nutritive sweetener (E951)], sodium saccharine [non-nutritive sweetener (E954)]	No	Sodium saccharin higher ratio than Aspartame *Contains phenylalanine
Checkers	Snack Food	Crisps	N knaks BBQ	Yes	Yes	N/A	Sodium saccharin [(E954) non-nutritive sweetener], extracts of spices, aspartame* [(E951) non-nutritive sweetener]	No	Sodium saccharin higher ratio than Aspartame *Contains phenylalanine

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Checkers	Snack Food	Crisps	N knaks Fruit Chutney	Yes	Yes	Saccharine	N/A	No	Only sodium saccharin [(E954) non-nutritive sweetener] *Contains phenylalanine. Packaging error
Checkers, Woolworths	Snack Food	Crisps	Lays Sweet & Smoky American BBQ	Yes	Yes	Aspartame	N/A	No	Aspartame* [non-nutritive sweetener (E951)], *Contains phenylalanine
Checkers, Woolworths	Snack Food	Crisps	Lays Sour Cream & Onion	Yes	Yes	N/A	Aspartame* [non-nutritive sweetener (E951)], sodium saccharin [non-nutritive sweetener	No	Only Lays with a combination of sweeteners
Checkers, Woolworths	Snack Food	Crisps	Lays Sweet Chilli	Yes	Yes	Aspartame	N/A	No	Aspartame* [non-nutritive sweetener (E951)]. *Contains phenylalanine

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Checkers	Snack Food	Crisps	Doritos Sour Cream & Mild Chilli	Yes	Yes	Aspartame	N/A	No	Aspartame* [non-nutritive sweetener (E951)], *Contains phenylalanine
Checkers	Snack Food	Crisps	Doritos Sweet Chilli	Yes	Yes	Aspartame	N/A	No	Aspartame* [non-nutritive sweetener (E951)], *Contains phenylalanine
Checkers	Snack Food	Crisps	Doritos 3D Bugles Lime & Sweet Chilli	Yes	Yes	Sucralose	N/A	No	Sucralose [(E955) non-nutritive sweetener]
Checkers	Snack Food	Crisps	Doritos 3D Bugles Cajun BBQ	Yes	Yes	Sucralose	N/A	No	Sucralose [(E955) non-nutritive sweetener]

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Checkers	Snack Food	Crisps	Simba Crunchz Chutney	Yes	Yes	N/A	Sodium saccharin [non-nutritive sweetener) (E954)], aspartame* [non-nutritive sweetener(E951)]	No	Only Dorito Flavour with combination of sweeteners, *Contains phenylalanine
Checkers	Snack Food	Crisps	Simba Fruit Chutney	Yes	Yes	N/A	Sodium saccharin [(E954) non-nutritive sweetener], aspartame* [(E951) non-nutritive sweetener]	No	Combination: sodium saccharin [(E954) non-nutritive sweetener], aspartame* [(E951) non-nutritive sweetener]
Checkers	Snack Food	Crisps	Simba Bits - Sweet Chilli	Yes	Yes	Aspartame	N/A	No	Aspartame* [non-nutritive sweetener (E951)]
Checkers	Snack Food	Crisps	Simba Bits - Tomato	Yes	Yes	Saccharine	N/A	No	Sodium saccharin [non-nutritive sweetener (E954)]

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Checkers	Snack Food	Popcorn	Simba Popcorn - Fruit Chutney	Yes	Yes	N/A	Aspartame* [non-nutritive sweetener (E951)], sodium saccharin [non-nutritive sweeteners(E954)]	No	Combination: sodium saccharin [(E954) non-nutritive sweetener], aspartame* [(E951) non-nutritive sweetener]
Checkers	Dairy	Custard	Danone Ultra Mel Custard: Vanilla	Yes	Yes	N/A	Sodium cyclamate (non-nutritive sweetener), sucralose (non-nutritive sweetener), sodium saccharin (non-nutritive sweetener)	Yes	Claim: Zero, No added sugar)
Checkers	Dairy	Custard	Clover Bliss Choc Dessert	Yes	Yes	N/A	Non-nutritive sweeteners (Acesulfame-K (E950) and Sodium Cyclamate (E952))	Yes	Source of Vitamins
Checkers	Dairy	Yoghurt	Clover Fruits of the forest with cereals - Strawberry/Cranberry	Yes	Yes	N/A	Non-nutritive sweeteners (Acesulfame-K (E950) and Sodium Cyclamate (E952))	Yes	Source of Vitamins/Bigger fruit pieces/creamy. Contains combination sweeteners

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Checkers	Dairy	Yoghurt	Clover Red Fruits and Cereals with Seeds	Yes	Yes	N/A	Non-nutritive sweeteners (Acesulfame-K (E950) and Sodium Cyclamate (E952))	Yes	Source of Vitamins/Bigger fruit pieces/creamy. Contains combination sweeteners
Checkers	Dairy	Yoghurt	Clover Guava with Cereals & Seeds	Yes	Yes	N/A	Sugar, Non-nutritive sweeteners (Acesulfame-K (E950) and Sodium Cyclamate (E952))	Yes	Claims: Source of Vitamins/Bigger fruit pieces/creamy. Contains combination sweeteners
Checkers	Dairy	Yoghurt	Clover Bliss Lemon Meringue	Yes	Yes	N/A	Non-nutritive sweeteners (Acesulfame-K (E950) and Sodium Cyclamate (E952))	Yes	Source of Vitamins
Checkers	Dairy	Yoghurt	Clover Classic - Vanilla	Yes	Yes	N/A	Non-nutritive sweeteners (Acesulfame-K (E950) and Sodium Cyclamate (E952))	No	Claims: Source of 10 Vitamins - Sweetener Combination

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Checkers	Dairy	Yoghurt	Clover Sip Up - Granadilla	Yes	Yes	N/A	Non-Nutritive Sweetener blend (E 952, E 950)	Yes	Claim: Low fat. It is unusual to see sweeteners declared in ingredient line in this manner. How would a consumer know which sweeteners have been blended? Sugar is also the second ingredient in the list
Checkers	Dairy	Yoghurt	Clover Sip Up - Strawberry	Yes	Yes	N/A	Non-Nutritive Sweetener blend (E 952, E 950)	Yes	Claim: Low fat. It is unusual to see sweeteners declared in ingredient line in this manner. How would a consumer know which sweeteners have been blended? Sugar is also the second ingredient in the list
Checkers	Dairy	Yoghurt	Clover Snack Packs Banana/Strawberry/Mixed Fruit	Yes	Yes	N/A	Sugar, Non-nutritive sweeteners (Acesulfame-K (E950) and Sodium Cyclamate (E952))	Yes	Claim: Low Fat, and suitable for kids

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Checkers	SSB	Juice	Clover Tropika - Pina Colada/Orange/Pineapple	Yes	Yes	Sucralose	N/A	No	All Trop ka flavours contained Sucralose and Sugar as the second ingredient on the list
Checkers	SSB	Juice	Clover Tropika UHT Orange/Pineapple/Mango/Tropical	Yes	Yes	Sucralose	N/A	No	All Trop ka UHT flavours contained Sucralose and Sugar as the second ingredient on the list
Checkers	Dairy	Yoghurt	Clover Duo Fruits and Yoghurt Flav Drink	Yes	Yes	Sucralose	N/A	No	Contains sugar and sucralose (E955) - not listed in the ingredient line as a non-nutritive sweetener
Checkers	Dairy	Yoghurt	Clover Duo Breakfast Sensation	Yes	Yes	Sucralose	N/A	No	Contains sugar and sucralose (E955) - not listed in the ingredient line as a non-nutritive sweetener

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Checkers	Dairy	Yoghurt	Clover Duo Peach/Apricot	Yes	Yes	Sucralose	N/A	No	Contains sugar and sucralose (E955) - not listed in the ingredient line as a non-nutritive sweetener
Checkers	Dairy	Yoghurt	Clover Duo Tropical Fruit	Yes	Yes	Sucralose	N/A	No	All Duos is clover range contained both sugar and sucralose
Checkers	Dairy	Juice	Clover Quali Nectar - Guava	Yes	Yes	N/A	Non-nutritive sweeteners (Acesulfame-K, Sodium Cyclamate, Steviol Glycosides)	No	Combination sweeteners + Sucrose as second ingredient - Steviol used for the first time in Clover recipe
Checkers	Dairy	Juice	Clover Quali Nectar - Mixed Berries	Yes	Yes	N/A	Non-nutritive sweeteners (Sodium Saccharin (E954), Sodium Cyclamate (E952), Acesulfame-K (E950))	No	Very similar to guava ingredients but a different sweetener combination noticed

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Checkers	Dairy	Juice	Clover Quali Nectar - Orange	Yes	Yes	N/A	Non-nutritive sweeteners [Sodium Saccharin (E954), Sodium Cyclamate (E952), Acesulfame-K (E950)]	No	Very similar to guava ingredients but a different sweetener combination noticed
Checkers	Dairy	Juice	Clover Mama Anna's Gamere	Yes	Yes	N/A	Non-Nutritive Sweeteners (Sucralose (E955), Acesulfame-K (E950))	No	N/A
Checkers	SSB	Iced Tea	Clover Manhattan Iced Tea – Blackcurrant	Yes	Yes	N/A	Non-nutritive Sweeteners (Sucralose, Acesulfame Potassium) (E955, E950)	No	Contains Fructose, Sugar and combination sweeteners
Checkers	SSB	Iced Tea	Clover Manhattan Iced Tea – Lemon	Yes	Yes	N/A	Non-nutritive Sweeteners (Sucralose, Acesulfame Potassium) (E955, E950)	No	Contains Fructose, Sugar and combination sweeteners

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Checkers	SSB	Iced Tea	Clover Manhattan Iced Tea – Peach	Yes	Yes	N/A	Non-nutritive Sweeteners (Sucralose, Acesulfame Potassium) (E955, E950)	No	Contains Fructose, Sugar and combination sweeteners
Checkers	SSB	Iced Tea	Clover Manhattan Iced Tea - Peach Lite	Yes	Yes	Aspartame	N/A	Yes	Lite - no fructose, no added sugar only Aspartame used
Checkers	SSB	Iced Tea	Clover Manhattan Iced Tea – Pineapple	Yes	Yes	N/A	Non-nutritive Sweeteners (Sucralose, Acesulfame Potassium) (E955, E950)	No	Contains Fructose, Sugar and combination sweeteners
Checkers	SSB	Iced Tea	Clover Manhattan Green Iced Tea - Apple mint	Yes	Yes	N/A	Non-nutritive Sweeteners (Sucralose, Acesulfame Potassium) (E955, E950)	No	Contains Fructose, Sugar and combination sweeteners

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Checkers	SSB	Iced Tea	Clover Manhattan Green Iced Tea - Ruby Grapefruit and Strawberry	Yes	Yes	N/A	Non-nutritive Sweeteners (Sucralose, Acesulfame Potassium) (E955, E950)	No	Contains Fructose & combination sweeteners only, no sugar
Checkers	SSB	Iced Tea	Clover Manhattan Green Iced Tea - Kiwi and Pear	Yes	Yes	N/A	Non-nutritive sweeteners [Acesulfame-K, Aspartame (Contains phenylalanine)] (E951, E950)	Yes	Claim: Lite. Contains no sugar, no fructose just combination sweeteners
Checkers	SSB	Iced Tea	Clover Manhattan Rooibos Iced Tea - Mixed Berry	Yes	Yes	N/A	Non-nutritive Sweeteners (Sucralose, Acesulfame Potassium) (E955, E950)	No	Contains Fructose, Sugar and combination sweeteners
Checkers	SSB	Iced Tea	Clover Manhattan Rooibos Iced Tea – Lemon	Yes	Yes	N/A	Non-nutritive Sweeteners (Sucralose, Acesulfame Potassium) (E955, E950)	No	Contains Fructose, Sugar and combination sweeteners

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Checkers	Dairy	Milkshake	Clover Super M - Crème Soda	Yes	Yes	N/A	Non-nutritive sweeteners (Acesulfame-K (E950) and Sodium Cyclamate (E952))	Yes	Claim: Med Fat Sweetened
Checkers	Dairy	Milkshake	Clover Super M - Banana	Yes	Yes	N/A	Non-nutritive sweeteners (Acesulfame-K (E950) and Sodium Cyclamate (E952))	Yes	Claim: Med Fat Sweetened
Checkers	Dairy	Milkshake	Clover Super M - Chocolate	Yes	Yes	N/A	Non-nutritive sweeteners (Acesulfame-K (E950) and Sodium Cyclamate (E952))	Yes	Claim: Med Fat Sweetened
Checkers	Dairy	Milkshake	Clover Super M - Strawberry	Yes	Yes	N/A	Non-nutritive sweeteners (Acesulfame-K (E950) and Sodium Cyclamate (E952))	Yes	Claim: Med Fat Sweetened

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Checkers	Dairy	Juice	Clover Quali Juice - Nectar Apple with Berry	No	Yes	N/A	Non-Nutritive Sweeteners (E952, E950)	No	Sweeteners not listed – E-numbers only
Checkers	Dairy	Juice	Clover Quali Juice - Nectar Berry	No	Yes	N/A	Non-Nutritive Sweeteners (E952, E950)	No	Sweeteners not listed – E-numbers only
Checkers	Dairy	Juice	Clover Quali Juice - Nectar Granadilla	No	Yes	N/A	Non-Nutritive Sweeteners (E952, E950)	No	Sweeteners not listed – E-numbers only
Checkers	SSB	Fizzy Drink	Clover Frankie's - Cinnamon Cola	Yes	Yes	N/A	Non-Nutritive Sweeteners (Sucralose (E955), Acesulfame-K (E950) and Sodium Cyclamate (E952)) Caffeine	No	Combination Sweeteners Caffeine

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Checkers	SSB	Fizzy Drink	Clover Frankie's - Cloudy Lemonade	Yes	Yes	N/A	Non-Nutritive Sweeteners (Sucralose (E955) Acesulfame-K (E950) and Sodium Cyclamate (E952))	No	No Caffeine
Checkers	SSB	Fizzy Drink	Clover Frankie's - Crème Soda	Yes	Yes	N/A	Non-Nutritive Sweeteners (Sucralose (E955) Acesulfame-K (E950) and Sodium Cyclamate (E952))	No	No Caffeine
Checkers	SSB	Fizzy Drink	Clover Frankie's - Root Beer	Yes	Yes	N/A	Non-Nutritive Sweeteners (Sucralose (E955) Acesulfame-K (E950) and Sodium Cyclamate (E952))	No	No Caffeine
Checkers	SSB	Fizzy Drink	Clover Frankie's - Ginger Beer	Yes	Yes	N/A	Non-Nutritive Sweeteners (Sucralose (E955) Acesulfame (-K) and Sodium Cyclamate (E952))	No	No Caffeine

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Checkers	Dairy	Yoghurt	Nolac - Strawberry Yoghurt	Yes	Yes	N/A	Non-nutritive sweeteners (Acesulfame-K (E950) and Sodium Cyclamate (E952))	Yes	Claims Lactose Free and Low Fat
Checkers	Dairy	Flavoured Cheese	Clover Cumbitos - Chutney Cheese Cubes	No	Yes	N/A	Sweetener (E955))	No	Name of Sweetener not listed. No sugar
Checkers	Snack Food	Cereal	Bokomo - Oats and Berries Bar	Yes	Yes	N/A	Sorbitol & Maltitol	Yes	High in Fibre, High in Energy
Checkers	Snack Food	Cereal	Bokomo - Oats and Yoghurt	Yes	Yes	N/A	Sorbitol & Maltitol	Yes	High in Fibre, High in Energy

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Checkers	Snack Food	Cereal	Bokomo - Oats & Nuts	Yes	Yes	N/A	Sorbitol & Maltitol	Yes	High in Fibre, High in Energy
Checkers	Snack Food	Cereal	Bokomo Oaties - Choc Flavoured Bar	Yes	Yes	N/A	Sorbitol & Maltitol	Yes	High in Fibre, High in Energy
Checkers, Dis-Chem	Snack Food	Cereal	Bokomo ProNutro - Creamy Strawberry Flavoured Bar	Yes	Yes	Sorbitol	N/A	Yes	High Protein, Vitamins
Checkers, Dis-Chem	Snack Food	Cereal	Bokomo ProNutro - Chocolate Brownie Flavoured Bar	Yes	Yes	Sorbitol	N/A	Yes	High Protein, Vitamins

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Checkers, Dis-Chem	Snack Food	Cereal	Bokomo ProNutro - Caramel Choc Flavoured Bar	Yes	Yes	N/A	Sorbitol & Maltitol	Yes	High Protein, Vitamins
Checkers, Dis-Chem	Snack Food	Cereal	Kellogg's - Crunchy Nut Cereal Bar	Yes	Yes	Sorbitol	N/A	Yes	N/A
Checkers, Dis-Chem	Snack Food	Cereal	Kellogg's Special K - Dark Chocolate Cereal Bar	Yes	Yes	Sorbitol	N/A	Yes	N/A
Checkers, Dis-Chem	Snack Food	Cereal	Kellogg's - Almond & Cranberry Cereal Bar	Yes	Yes	Sorbitol	N/A	Yes	N/A

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Checkers, Dis-Chem	Snack Food	Cereal	Kellogg's Special K - Red Berries Cereal Bar	Yes	Yes	Sorbitol	N/A	Yes	N/A
Checkers, Woolworths	Snack Food	Cereal	FUTURELIFE - Zero Original Flavour	Yes	Yes	N/A	[Sucralose (Non-nutritive sweetener), Erythritol, Steviol Glycoside]	Yes	1,5g Fat, High Protein, No Added Cane Sugar, High in Dietary Fibre
Checkers, Woolworths	Snack Food	Cereal	FUTURELIFE - Smart Oats Original Flavour	Yes	Yes	Sucralose	N/A	Yes	38% Reduced Sugar
Checkers, Woolworths	Snack Food	Cereal	FUTURELIFE - Smart Oats Mixed Berries Flavour	Yes	Yes	Sucralose	N/A	Yes	38% Reduced Sugar

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Checkers, Woolworths	Snack Food	Cereal	FUTURELIFE - Smart Oats Honey Flavour	Yes	Yes	Sucralose	N/A	Yes	38% Reduced Sugar
Checkers, Woolworths	Snack Food	Cereal	FUTURELIFE - Smart Oats Chocolate Flavour	Yes	Yes	Sucralose	N/A	Yes	38% Reduced Sugar
Checkers, Woolworths	Snack Food	Cereal	FUTURELIFE - Zero Oats Apple Berry Flavour	Yes	Yes	N/A	[Sucralose (Non-nutritive sweetener), Erythritol, Steviol Glycoside]	Yes	2g Fat, High Protein, No Added Cane Sugar, High in Dietary Fibre
Checkers	Dairy	Custard	Parmalat - Lite Vanilla Custard	Yes	Yes	N/A	Non-nutritive sweetener (acesulfame-K and sucralose)	Yes	Claim: Lite

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Checkers	Dairy	Juice	Bonita - Cabana Orange	Yes	Yes	N/A	Non-nutritive sweetener (sodium cyclamate, sodium saccharin, acesulfame-K)	No	Fruit Dairy Blend
Checkers	Dairy	Juice	Bonita - Cabana Tropical	Yes	Yes	N/A	Non-nutritive sweetener (sodium cyclamate, sodium saccharin, acesulfame-K)	No	Fruit Dairy Blend
Checkers	Dairy	Juice	Bonita- Cabana Pineapple	Yes	Yes	N/A	Non-nutritive sweetener (sodium cyclamate, sodium saccharin, acesulfame-K)	No	Fruit Dairy Blend
Checkers	Dairy	Juice	Bonita - Cabana Peach	Yes	Yes	N/A	Non-nutritive sweetener (sodium cyclamate, sodium saccharin, acesulfame-K)	No	Fruit Dairy Blend

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Checkers	Dairy	Juice	Bonita - Cabana Mango	Yes	Yes	N/A	Non-nutritive sweetener (sodium cyclamate, sodium saccharin, acesulfame-K)	No	Fruit Dairy Blend
Checkers	Dairy	Juice	Bonita - Cabana Granadilla	Yes	Yes	N/A	Non-nutritive sweetener (sodium cyclamate, sodium saccharin, acesulfame-K)	No	Fruit Dairy Blend
Checkers	Dairy	Milkshake	Steri Stumpie Lite - Chocolate	Yes	Yes	Sucralose	N/A	Yes	Claim: Lite
Checkers	Dairy	Milkshake	Steri Stumpie Lite - Strawberry	Yes	Yes	Sucralose	N/A	Yes	Claim: Lite

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Checkers	Dairy	Milkshake	Steri Stumpie Lite - Soda	Yes	Yes	Sucralose	N/A	Yes	Claim: Lite
Checkers	Dairy	Cottage Cheese	President - Sweet Thai Chilli	Yes	Yes	Aspartame	N/A		*Contains Phenylalanine
Checkers	Snack Food	Sauces	Nestle - MAGGI Lazenby Worcestershire Sauce	Yes	Yes	N/A	Non-nutritive sweeteners (Sodium cyclamate (E952) and Acesulfame-K (E950)	No	
Checkers, Woolworths	Energy Drinks	Energy Drinks	Powerade Naartjie	No	Yes	N/A	Sweeteners (Aspartame, Acesulfame-K)	No	

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Checkers, Woolworths	Energy Drinks	Energy Drinks	Powerade - Zero	No	Yes	N/A	Sweeteners (Sucralose, Acesulfame-K)	Yes	Zero Sugar/Scientifically Formulated/Low Kilojoule Sports Drink
Checkers, Woolworths	SSB	Fizzy Drink	Coca-Cola No Sugar	No	Yes	N/A	Non-Nutritive Sweeteners (Aspartame*, Acesulfame-K)	Yes	Great Coca-Cola taste, zero sugar, low kilojoule. *Contains Phenylalanine
Checkers, Woolworths	SSB	Fizzy Drink	Coco-Cola No Sugar Light Taste	No	Yes	N/A	Non-nutritive sweeteners (Aspartame*, Acesulfame-K, Sucralose)	Yes	Light taste, no sugar, low kilojoule. *Contains Phenylalanine
Checkers, Woolworths	SSB	Fizzy Drink	Fanta: Sparkling Orange Flavoured Drink	Yes	Yes	N/A	Non-Nutritive Sweeteners (Acesulfame-K, Aspartame*, Sucralose)	No	

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Checkers	SSB	Fizzy Drink	Sparletta Crème Soda Low Kilojoule Drink	Yes	Yes	N/A	Non-Nutritive Sweeteners (Sodium cyclamate, Sodium saccharin)	Yes	Low Kilojoule
Checkers	SSB	Fizzy Drink	Sparletta Pine Nut Low Kilojoule Drink	Yes	Yes	N/A	Non-Nutritive Sweeteners (Sodium cyclamate, Acesulfame-K, Aspartame*)	Yes	Low Kilojoule
Checkers	SSB	Fizzy Drink	Sparletta Sparberry Low Kilojoule Drink	Yes	Yes	N/A	Nutritive Sweeteners (Sodium cyclamate, Sodium saccharin, Acesulfame-K)	Yes	Low Kilojoule
Checkers, Woolworths	SSB	Fizzy Drink	Sparletta Iron Brew Low Kilojoule Drink	Yes	Yes	N/A	Non-Nutritive Sweetener (Sodium cyclamate, Sodium saccharin, Acesulfame-K)	Yes	Low Kilojoule

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Checkers	SSB	Fizzy Drink	Fanta No Sugar: Sparkling Orange Flavoured Low Kilojoule Drink	No	Yes	N/A	Non-nutritive sweeteners (Sodium cyclamate, Acesulfame-K and Aspartame*)	Yes	Zero Sugar, Low Kilojoule
Checkers	SSB	Fizzy Drink	Fanta: Sparkling Grape Flavoured Drink	Yes	Yes	N/A	Non-Nutritive Sweetener (Sodium Cyclamate, Sodium saccharin)	No	N/A
Checkers	SSB	Fizzy Drink	Fanta: Sparkling Pineapple Flavoured Drink	Yes	Yes	N/A	Non-Nutritive Sweeteners (Acesulfame-K, Sucralose)	No	N/A
Checkers	SSB	Fizzy Drink	Fanta: Sparkling Mango Flavoured Low Kilojoule Drink	Yes	Yes	N/A	Non-Nutritive Sweeteners (Sodium cyclamate, Sodium saccharin)	Yes	Low Kilojoule

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Checkers, Woolworths	SSB	Fizzy Drink	Sprite Lemon Lime	Yes	Yes	N/A	Non-nutritive Sweeteners (Acesulfame-K, Aspartame*)	Yes	Low Kilojoule
Checkers	SSB	Fizzy Drink	Sprite No Sugar: Lemon & Lime Flavoured Low Kilojoule Drink	Yes	Yes	N/A	Non-nutritive Sweeteners (Aspartame*, Acesulfame-K, Sucralose)	Yes	Zero Sugar/Low Kilojoule
Checkers	SSB	Fizzy Drink	Sprite: Lemon & Lime & Cucumber	Yes	Yes	N/A	Non-nutritive Sweeteners (Acesulfame-K, Aspartame*)	No	N/A
Checkers, Woolworths	Energy Drinks	Energy Drinks	Powerade Zero Sugar: Mountain Blast	No	Yes	N/A	Non-Nutritive Sweeteners (Sucralose, Acesulfame-K)	Yes	Zero Sugar

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Checkers, Woolworths	Energy Drinks	Energy Drinks	Powerade: Ion4 Naartjie Sports Drink Concentrate	No	Yes	N/A	Non-Nutritive Sweeteners (Acesulfame-K, Sucralose)	No	N/A
Checkers, Woolworths	Energy Drinks	Energy Drinks	Powerade: Ion4 Jagged Ice Sports Drink Concentrate	No	Yes	N/A	Non-Nutritive Sweeteners (Acesulfame-K, Sucralose)	No	N/A
Checkers, Woolworths	Energy Drinks	Energy Drinks	Powerade: Ion4 Mountain Blast Sports Drink Concentrate	No	Yes	N/A	Non-Nutritive Sweeteners (Acesulfame-K, Sucralose)	No	N/A
Checkers	SSB	Flavoured Water	Bonaqua Sparkling Litchi Flavoured Low Kilojoule Drink	Yes	Yes	N/A	Non-Nutritive Sweeteners (Acesulfame-K, Sucralose)	Yes	Low Kilojoule

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Checkers	SSB	Flavoured Water	Bonaqua Sparkling Strawberry Flavoured Low Kilojoule Drink	Yes	Yes	N/A	Non-nutritive Sweeteners (Acesulfame-k, Aspartame*)	Yes	Low Kilojoule
Checkers	SSB	Flavoured Water	Bonaqua Sparkling Naartjie Flavoured Low Kilojoule Drink	Yes	Yes	N/A	Non-Nutritive Sweeteners (Acesulfame-K, Sucralose)	Yes	Low Kilojoule
Checkers	SSB	Fizzy Drink	Schweppes Mojito: Mint & Lime Flavoured Drink	Yes	Yes	N/A	Non-Nutritive Sweeteners (Sodium saccharin)	No	N/A
Checkers	SSB	Fizzy Drink	Schweppes Tropical Sunset: Citrus Blend Flavoured Drink	Yes	Yes	N/A	Non-Nutritive Sweeteners (Sodium saccharin)	No	N/A

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Checkers	SSB	Fizzy Drink	Schweppes Lemonade	Yes	Yes	N/A	Non-Nutritive Sweeteners (Acesulfame-K, Sodium saccharin)	No	N/A
Checkers	SSB	Fizzy Drink	Schweppes Indian Tonic Water – No Sugar	No	Yes	N/A	Non-Nutritive Sweeteners (Aspartame*, Acesulfame-K)	Yes	No sugar
Checkers	SSB	Fizzy Drink	Schweppes Ginger Ale	Yes	Yes	N/A	Non-Nutritive Sweeteners (Sodium cyclamate, Acesulfame-K, Aspartame*)	No	N/A
Checkers	SSB	Fizzy Drink	Schweppes Dry Lemon	Yes	Yes	N/A	Non-Nutritive Sweetener (Sodium saccharin)	No	N/A

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Checkers	SSB	Juice	Cappy 12% Orange Juice Drink: Orange Pulpy	Yes	Yes	N/A	Non-Nutritive Sweeteners (Sodium saccharin, Acesulfame-K)	No	N/A
Checkers	SSB	Fizzy Drink	Stoney Classic	Yes	Yes	N/A	Non-Nutritive Sweetener (Sodium cyclamate, Sodium saccharin, Acesulfame-K)	No	N/A
Checkers	SSB	Fizzy Drink	Stoney No Sugar	No	Yes	N/A	non-nutritive sweeteners (sodium cyclamate, acesulfame-K and aspartame*)	Yes	No Sugar R9 on the can
Checkers	SSB	Fizzy Drink	Stoney Extra Kwetsa	Yes	Yes	N/A	Non-Nutritive Sweetener (Acesulfame-K, Sucralose)	No	N/A

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Woolworths	Snack Food	Crisps	Woolworths-Chutney Naks	Yes	Yes	Sucralose	N/A	Yes	No added MSG, no azo dye colourants including tartrazine
Woolworths	Snack Food	Crisps	Woolworths - Fruit Chutney Flavoured Potato Crisps 125 g	Yes	Yes	Sucralose	N/A	Yes	No added MSG
Checkers, Dis-Chem	Snack Food	Cereal	Bokomo Otees Original Flavour Bars	Yes	Yes	Sorbitol	N/A	N/A	N/A
Woolworths	Snack Food	Crisps	Woolworths - Sweet Chilli Flavoured Farmer's Crisps	Yes	Yes	Sucralose	N/A	N/A	N/A

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Woolworths	Confectionary	Soft Candy	Woolworths - Milk Bottles Sweets	Yes	Yes	Sorbitol	N/A	N/A	N/A
Woolworths	Confectionary	Hard Candy	Woolworths - Butterscotch Flavoured Candy	No	Yes	Stevia	N/A	No	N/A
Checkers, Woolworths, Dis-Chem	Confectionary	Hard Candy	Halls - Citrus Mix Flavoured Sugar- Free Candy	No	Yes	N/A	Aspartame, Acesulfame-K	Yes	Sugar-Free
Dis-Chem	Snack Food	Energy Bar	Primal Energy Bar - Chocolate Strawberry	Yes	Yes	Sorbitol	N/A	No	N/A

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Dis-Chem	Snack Food	Energy Bar	Primal Energy Bar - Strawberry	Yes	Yes	Sorbitol	N/A	No	N/A
Dis-Chem	Snack Food	Energy Bar	Primal Energy Bar - Double Chocolate	Yes	Yes	Sorbitol	N/A	No	N/A
Dis-Chem	Snack Food	Energy Bar	Primal Energy Bar - Chocolate Nut Caramel	Yes	Yes	Sorbitol	N/A	No	N/A
Dis-Chem	Energy Drinks	Shakes	Primal Skinny Whey - Peanut Butter Cup	No	Yes	Sucralose	N/A	Yes	Skinny - Whey Protein

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Dis-Chem	Energy Drinks	Shakes	Primal Whey Protein - Chocolate	No	Yes	Sucralose	N/A	No	N/A
Dis-Chem	Energy Drinks	Shakes	Primal Whey Protein - Strawberry	No	Yes	Sucralose	N/A	No	N/A
Dis-Chem	Energy Drinks	Shakes	Diet Shake 900g (Lemon Crème)	No	Yes	Sucralose	N/A	No	N/A
Dis-Chem	Energy Drinks	Shakes	Primal Whey Protein Pre-Workout 510g (Cherry Berry)	No	Yes	Sucralose	N/A	No	N/A

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Dis-Chem	Energy Drinks	Shakes	Primal Mass Gain - Vanilla	No	Yes	Sucralose	N/A	No	N/A
Dis-Chem	Energy Drinks	Shakes	Primal Diet Shake 900g (Strawberries & Cream)	No	Yes	Sucralose	N/A	Yes	Diet - meal replacement
Dis-Chem	Snack Food	Energy Bar	Primal Energy Boost Bar - Pink Bar	No	Yes	Sucralose	N/A	Yes	Energy Boost - A balanced composition of protein, carbohydrates, and fat, enriched with vitamins and minerals
Dis-Chem	Energy Drinks	Energy Drinks	Primal Energy Force - Energy Force 500ml (Baobab)	No	Yes	N/A	Non-Nutritive Sweeteners (Sodium Cyclamate, Sodium Saccharine, Acesulfame-K)	Yes	Caffeine, Energy Drink, primal nutrition, supplement

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Dis-Chem	Energy Drinks	Energy Drinks	Primal Energy Force - Energy Force 500ml (Hibiscus)	No	Yes	N/A	Non-Nutritive Sweeteners (Sodium Cyclamate, Sodium Saccharine, Acesulfame-K)		
Dis-Chem	Energy Drinks	Energy Drinks	Primal Energy Force - Energy Force 500ml (Misty White)	No	Yes	N/A	Non-Nutritive Sweeteners (Sucralose, Acesulfame-K)	Yes	Sugar-free
Dis-Chem	SSB	Juice	Footy's Ready to Drink Sugar-free – Raspberry	No	Yes	Stevia	N/A	Yes	Sugar-free - stevia extract, suitable for all ages
Dis-Chem	SSB	Juice	Footy's Ready to Drink Sugar-free - Lemon and Lime	No	Yes	Stevia	N/A	Yes	Sugar-free - stevia extract, suitable for all ages

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Dis-Chem	SSB	Juice	Footy's Ready to Drink Sugar-free- Strawberry	No	Yes	Stevia	N/A	Yes	Sugar-free - stevia extract, suitable for all ages
Dis-Chem	SSB	Juice	Footy's Ready to Drink Sugar-free- Naartjie	No	Yes	Stevia	N/A	Yes	Sugar-free - stevia extract, suitable for all ages
Dis-Chem	SSB	Juice	Footy's Ready to Drink Sugar-free- Passion Fruit	No	Yes	Stevia	N/A	Yes	Sugar-free - stevia extract, suitable for all ages
Dis-Chem	SSB	Juice	Footy's Ready to Drink Sugar-free- Grape	No	Yes	Stevia	N/A	Yes	Sugar-free - stevia extract, suitable for all ages

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Dis-Chem	Snack Food	Dessert	Footy's Sugar-free Jelly - Raspberry	No	Yes	Stevia	N/A	Yes	Sugar-free - stevia extract, suitable for all ages
Dis-Chem	Snack Food	Dessert	Footy's Sugar-free Jelly - Lemon & Lime	No	Yes	Stevia	N/A	Yes	Sugar-free - stevia extract, suitable for all ages
Dis-Chem	Snack Food	Dessert	Footy's Sugar-free Jelly - Grape	No	Yes	Stevia	N/A	Yes	Sugar-free - stevia extract, suitable for all ages
Dis-Chem	Snack Food	Dessert	Footy's Sugar-free Jelly - Naartjie	No	Yes	Stevia	N/A	Yes	Sugar-free - stevia extract, suitable for all ages

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Dis-Chem	Snack Food	Dessert	Footy's Sugar-free Jelly – Strawberry	No	Yes	Stevia	N/A	Yes	Sugar-free - stevia extract, suitable for all ages
Dis-Chem	SSB	Juice	Footy's Sugar-free Powdered Sachet - Strawberry	No	Yes	Stevia	N/A	Yes	Sugar-free - stevia extract, suitable for all ages
Dis-Chem	SSB	Juice	Footy's Sugar-free Powdered Sachet – Grape	No	Yes	Stevia	N/A	Yes	Sugar-free - stevia extract, suitable for all ages
Dis-Chem	SSB	Juice	Footy's Sugar-free Powdered Sachet – Naartjie	No	Yes	Stevia	N/A	Yes	Sugar-free - stevia extract, suitable for all ages

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Dis-Chem	SSB	Juice	Footy's Sugar-free Powdered Sachet - Lemon & Lime	No	Yes	Stevia	N/A	Yes	Sugar-free - stevia extract, suitable for all ages
Dis-Chem	SSB	Juice	Footy's Sugar-free Powdered Sachet - Raspberry	No	Yes	Stevia	N/A	Yes	Sugar-free - stevia extract, suitable for all ages
Dis-Chem	SSB	Juice	Footy's Sugar-free Powdered Sachet - Passion Fruit	No	Yes	Stevia	N/A	Yes	Sugar-free - stevia extract, suitable for all ages
Dis-Chem	Snack Food	Dessert	Footy's Sugar-free Vegan Jelly - Passion Fruit	No	Yes	Stevia	N/A	Yes	Vegan, Sugar-free, High Vitamin C

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Dis-Chem	Snack Food	Dessert	Footy's Sugar-free Vegan Jelly - Raspberry	No	Yes	Stevia	N/A	Yes	Vegan, Sugar-free, High Vitamin C
Dis-Chem	Snack Food	Dessert	Footy's Sugar-free Vegan Jelly – Grape	No	Yes	Stevia	N/A	Yes	Vegan, Sugar-free, High Vitamin C
Dis-Chem	Snack Food	Dessert	Footy's Sugar-free Vegan Jelly - Lemon & Lime	No	Yes	Stevia	N/A	Yes	Vegan, Sugar-free, High Vitamin C
Dis-Chem	Snack Food	Dessert	Footy's Sugar-free Vegan Jelly – Naartjie	No	Yes	Stevia	N/A	Yes	Vegan, Sugar-free, High Vitamin C

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Dis-Chem	Snack Food	Energy Bar	Biogen Protein Bites - Doble Choc	No	Yes	N/A	Sucralose and Ace-K	Yes	High Protein
Dis-Chem	Snack Food	Energy Bar	Biogen Protein Bites - Peanut Butter	No	Yes	N/A	Sucralose and Ace-K	Yes	High Protein
Dis-Chem	Energy Drinks	Energy Drinks	Biogen Water Flavour Enhancer – Pineapple	No	Yes	N/A	Sucralose and Ace-K	Yes	Zero Sugar, Zero Colours, Zero Aspartame
Dis-Chem	Energy Drinks	Energy Drinks	Biogen Water Flavour Enhancer – Litchi	No	Yes	N/A	Sucralose and Ace-K	Yes	Zero Sugar, Zero Colours, Zero Aspartame

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Dis-Chem	Energy Drinks	Energy Drinks	Biogen Water Flavour Enhancer – Lime	No	Yes	N/A	Sucralose and Ace-K	Yes	Zero Sugar, Zero Colours, Zero Aspartame
Dis-Chem	Energy Drinks	Energy Drinks	Biogen Water Flavour Enhancer – Berry	No	Yes	N/A	Sucralose and Ace-K	Yes	Zero Sugar, Zero Colours, Zero Aspartame
Dis-Chem	Energy Drinks	Energy Drinks	Biogen Water Flavour Enhancer - Coco Pine	No	Yes	N/A	Sucralose and Ace-K	Yes	Zero Sugar, Zero Colours, Zero Aspartame
Dis-Chem	Energy Drinks	Energy Drinks	Biogen Water Flavour Enhancer – Apple	No	Yes	N/A	Sucralose and Ace-K	Yes	Zero Sugar, Zero Colours, Zero Aspartame

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Dis-Chem	Energy Drinks	Energy Drinks	Biogen Thermocut Slim Sticks – Berry	No	Yes	N/A	Ace-K and Aspartame	Yes	High in Protein, Low GI, Sugar-free
Dis-Chem	Energy Drinks	Energy Drinks	Biogen Thermocut Slim Sticks – Pineapple	No	Yes	N/A	Ace-K and Aspartame	Yes	High in Protein, Low GI, Sugar-free
Dis-Chem	Energy Drinks	Shakes	Biogen Protein Shake - Choc Brownie	No	Yes	N/A	Sucralose and Stevia	Yes	High in Protein, Low GI, Sugar-free
Dis-Chem	Energy Drinks	Shakes	Biogen Protein Shake - Vanilla Ice-Cream	No	Yes	N/A	Sucralose and Stevia	Yes	High in Protein, Low GI, Sugar-free

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Dis-Chem	Energy Drinks	Shakes	Biogen Protein Shake – Strawberry	No	Yes	N/A	Sucralose and Stevia	Yes	High in Protein, Low GI, Sugar-free
Dis-Chem	Energy Drinks	Energy Drinks	Biogen IQUID L-CARNITINE – Blackcurrant	No	Yes	N/A	Sucralose and Ace-K	Yes	High in Protein, Low GI, Sugar-free
Dis-Chem	Energy Drinks	Energy Drinks	Biogen IQUID L-CARNITINE – Apple	No	Yes	N/A	Sucralose and Ace	Yes	High in Protein, Low GI, Sugar-free
Dis-Chem	Energy Drinks	Energy Drinks	Biogen IQUID L-CARNITINE – Strawberry	No	Yes	N/A	Sucralose and Ace-K	Yes	High in Protein, Low GI, Sugar-free

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Dis-Chem	Energy Drinks	Shakes	Biogen LEAN WHEY SACHET	No	Yes	Sucralose	N/A	Yes	Low Carb, High Protein Shake
Dis-Chem	Dairy	Juice	Spring Meadow Dairy Farm - Coco pine Dairy Flav Fruit Blend Sweetened	Yes	Yes	N/A	(Sodium Cyclamate, Sodium Saccharin, Acesulfame K)	No	N/A
Checkers	Snack Food	Crisps	Twiggles - Chilli Tomato Flav	Yes	Yes	N/A	Sweeteners (E951-E954)	No	N/A
Checkers	Snack Food	Crisps	Twiggles - Sizzling Steak Flav	Yes	Yes	N/A	Sweeteners (E951, E952-E954)	No	N/A

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Checkers	Snack Food	Crisps	Twiggles - Cheese & Onion Flav	Yes	Yes	N/A	Sweeteners (E951, E952-E954)	No	N/A
Checkers	Snack Food	Crisps	Twiggles - Sweet Chilli Flav	Yes	Yes	N/A	Sweeteners (E951, E952-E954)	No	N/A
Checkers	Snack Food	Crisps	Twiggles - Real Cheese Flav	Yes	Yes	N/A	Sweeteners (E951, E952-E954)	No	N/A
Woolworths	Confectionary	Soft Candy	Woolies - Soft Eating Gum	No	Yes	Sorbitol	N/A	No	N/A

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Woolworths	Confectionary	Soft Candy	Woolies - Mi k Bottles	No	Yes	Sorbitol	N/A	Yes	Sugar-free
Checkers, Woolworths, Dis-Chem	Gum	Gum	Stimorol Wild Cherry Flavoured Sugar-free Gum	No	Yes		ASPARTAME & ACESULFAME-K & SUCRALOSE, Xylitol, Sorbitol, Mannitol	Yes	Sugar-free Gum
Woolworths	Confectionary	Soft Candy	Woolies - Fantasy Galore	No	Yes	Sorbitol	N/A	Yes	Sugar-free
Woolworths	Confectionary	Soft Candy	Woolies - Jelly Snake	No	Yes	Sorbitol	N/A	Yes	Sugar-free

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Woolworths	Confectionary	Soft Candy	Woolies - Gummy Rings	No	Yes	Sorbitol	N/A	Yes	Sugar-free
Checkers, Woolworths, Dis-Chem	Gum	Gum	Wrigley's Orbit® Bubblemint Sugar-free Chewing Gum 46 Pcs	No	Yes	N/A	Xylitol; Sorbitol, Aspartame, Mannitol, Acesulfame K, Sucralose	Yes	Sugar-free Gum
Woolworths	Confectionary	Soft Candy	Woolies Gelatine Free Mini Soft Eating Gums	No	Yes	Sorbitol	N/A	Yes	Sugar-free
Checkers, Woolworths, Dis-Chem	Gum	Gum	Clorets Eliminator Sugar-free Chewing Gum	No	Yes	Aspartame	N/A	Yes	Sugar-free

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Checkers, Woolworths, Dis-Chem	Gum	Gum	Stimorol X-Fresh Spearmint Sugar-free Chewing Gum	No	Yes	N/A	Aspartame, Acesulfame-K	Yes	Sugar-free
Checkers, Woolworths, Dis-Chem	Gum	Gum	Stimorol X-Fresh Watermelon Sugar-free Chewing Gum	No	Yes	N/A	XYLITOL, ISOMALT, SORBITOL, ASPARTAME	Yes	Sugar-free
Woolworths	Confectionary	Soft Candy	Woolies - Fruit Flav Chews	No	Yes	N/A	MALTITOLS, ISOMALT	Yes	These sweets have been made with the sugar substitute, Maltitol. Sugar-free
Checkers, Woolworths, Dis-Chem	Gum	Gum	Stimorol Waves Peppermint Sugar-free Chewing Gum	No	Yes	N/A	XYLITOL, ISOMALT, SORBITOL, ASPARTAME	Yes	Sugar-free

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Checkers, Woolworths, Dis-Chem	Gum	Gum	Orbit Watermelon Flavoured Chewing Gum	No	Yes	N/A	Xylitol; Sorbitol, Aspartame, Sweetener Mannitol, Acesulfame-K, Sucralose	Yes	Sugar-free
Checkers, Woolworths, Dis-Chem	Gum	Gum	Wrigley's Orbit™ White Spearmint Chewing Gum	No	Yes	N/A	Xylitol; Sorbitol, Sweetener Aspartame, Mannitol, Acesulfame-K, Sucralose	Yes	Sugar-free Xylitol for teeth whitening
Checkers	Snack Food	Crisps	Corn Nibs Roasted Mealie Kernels Tomatoe	Yes	Yes	Cyclamic acid	N/A	No	N/A
Checkers	Snack Food	Frozen Food	Vejoy Soya Kebabs	Yes	Yes	Sorbitol	N/A	Yes	Wheat, Gluten, Cow's milk, Soya (allergens)

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Checkers	Snack Food	Frozen Food	100% Vegetarian Crumbed Chicken Style Schnitzel	Yes	Yes	Sorbitol	N/A	Yes	High in protein High in energy
Dis-Chem	Snack Food	Dessert	Simply delish Zero Instant Pudding Chocolate flavour	No	Yes	N/A	Aspartame, Acesulfame-K	Yes	Sugar-free Low fat Contains Phenylalanine Contains soy (allergen) Preservative free Gluten free
Dis-Chem	Snack Food	Dessert	Simply delish Zero Instant Pudding Vanilla flavour	No	Yes	N/A	Aspartame, Acesulfame-K	Yes	Sugar-free Low fat Contains Phenylalanine Contains soy (allergen) Preservative free Gluten free
Checkers	SSB	Flavoured Water	Bonaqua Sparkling Naartjie Flavoured	Yes	Yes	N/A	Aspartame, Acesulfame-K Sucralose	Yes	Low Kj

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Checkers	SSB	Flavoured Water	Bonaqua Sparkling Strawberry Flavoured	Yes	Yes	N/A	Acesulfame-K, Aspartame	Yes	Low Kj
Checkers	SSB	Flavoured Water	Aquelle Sparkling Flavoured Drink Apple	Yes	Yes	N/A	Acesulfame-K, Aspartame	Yes	Low Kj Contains Phenylalanine
Checkers	SSB	Flavoured Water	Aquelle Sparkling Flavoured Drink Naartjie	Yes	Yes	N/A	Acesulfame-K, Aspartame	Yes	Low Kj Contains phenylalanine
Checkers	SSB	Flavoured Water	Aquelle Sparkling Flavoured Drink Granadilla	Yes	Yes	N/A	Acesulfame-K, Aspartame	Yes	Low Kj Contains phenylalanine

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Checkers	SSB	Flavoured Water	Aquelle Sparkling Flavoured Drink Litchi	Yes	Yes	N/A	Acesulfame-K, Aspartame	Yes	Low Kj Contains phenylalanine
Checkers	SSB	Flavoured Water	Aquelle Sparkling Flavoured Drink Marula	Yes	Yes	N/A	Acesulfame-K, Aspartame	Yes	Low Kj Contains phenylalanine
Checkers	SSB	Flavoured Water	Aquelle Sparkling Flavoured Drink Strawberry	Yes	Yes	N/A	Acesulfame-K, Aspartame	Yes	Low Kj Contains phenylalanine
Checkers	SSB	Flavoured Water	Aquelle Sparkling Flavoured Drink Honey Melon	Yes	Yes	N/A	Acesulfame-K, Aspartame	Yes	Low Kj Contains phenylalanine

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Checkers	SSB	Flavoured Water	Aquelle Sparkling Flavoured Drink Pineapple	Yes	Yes	N/A	Acesulfame-K, Aspartame	Yes	Low Kj Contains phenylalanine
Checkers	SSB	Flavoured Water	Aquelle Sparkling Flavoured Drink Watermelon	Yes	Yes	N/A	Acesulfame-K, Aspartame	Yes	Low Kj Contains phenylalanine
Checkers	Dairy	Cottage Cheese	White Rock Produced by Fairview Blueberry and Apple Semi-soft medium fat cheese	no	Yes	Sucralose	N/A	No	N/A
Checkers	Confectionary	Hard Candy	Amajoya Creamy Toffee Original	Yes	Yes	Sorbitol	N/A	No	N/A

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Checkers	Confectionary	Hard Candy	Amajoya Creamy Toffee Milk Éclair	Yes	Yes	Sorbitol	N/A	No	N/A
Checkers	Confectionary	Hard Candy	Amajoya Creamy Toffee Mint Éclair	Yes	Yes	Sorbitol	N/A	No	N/A
Checkers, Woolworths	Confectionary	Hard Candy	Halls Mentholypytus Sugar-free	No	Yes	N/A	Isomaltitol, Acesulfame-K, Aspartame	No	Contains Phenylalanine
Woolworths	Snack Food	Crisps	Woolworths Lentil & Quinoa BBQ Pop Chips	Yes	Yes	Sucralose	N/A	No	N/A

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Checkers	Snack Food	Crisps	Flannagan's Moreish Irish Kettle Fried Chips Macgilly's Balsamic Vinegar	Yes	Yes	SUCRALOSE	N/A	No	N/A
Checkers	Snack Food	Crisps	Big Korn Bites Tomatoe flavour	Yes	Yes	Sodium Saccharin	N/A	No	N/A
Checkers	Snack Food	Crisps	Crispy caramelised onion flavoured rings	No	Yes	Sucralose	N/A	No	N/A
Checkers	Snack Food	Crisps	Willards Cheese Curls Fruit Chutney	No	Yes	N/A	Sodium Saccharin, Aspartame	No	N/A

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Checkers	Snack Food	Crisps	Willards Cheese Curls Balls Fruit Chutney	Yes	Yes	N/A	Sodium Saccharin, Aspartame	No	N/A
Checkers	Snack Food	Crisps	Willards Monster Munch Original	Yes	Yes	Sodium Saccharin	N/A	No	N/A
Checkers	Snack Food	Crisps	Simba Ghost Pops	Yes	Yes	N/A	Sodium Saccharin, Aspartame	No	N/A
Checkers	Snack Food	Crisps	Doritos 3D Cajun BBQ	No	Yes	Sucralose	N/A	No	N/A

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Checkers	Snack Food	Crisps	Sour Cream & Mild Chilli Flavoured Corn Chips	Yes	Yes	Aspartame	N/A	No	N/A
Checkers	Snack Food	Crisps	Steakhouse Flavoured Potato Chips	Yes	Yes	Sucralose	N/A	No	N/A
Checkers	Snack Food	Crisps	Spare R b Flavoured Potato Chips	Yes	Yes	Sucralose	N/A	No	N/A
Checkers	Snack Food	Crisps	Fruit Chutney Flavoured Potato Chips	Yes	Yes	N/A	Sodium Saccharin, Aspartame	No	N/A

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Checkers	Snack Food	Crisps	Atchar Flavoured Potato Chips	Yes	Yes	Sucralose	N/A	No	N/A
Checkers	Snack Food	Crisps	Fritos Sweet Barbeque Flavoured Corn Chips	Yes	Yes	Sodium Saccharin	N/A	No	N/A
Checkers	Snack Food	Crisps	Fritos Sweet Chilli Flavoured Corn Chips	Yes	Yes	Aspartame	N/A	No	N/A
Dis-Chem	Snack Food	Crisps	Italian Tomato Flavoured Lentil Snack	Yes	Yes	Aspartame	N/A	No	N/A

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Checkers	Dairy	Yoghurt	Clover Classic strawberry flavoured low fat dairy snack	Yes	Yes	N/A	Acesulfame-K, sodium cyclamate	Yes	Source of 10 vitamins
Checkers	Dairy	Yoghurt	Clover Bliss Double Cream Strawberry and Cream	Yes	Yes	N/A	Acesulfame-K, sodium cyclamate	Yes	Source of 10 vitamins
Checkers	Dairy	Yoghurt	Clover Bliss Lemon Meringue	Yes	Yes	N/A	Acesulfame-K, sodium cyclamate	Yes	Source of 10 vitamins
Checkers	Dairy	Yoghurt	Clover Fruits of the forest with Cereals Strawberry and Cranberry	Yes	Yes	N/A	Acesulfame-K, sodium cyclamate	Yes	Source of 10 vitamins

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Checkers	Dairy	Yoghurt	Clover Fruits of the forest Stewed Fruit	Yes	Yes	N/A	Acesulfame-K, sodium cyclamate	Yes	Source of 10 vitamins
Checkers	Dairy	Yoghurt	Clover Classic Apricot flavoured low fat dairy snack	Yes	Yes	N/A	Acesulfame-K, sodium cyclamate	Yes	Source of 10 vitamins
Checkers	Dairy	Yoghurt	Clover Classic Mixed Fruit flavoured low fat dairy snack	Yes	Yes	N/A	Acesulfame-K, sodium cyclamate	Yes	Source of 10 vitamins
Checkers	Dairy	Yoghurt	Clover Classic Vanilla flavoured low fat dairy snack	Yes	Yes	N/A	Acesulfame-K, sodium cyclamate	Yes	Source of 10 vitamins

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Checkers	Dairy	Yoghurt	Clover Classic Blueberry and cream flavoured low fat dairy snack	Yes	Yes	N/A	Acesulfame-K, sodium cyclamate	Yes	Source of 10 vitamins
Checkers	Dairy	Yoghurt	Spring Meadow Medium Fat Peach Flavoured Yoghurt	Yes	Yes	N/A	Acesulfame-K, sodium cyclamate	No	N/A
Checkers	Dairy	Yoghurt	Spring Meadow Medium Fat Granadilla Flavoured Yoghurt	Yes	Yes	N/A	Acesulfame-K, sodium cyclamate	No	N/A
Checkers	Dairy	Yoghurt	Spring Meadow Medium Fat Strawberry Flavoured Yoghurt	Yes	Yes	N/A	Acesulfame-K, sodium cyclamate	No	N/A

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Checkers	Dairy	Yogisip	Clover Sip Up Strawberry Low Fat Drinking Dairy Snack with Strawberry	Yes	Yes	N/A	Acesulfame-K, sodium cyclamate	Yes	10 Sources of vitamins, source of calcium low fat, has cow's mi k (allergen)
Checkers	Dairy	Yogisip	Clover Sip Up Marula Low Fat Drinking Dairy Snack with Marula	Yes	Yes	N/A	Acesulfame-K, sodium cyclamate	Yes	10 Sources of vitamins, source of calcium low fat, has cow's mi k(allergen)
Checkers	Dairy	Yogisip	Clover Sip Up Grandilla Low Fat Drinking Dairy Snack with Grandilla	Yes	Yes	N/A	Acesulfame-K, sodium cyclamate	Yes	10 Sources of vitamins, source of calcium low fat, has cow's mi k(allergen)
Checkers	Dairy	Yogisip	Clover Sip Up Apricot Low Fat Drinking Dairy Snack with Apricot	Yes	Yes	N/A	Acesulfame-K, sodium cyclamate	Yes	10 Sources of vitamins, source of calcium low fat, has cow's mi k(allergen)

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Checkers	Dairy	Yogisip	Clover Active Drink on the go snack Mi ky Chocolate Flavoured	Yes	Yes	N/A	Acesulfame-K, sodium cyclamate	Yes	Nutrient, high in energy, source of protein 18 amino acids, source of calcium Source of 12 vitamins
Checkers	Dairy	Yogisip	Clover Active Drink on the go snack Strawberry and Banana Flavoured	Yes	Yes	N/A	Acesulfame-K, sodium cyclamate	Yes	Nutrient, high in energy, source of protein 18 amino acids, source of calcium Source of 12 vitamins
Checkers	Dairy	Yogisip	Clover Active Drink on the go snack Vanilla Caramel Flavoured	Yes	Yes	N/A	Acesulfame-K, sodium cyclamate	Yes	Nutrient, high in energy, source of protein 18 amino acids, source of calcium Source of 12 vitamins
Dis-Chem	Snack Food	Dessert	Simply Delish Chocolate Instant Pudding	No	Yes	N/A	Erythritol, Stevia Extract	Yes	Sugar-free Diabetic Friendly Keto Certified

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Dis-Chem	Snack Food	Dessert	Simply Delish Banana Instant Pudding	No	Yes	N/A	Erythritol, Stevia Extract	Yes	Sugar-free Diabetic Friendly Keto Certified
Dis-Chem	Snack Food	Dessert	Simply Delish Strawberry Instant Pudding	No	Yes	N/A	Erythritol, Stevia Extract	Yes	Sugar-free Diabetic Friendly Keto Certified
Dis-Chem	Snack Food	Dessert	Simply Delish Vanilla Instant Pudding	No	Yes	N/A	Erythritol, Stevia Extract	Yes	Sugar-free Diabetic Friendly Keto Certified
Dis-Chem	Snack Food	Dessert	Simply Delish Strawberry Jelly	No	Yes	N/A	Erythritol, Stevia Extract	Yes	Keto Friendly Sugar-free

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Dis-Chem	Snack Food	Dessert	Simply Delish Peach Jelly	No	Yes	N/A	Erythritol, Stevia Extract	Yes	Keto Friendly Sugar-free
Dis-Chem	Snack Food	Dessert	Simply Delish Raspberry Jelly	No	Yes	N/A	Erythritol, Stevia Extract	Yes	Keto Friendly Sugar-free
Dis-Chem	Snack Food	Dessert	Simply Delish Orange Jelly	No	Yes	N/A	Erythritol, Stevia Extract	Yes	Keto Friendly Sugar-free
Dis-Chem	Snack Food	Biscuits	Gullon Chocolate Chip Cookies	No	Yes	N/A	Maltitol and Isomalt	Yes	Sugar-free High fibre High oleic sunflower oil

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Dis-Chem	Snack Food	Biscuits	Gullon Twins Cocoa Cookies Sandwich Cookies	No	Yes	Maltitol	N/A	Yes	Sugar-free High fibre High oleic sunflower oil
Dis-Chem	Snack Food	Biscuits	Gullon Dark Chocolate Digestive	No	Yes	Maltitol	N/A	Yes	Sugar-free High fibre High oleic sunflower oil
Dis-Chem	Snack Food	Biscuits	Gullon Maria Biscuits	No	Yes	Maltitol	N/A	Yes	Sugar-free High fibre High oleic sunflower oil
Dis-Chem	Snack Food	Biscuits	Gullon Shortbread Biscuits	No	Yes	N/A	Maltitol and Isomalt	Yes	Sugar-free High fibre High oleic sunflower oil

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Dis-Chem	Snack Food	Biscuits	Gullon Whole Grains Breakfast Biscuit	No	Yes	Maltitol		Yes	Sugar-free High fibre High oleic sunflower oil
Dis-Chem	Snack Food	Biscuits	Gullon Whole Grains Breakfast Biscuit with Yoghurt Filling	No	Yes	Maltitol		Yes	Sugar-free High fibre High oleic sunflower oil
Dis-Chem	Snack Food	Biscuits	Gullon Digestive Biscuit	No	Yes	N/A	Maltitol and Isomalt	Yes	Sugar-free High fibre High oleic sunflower oil
Dis-Chem	Snack Food	Biscuits	Gullon Oaty Biscuits	No	Yes	Maltitol		Yes	Sugar-free High fibre High oleic sunflower oil

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Dis-Chem	Snack Food	Biscuits	Gullon Chocolate Sandwich	No	Yes	Maltitol		Yes	Sugar-free High fibre High oleic sunflower oil
Dis-Chem	Snack Food	Biscuits	Gullon Vanilla Wafer	No	Yes	N/A	Maltitol and Isomalt	Yes	Sugar-free High fibre High oleic sunflower oil
Dis-Chem	Snack Food	Biscuits	Gullon Chocolate Wafer	No	Yes	N/A	Maltitol and Isomalt	Yes	Sugar-free High fibre High oleic sunflower oil
Dis-Chem	Diabetic Friendly	Biscuits	Gullon Whole Grain Fibre Biscuit	No	Yes	Maltitol	N/A	Yes	Sugar-free High fibre High oleic sunflower oil

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Dis-Chem	Diabetic Friendly	Biscuits	Bags of Bite - Buttermilk Rusks	No	Yes	Sucralose	N/A	Yes	No added sugar Suitable for diabetics
Dis-Chem	Diabetic Friendly	Biscuits	Bags of Bite - Oats Rusks	No	Yes	N/A	Polydextrose, Isomalt, Sucralose	Yes	No added sugar Suitable for diabetics Wheat Free
Dis-Chem	Diabetic Friendly	Biscuits	Bags of Bite - Sunflower Seed and Oat Rusks	No	Yes	N/A	Polydextrose, Isomalt, Sucralose	Yes	No added sugar Suitable for diabetics Wheat Free
Dis-Chem	Snack Food	Biscuits	Bags of Bite - Chunky Choc & Macadamia Biscuits	No	Yes	N/A	Polydextrose, Isomalt, Sucralose	Yes	No added sugar Suitable for diabetics

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Dis-Chem	Snack Food	Biscuits	Bags of Bite - Pecan & Espresso Biscuits	No	Yes	N/A	Polydextrose, Isomalt, Sucralose	Yes	No added sugar Suitable for diabetics
Dis-Chem	Snack Food	Biscuits	Bags of Bite - Choc Orange & Coconut Chews Biscuits	No	Yes	N/A	Polydextrose, Isomalt, Sucralose	Yes	No added sugar Suitable for diabetics
Dis-Chem	Snack Food	Biscuits	Tirma - Snack Bezero 70% Dark Chocolate	No	Yes	Maltitol	N/A	Yes	No added sugar
Dis-Chem	Snack Food	Biscuits	Tirma - Snack Bezero 70% Milk Chocolate	No	Yes	N/A	Maltitol and acesulfame potassium	Yes	No added sugar

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Dis-Chem	Snack Food	Chocolate	Tirma Milk Chocolate With Whole Almonds	No	Yes	Acesulfame Potassium	N/A	Yes	No added sugar
Dis-Chem	Snack Food	Biscuits	Tirma 70% Dark Chocolate Wafer	No	Yes	N/A	Maltitol, Lactitol and Acesulfame Potassium	Yes	No added sugar
Dis-Chem	Snack Food	Chocolate	Tirma 70% Dark Chocolate Bar	No	Yes	N/A	Maltitol, Lactitol and Acesulfame Potassium	Yes	No added sugar
Dis-Chem	Snack Food	Chocolate	Tirma Milk Chocolate Bar	No	Yes	N/A	Maltitol and Acesulfame Potassium	Yes	No added sugar

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Dis-Chem	Confectionary	Hard Candy	Tirma Fruit Candies	No	Yes	N/A	Isomalt and Acesulfame Potassium	Yes	No added sugar
Dis-Chem	Snack Food	Dessert	Tony Ferguson Jelly Raspberry	No	Yes	N/A	Sodium Cyclamate, Aspartame *, Sodium Saccharine	Yes	No added sugar
Dis-Chem	Snack Food	Dessert	Tony Ferguson Jelly Blueberry	No	Yes	N/A	Sodium Cyclamate, Aspartame *, Sodium Saccharine	Yes	No added sugar
Dis-Chem	Snack Food	Dessert	Tony Ferguson Jelly Litchi	No	Yes	N/A	Sodium Cyclamate, Aspartame *, Sodium Saccharine	Yes	No added sugar

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Dis-Chem	Snack Food	Dessert	Tony Ferguson Jelly Lemon and Lime	No	Yes	N/A	Sodium Cyclamate, Aspartame *, Sodium Saccharine	Yes	No added sugar
Dis-Chem	Energy Drinks	Concentrate	Tony Ferguson Water Infusion Drops Raspberry	No	Yes	N/A	Sucralose & Acesulfame-K	Yes	No added sugar
Dis-Chem	Energy Drinks	Concentrate	Tony Ferguson Water Infusion Crème Soda	No	Yes	N/A	Sucralose & Acesulfame-K	Yes	No added sugar
Dis-Chem	Energy Drinks	Concentrate	Tony Ferguson Water Infusion Drops Lemonade	No	Yes	N/A	Sucralose & Acesulfame-K	Yes	No added sugar

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Dis-Chem	Energy Drinks	Concentrate	Tony Ferguson Water Infusion Drops Watermelon	No	Yes	N/A	Sucralose & Acesulfame-K	Yes	No added sugar
Dis-Chem	Energy Drinks	Concentrate	Tony Ferguson Water Infusion Drops Tropical Fizz	No	Yes	N/A	Sucralose & Acesulfame-K	Yes	No added sugar
Dis-Chem	Energy Drinks	Concentrate	Tony Ferguson Water Infusion Drops Pomegranate and Cranberry	No	Yes	N/A	Sucralose & Acesulfame-K	Yes	No added sugar
Dis-Chem	Energy Drinks	Dessert	Tony Ferguson Dessert Mix Vanilla Flavour	No	Yes	N/A	Aspartame* and Acesulfame-K	Yes	No added sugar

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Dis-Chem	Snack Food	Dessert	Tony Ferguson Dessert Mix Chocolate Flavour	No	Yes	N/A	Aspartame* and Acesulfame-K	Yes	No added sugar
Dis-Chem	Energy Drinks	Shakes	Tony Ferguson Chocolate Flavour Shake Mix	No	Yes	N/A	Nutriose and Sucralose	Yes	No added sugar Carb Free High Protein
Dis-Chem	Energy Drinks	Shakes	Tony Ferguson Vanilla Flavour Shake Mix	No	Yes	N/A	Nutriose and Sucralose	Yes	No added sugar Carb Free High Protein
Dis-Chem	Energy Drinks	Shakes	Tony Ferguson Strawberry Flavour Shake Mix	No	Yes	N/A	Nutriose and Sucralose	Yes	No added sugar Carb Free High Protein

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Dis-Chem	Snack Food	Biscuits	Voortman Sugar-free Mini Iced Oatmeal Cookies	No	Yes	N/A	Maltitol and acesulfame potassium	Yes	Sugar-free
Dis-Chem	Snack Food	Biscuits	Voortman Sugar-free Mini Vanilla Shortbread Cookies	No	Yes	N/A	Maltitol and acesulfame potassium	Yes	Sugar-free
Dis-Chem	Snack Food	Biscuits	Voortman Sugar-free Chocolate Wafers	No	Yes	N/A	Sorbitol & Aspartame	Yes	Sugar-free
Dis-Chem	Snack Food	Biscuits	Voortman Sugar-free Orange Creme Wafers	No	Yes	N/A	Sorbitol & Aspartame	Yes	Sugar-free

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Dis-Chem	Snack Food	Biscuits	Voortman Sugar-free Vanilla Wafers	No	Yes	N/A	Sorbitol & Aspartame	Yes	Sugar-free
Dis-Chem	Snack Food	Biscuits	Voortman Sugar-free Strawberry Wafers	No	Yes	N/A	Sorbitol & Aspartame	Yes	Sugar-free
Dis-Chem	Snack Food	Biscuits	Voortman Sugar-free Coconut Crème Wafers	No	Yes	N/A	Sorbitol & Aspartame	Yes	Sugar-free
Dis-Chem	Snack Food	Biscuits	Voortman Sugar-free Key Lime Wafers	No	Yes	N/A	Sorbitol & Aspartame	Yes	Sugar-free

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Dis-Chem	Snack Food	Biscuits	Voortman Sugar-free Lemon Wafers	No	Yes	N/A	Sorbitol & Aspartame	Yes	Sugar-free
Dis-Chem	Snack Food	Biscuits	Voortman Sugar-free Chocolate Chip Cookies	No	Yes	N/A	Maltitol and acesulfame potassium	Yes	Sugar-free
Dis-Chem	Snack Food	Biscuits	Voortman Sugar-free Fudge Brownie Chocolate Chip Cookies	No	Yes	N/A	Maltitol, Sorbitol and acesulfame potassium	Yes	Sugar-free
Dis-Chem	Snack Food	Biscuits	Voortman Sugar-free Fudge Striped Shortbread Cookies	No	Yes	N/A	Maltitol and acesulfame potassium	Yes	Sugar-free

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Dis-Chem	Snack Food	Biscuits	Voortman Sugar-free Oatmeal Cookies	No	Yes	Maltitol	N/A	Yes	Sugar-free
Dis-Chem	Snack Food	Biscuits	Voortman Sugar-free Pecan Chocolate Chip Cookies	No	Yes	N/A	Maltitol, Sorbitol and acesulfame potassium	Yes	Sugar-free
Dis-Chem	Snack Food	Biscuits	Voortman Sugar-free Pecan Shortbread Cookies	No	Yes	N/A	Maltitol and acesulfame potassium	Yes	Sugar-free
Dis-Chem	Snack Food	Biscuits	Voortman Sugar-free Shortbread Cookies	No	Yes	N/A	Maltitol and acesulfame potassium	Yes	Sugar-free

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Dis-Chem	Snack Food	Biscuits	Voortman Sugar-free Almonette Cookies	No	Yes	N/A	Maltitol and acesulfame potassium	Yes	Sugar-free
Dis-Chem	Snack Food	Biscuits	Voortman Sugar-free Coconut Cookies	No	Yes	Maltitol	N/A	Yes	Sugar-free
Dis-Chem	Confectionary	Soft Candy	De Bron Marsh Mallow	No	Yes	N/A	Maltitol and Isomalt	Yes	Sugar-free
Dis-Chem	Confectionary	Soft Candy	De Bron Chewy Gums	No	Yes	Maltitol	N/A	Yes	Sugar-free

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Dis-Chem	Confectionary	Soft Candy	De Bron Butter Toffees	No	Yes	Isomalt	N/A	Yes	Sugar-free
Dis-Chem	Confectionary	Soft Candy	De Bron Caribbean Mix	No	Yes	N/A	Maltitol Syrup, Isomalt, Sucralose	Yes	Sugar-free
Dis-Chem	Confectionary	Soft Candy	De Bron Fruit and Juice Toffee	No	Yes	N/A	Maltitol Syrup, Mannitol, Sucralose	Yes	Sugar-free
Dis-Chem	Confectionary	Soft Candy	De Bron Jellybeans	No	Yes	Maltitol	N/A	Yes	Sugar-free

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Dis-Chem	Confectionary	Soft Candy	De Bron Fruit Gums	No	Yes	Maltitol	N/A	Yes	Sugar-free
Dis-Chem	Confectionary	Soft Candy	De Bron Liquorice Coins	No	Yes	Maltitol	N/A	Yes	Sugar-free
Dis-Chem	Confectionary	Hard Candy	De Bron Peppermint Mint	No	Yes	Sorbitol	N/A	Yes	Sugar-free
Dis-Chem	Confectionary	Soft Candy	De Bron Cola Gums	No	Yes	Maltitol	N/A	Yes	Sugar-free

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Dis-Chem	Confectionary	Soft Candy	De Bron Wine Gums	No	Yes	Maltitol	N/A	Yes	Sugar-free
Dis-Chem	Confectionary	Soft Candy	De Bron Mint Toffees	No	Yes	N/A	Maltitol Syrup and Maltitol	Yes	Sugar-free
Dis-Chem	Confectionary	Soft Candy	De Bron Gum Drops	No	Yes	Maltitol	N/A	Yes	Sugar-free
Dis-Chem	Diabetic Friendly	Sauces	Walden Farm - Chocolate Syrup	No	Yes	Sucralose	N/A	Yes	Near Zero Sugar, Calories and Fat

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Dis-Chem	Diabetic Friendly	Sauces	Walden Farm - Caramel Syrup	No	Yes	Sucralose	N/A	Yes	Near Zero Sugar and Fat
Dis-Chem	Diabetic Friendly	Sauces	Walden Farm - Pancake Syrup	No	Yes	Sucralose	N/A	Yes	Near Zero Sugar, Calorie and Fat
Dis-Chem	Diabetic Friendly	Sauces	Walden Farm - Vegan Thousand Island	No	Yes	Sucralose	N/A	Yes	Near Zero Sugar, Calorie and Fat
Dis-Chem	Diabetic Friendly	Sauces	Walden Farm - Chipotle Ranch	No	Yes	Sucralose	N/A	Yes	Near Zero Sugar, Calorie and Fat

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Dis-Chem	Diabetic Friendly	Sauces	Walden Farm - Honey Dip	No	Yes	Sucralose	N/A	Yes	Near Zero Sugar, Calorie and Fat
Dis-Chem	Diabetic Friendly	Sauces	Walden Farm - Cesar	No	Yes	Sucralose	N/A	Yes	Near Zero Sugar, Calorie and Fat
Dis-Chem	Diabetic Friendly	Sauces	Walden Farm - Barbeque Smoked	No	Yes	Sucralose	N/A	Yes	Near Zero Sugar, Calorie and Fat
Dis-Chem	Diabetic Friendly	Sauces	Walden Farm - Ketchup Smoked	No	Yes	Sucralose	N/A	Yes	Near Zero Sugar, Calorie and Fat

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Dis-Chem	Diabetic Friendly	Sauces	Walden Farm - Honey Barbeque	No	Yes	Sucralose	N/A	Yes	Near Zero Sugar, Calorie and Fat
Dis-Chem	Diabetic Friendly	Sauces	Walden Farm - Thick & Spicy Barbeque	No	Yes	Sucralose	N/A	Yes	Near Zero Sugar, Calorie and Fat
Checkers	Gum	Gum	Orbit Peppermint Flavoured Sugar-free Chewing Gum	No	Yes	N/A	Aspartame*, Mannitol, Acesulfame-K	Yes	Sugar-free
Checkers	Gum	Gum	Orbit Spearmint Flavoured sugar-free Chewing Gum	No	Yes	N/A	Mannitol, Maltitol Syrup, Sucralose; Acesulfame-K	Yes	Sugar-free

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Checkers	Gum	Gum	Orbit Strawberry Flavoured sugar-free Chewing Gum	No	Yes	N/A	Sucralose; Acesulfame-K	Yes	Sugar-free
Checkers	Gum	Gum	Airwaves Menthol And Eucalyptus Flavoured sugar-free Chewing Gum.	No	Yes	N/A	Sweetener Aspartame*, Acesulfame-K, Artificial Sweetener Mannitol	Yes	Sugar-free
Checkers	Gum	Gum	Blackcurrant Flavoured sugar-free Chewing Gum.	No	Yes	N/A	Aspartame*, Acesulfame-K, Mannitol, Sucralose	Yes	Sugar-free
Checkers	Energy Drinks	Concentrate	Elvin Slimsy Mixed Berry Flavoured 1lt	No	Yes	N/A	Sodium Cyclamate, saccharin, Acesulfame-K	Yes	Endorsed by Weigh Less - Sugar-free

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Checkers	Energy Drinks	Concentrate	Elvin Slimsy Mixed Ruby Grapefruit Flavoured 1lt	No	Yes	N/A	Sodium Cyclamate, saccharin, Acesulfame-K	Yes	Endorsed by Weigh Less - Sugar-free
Checkers	Energy Drinks	Concentrate	Elvin Slimsy Lemon & Lime Flav Concentrate Squash 1L	No	Yes	N/A	Sodium Cyclamate, saccharin, Acesulfame-K	Yes	Endorsed by Weigh Less - Sugar-free
Checkers	Energy Drinks	Concentrate	Elvin Slimsy Mango Flav Concentrate 1L	No	Yes	N/A	Sodium Cyclamate, saccharin, Acesulfame-K	Yes	Endorsed by Weigh Less - Sugar-free
Checkers	Energy Drinks	Concentrate	Elvin Slimsy Passion Fruit Flav Concentrate 1L	No	Yes	N/A	Sodium Cyclamate, saccharin, Acesulfame-K	Yes	Endorsed by Weigh Less - Sugar-free

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Checkers	Energy Drinks	Concentrate	Elvin Slimsy Pomegranate Flav Concentrate 1L	No	Yes	N/A	Sodium Cyclamate, saccharin, Acesulfame-K	Yes	Endorsed by Weigh Less - Sugar-free
Checkers	SSB	Fizzy Drink	Pepsi Light	No	Yes	Acesulfame-K	N/A	Yes	Sugar-free
Checkers	SSB	Fizzy Drink	Pepsi Max	No	Yes	Aspartame	N/A	Yes	Sugar-free
Checkers	SSB	Fizzy Drink	Pepsi Mountain Dew	No	Yes	N/A	Aspartame, Sucralose, Acesulfame-K	Yes	Sugar-free

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Checkers	SSB	Fizzy Drink	Zip Cola Zero Soft Drink	No	Yes	N/A	Aspartame*, Acesulfame-K	Yes	Sugar-free
Checkers	Energy Drinks	Energy Drinks	Red Bull Sugar-free	No	Yes	N/A	Aspartame*, Acesulfame-K	Yes	Sugar-free, Zero Calories
Checkers	Energy Drinks	Energy Drinks	Monster Original	No	Yes	Sucralose	N/A	Yes	Sugar-free, Zero Calories
Checkers	Energy Drinks	Energy Drinks	Monster Energy Absolutely Zero	No	Yes	Sucralose	N/A	Yes	Sugar-free, Zero Calories

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Checkers	Energy Drinks	Energy Drinks	Monster Energy Zero Ultra	No	Yes	Sucralose	N/A	Yes	Sugar-free, Zero Calories
Woolworths	Energy Drinks	Energy Drinks	Power Play Original	No	Yes	Sucralose	N/A	Yes	Sugar-free, Zero Calories
Woolworths	SSB	Fizzy Drink	Sugar-free Ginger Flavoured Sparkling Drink	No	Yes	N/A	Acesulfame-K, Sucralose	Yes	Sugar-free, Zero Calories
Woolworths	SSB	Fizzy Drink	Ginger Ale Sugar-free	No	Yes	N/A	Acesulfame-K, Sucralose	Yes	Sugar-free, Zero Calories

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Woolworths	SSB	Fizzy Drink	Protein2Go Orange Flavoured	No	Yes	Sucralose		Yes	Sugar-free, Zero Calories
Woolworths	SSB	Fizzy Drink	Sugar-free Cola & Cherry Flavoured Sparkling Drink	No	Yes	N/A	Acesulfame-K, Sucralose	Yes	Sugar-free, Zero Calories
Woolworths	SSB	Fizzy Drink	Sugar-free Cola & Vanilla Flavoured Sparkling Drink	No	Yes	N/A	Acesulfame-K, Sucralose	Yes	Sugar-free, Zero Calories
Woolworths	SSB	Fizzy Drink	Protein2Go Lime Flavoured Still Drink	No	Yes	Sucralose	N/A	Yes	Sugar-free - diabetic friendly

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Woolworths	SSB	Fizzy Drink	Sugar-free Passion Fruit Flavoured Sparkling Drink	No	Yes	N/A	Acesulfame-K, Sucralose	Yes	Sugar-free - diabetic friendly
Dis-Chem, Checkers	Diabetic Friendly	Biscuits	Tantalize Cappuccino Biscotti	No	Yes	N/A	Erythritol, sodium cyclamate and acesulfame-K	Yes	Sugar-free - diabetic friendly
Dis-Chem, Checkers	Diabetic Friendly	Biscuits	Tantalize Chocolate & Chai Biscotti	No	Yes	N/A	Erythritol, sodium cyclamate and acesulfame-K, Maltitol	Yes	Sugar-free - diabetic friendly
Dis-Chem, Checkers	Diabetic Friendly	Biscuits	Tantalize Chocolate Orange Biscotti	No	Yes	N/A	Erythritol, sodium cyclamate and acesulfame-K, Maltitol	Yes	Sugar-free - diabetic friendly

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Dis-Chem, Checkers	Diabetic Friendly	Dessert	Tantalize Dessert Mousse - Chocolate Combo	No	Yes	N/A	Aspartame and acesulfame-K	Yes	Sugar-free - diabetic friendly
Dis-Chem, Checkers	Diabetic Friendly	Dessert	Tantalize Classic Chocolate Mousse	No	Yes	N/A	Aspartame and acesulfame-K	Yes	Sugar-free - diabetic friendly
Dis-Chem, Checkers	Diabetic Friendly	Dessert	Tantalize Apple Pie Mousse	No	Yes	N/A	Aspartame and acesulfame-K	Yes	Sugar-free - diabetic friendly
Dis-Chem, Checkers	Diabetic Friendly	Dessert	Tantalize Blackcurrant Mousse	No	Yes	N/A	Aspartame and acesulfame-K	Yes	Sugar-free - diabetic friendly

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Dis-Chem, Checkers	Diabetic Friendly	Dessert	Tantalize Litchi Mousse	No	Yes	N/A	Aspartame and acesulfame-K	Yes	Sugar-free - diabetic friendly
Dis-Chem, Checkers	Diabetic Friendly	Dessert	Tantalize Passionfruit Mousse	No	Yes	N/A	Aspartame and acesulfame-K	Yes	Sugar-free - diabetic friendly
Dis-Chem, Checkers	Diabetic Friendly	Dessert	Tantalize Chai Spice Mousse	No	Yes	N/A	Aspartame and acesulfame-K	Yes	Sugar-free - diabetic friendly
Dis-Chem, Checkers	Diabetic Friendly	Dessert	Tantalize Cappuccino Mousse	No	Yes	N/A	Aspartame and acesulfame-K	Yes	Sugar-free - diabetic friendly

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Dis-Chem, Checkers	Diabetic Friendly	Dessert	Tantalize Bubble Gum Mousse	No	Yes	N/A	Aspartame and acesulfame-K	Yes	Sugar-free - diabetic friendly
Dis-Chem, Checkers	Diabetic Friendly	Dessert	Tantalize Bubble Ginger Mousse	No	Yes	N/A	Aspartame and acesulfame-K	Yes	Sugar-free - diabetic friendly
Dis-Chem, Checkers	Diabetic Friendly	Dessert	Tantalize Bubble Guava Mousse	No	Yes	N/A	Aspartame and acesulfame-K	Yes	Sugar-free - diabetic friendly
Dis-Chem, Checkers	Diabetic Friendly	Dessert	Tantalize Coconut Ginger Mousse	No	Yes	N/A	Aspartame and acesulfame-K	Yes	Sugar-free - diabetic friendly

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Dis-Chem, Checkers	Diabetic Friendly	Dessert	Tantalize Cherry Mousse	No	Yes	N/A	Aspartame and acesulfame-K	Yes	Sugar-free - diabetic friendly
Dis-Chem, Checkers	Diabetic Friendly	Dessert	Tantalize Naartjie Mousse	No	Yes	N/A	Aspartame and acesulfame-K	Yes	Sugar-free - diabetic friendly
Dis-Chem, Checkers	Diabetic Friendly	Dessert	Tantalize Hazelnut Mousse	No	Yes	N/A	Aspartame and acesulfame-K	Yes	Sugar-free - diabetic friendly
Dis-Chem, Checkers	Diabetic Friendly	Dessert	Tantalize Lime Mousse	No	Yes	N/A	Aspartame and acesulfame-K	Yes	Sugar-free - diabetic friendly

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Dis-Chem, Checkers	Diabetic Friendly	Dessert	Tantalize Mango Mousse	No	Yes	N/A	Aspartame and acesulfame-K	Yes	Sugar-free - diabetic friendly
Dis-Chem, Checkers	Diabetic Friendly	Dessert	Tantalize Peanut Butter Mousse	No	Yes	N/A	Aspartame and acesulfame-K	Yes	Sugar-free - diabetic friendly
Dis-Chem, Checkers	Diabetic Friendly	Dessert	Tantalize Orange Mousse	No	Yes	N/A	Aspartame and acesulfame-K	Yes	Sugar-free - diabetic friendly
Dis-Chem, Checkers	Diabetic Friendly	Dessert	Tantalize Peppermint Mousse	No	Yes	N/A	Aspartame and acesulfame-K	Yes	Sugar-free - diabetic friendly

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Dis-Chem, Checkers	Diabetic Friendly	Dessert	Tantalize Banana Flavoured Syrup	No	Yes	N/A	Sodium cyclamate, acesulfame-K and steviol glycosides	Yes	Sugar-free - diabetic friendly
Dis-Chem, Checkers	Diabetic Friendly	Dessert	Tantalize Rose Flavoured Syrup	No	Yes	N/A	Sodium cyclamate, acesulfame-K and steviol glycosides	Yes	Sugar-free - diabetic friendly
Dis-Chem, Checkers	Diabetic Friendly	Dessert	Tantalize Strawberry Flavoured Syrup	No	Yes	N/A	Sodium cyclamate, acesulfame-K and steviol glycosides	Yes	Sugar-free - diabetic friendly
Dis-Chem, Checkers	Diabetic Friendly	Dessert	Tantalize Toffee Flavoured Syrup	No	Yes	N/A	Sodium cyclamate, acesulfame-K and steviol glycosides	Yes	Sugar-free - diabetic friendly

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Dis-Chem, Checkers	Diabetic Friendly	Dessert	Tantalize Vanilla Custard Flavoured Syrup	No	Yes	N/A	Sodium cyclamate, acesulfame-K and steviol glycosides	Yes	Sugar-free - diabetic friendly
Dis-Chem, Checkers	Diabetic Friendly	Dessert	Tantalize Cappuccino Flavoured Syrup	No	Yes	N/A	Sodium cyclamate, acesulfame-K and steviol glycosides	Yes	Sugar-free - diabetic friendly
Dis-Chem, Checkers	Diabetic Friendly	Dessert	Tantalize Hazelnut Flavoured Syrup	No	Yes	N/A	Sodium cyclamate, acesulfame-K and steviol glycosides	Yes	Sugar-free - diabetic friendly
Dis-Chem, Checkers	Diabetic Friendly	Dessert	Tantalize Instant Vanilla Custard Powder	No	Yes	N/A	aspartame* and acesulfame k	Yes	Sugar-free - diabetic friendly

Store/s	Category	Product	Product Description	Does the product contain sugar?	Does it contain non-nutritive sweeteners?	Single NNS	Combination NNSs	Does the product contain a wellness claim?	Health & Wellness Claim
Dis-Chem, Checkers	Diabetic Friendly	Dessert	Tantilize Instant Vanilla Custard Powder	No	Yes	N/A	aspartame* and acesulfame k	Yes	Sugar-free - diabetic friendly

What can be concluded from this study coupled with the results presented from the survey, there are many participants consuming NNSs unknowingly, consumers don't read product labels and consumers lack education and awareness on NNSs. The data highlighted the education gap confirming the initial assumption that there is a high probability that many South African consumers are consuming NNSs without being aware of it. The point of this scientific product database was also to showcase the products available to South Africans that contain NNSs across the various categories examined. While the survey targeted adults 18 and older, it must be highlighted that these products that contain NNSs are not all only consumed by adults but are also consumed by young children.

4.7 Conclusion

Chapter 4 encompasses the results of the study that cover all the objectives of the study. The results illustrated in this chapter raises potential concern on the topic of NNSs and consumer knowledge, perception, awareness and its widespread use in the food and beverage industry. The next chapter will draw conclusions based on the data analysed and make pertinent recommendations stemming from the conclusions.

Chapter 5
CONCLUSION

5.1 Introduction

This chapter draws conclusions from the main findings of the study that were discussed in the previous chapter and makes recommendations. The strengths, limitations and recommendations are also discussed to assist and provide guidance for future studies within this field.

5.2 Summary of findings

This study aimed to research three main objectives:

- To determine the level of awareness, and perception of South African consumers on NNSs in products they consume through a consumer survey and whether consumption of NNS occurred knowingly.
- To determine the consumption of beverages, sweeteners and snack products through the NNS consumer survey.
- To establish a scientific product database detailing a breakdown of NNSs in a sample of packaged products available in retail outlets in SA through product label analysis.

The NNSs consumer survey aimed to investigate how much consumers knew about NNSs, how aware they were about sweeteners, whether they consumed them knowingly, and what products were being consumed. In general, the study results are representative of the South African demographics, albeit there was slight overrepresentation of the Indian population. This research positioned the consumer at the forefront so the outcome of the study can guide consumer education on NNSs. The results showed that a significant number of consumers were not aware of saccharin, aspartame, stevia and sucralose which are most commonly used in food and beverage products. Xylitol was the only sweetener that consumers were aware of, a total of 61% had heard of it. Alarmingly, due to the lack of knowledge and awareness, many consumers have reported that they are having products that contain one or more of the sweeteners that they have not heard of, in their diets. This result also brings to light that SA consumers are not conscious of product labels or ingredient declarations. If product labels were read, this would mean that a higher percentage of consumers would have been familiar with aspartame and sucralose as a minimum, seeing that these are so commonly used in both food and beverages today.

With regards to the safety element associated with the use of NNSs, consumers expressed that they were unsure about the safety of NNSs and were concerned about consuming them. While this was a concern from a significant proportion of participants, participants reported consumption of NNSs in number of products that contained them. Interestingly, participants that did not have a formal education agreed that sweeteners were not good for health compared to those that were educated. Although 77.1% of the participants had tertiary level education, many participants were unaware of the range of NNSs used in food and beverages which alludes to the fact that a gap in consumer knowledge exists regardless of the education level of the person. This surely echoes more concern that consumers lack awareness and education on sweeteners, importance of reading product labels or ingredient

declarations, and examining the breakdown of ingredients used in the products they consume. This also creates a bigger concern for those consumers who are unable to read due to the varying levels of education in SA. This causes more reason to ask the worrisome questions like how will these consumers know what they are consuming or how can these consumers be better supported? How can the food and beverage industry consider consumer knowledge, health and wellness and 'clean up' product labels by using fewer ingredients, ingredients that consumers know and trust and find ways to enhance consumer education, working with large industry groups like the CGCSA and DoH to heighten consumer knowledge and awareness on topics that could help consumers make good and sound food choices?

A sugar tax levy was introduced in the SSB industry in efforts to support the strategic health plan in SA. This forced manufacturers to cut down sugar in SSBs and use sweeteners to compensate for the reduction without compromising the taste of the product. By developing a product database with products containing NNSs, there has been a prolific number of snack food products that contain NNSs. While the sugar tax levy has no bearing on these products, manufacturers have found a loophole by using a cheaper form of sweetness and have included it into food as well. The concern with this is that, through this study, it was emphasised how a small amount of NNSs is used to obtain a high potency of sweetness vs. that of sugar. Sweeteners are significantly sweeter that sucrose and what seems to appear as a benefit of lower-calorie or no-calorie, manufacturers have now introduced much sweeter products in the form of reduced sugar or sugar-free or simply no claim at all but at what cost? Another concern that should be linked here is the result that was illustrated for participants love for sugar or sweetness. Today, manufacturers are introducing more and more products with sweeteners, attracting consumers to high sugar products that could eventually lead consumers to become more prone to sweet options. These products are also not just limited for consumption to adults only, what manufacturers must remember is that young children are also exposed to these products and could also be consuming products that contain NNSs from a young age. While these products may not be marketed to children, children must be considered here.

Through the scientific label analysis part of this study, 419 products containing NNSs have been recognised, documented and are available as an instrument for further use. From this finding, the concern that must be highlighted here is that NNSs are widely used in food and is not limited to the SSB industry. As mentioned, the sugar tax levy forced the beverage industry to reformulate using sweeteners, but what needs to be investigated further is the reason why sweeteners are so heavily used in the snack food industry?

5.3 Strengths of the study

- The development, design, and execution of the NNS consumer survey was a key element of this research. It had a national reach with 388 participants who consented to participate. To achieve the national reach, two field workers were also recruited to fast track the administration of the NNS survey in different provinces, using student networks in the various provinces to

share the survey. This effort not only ensured the NNSs survey reached all provinces to obtain a demographic representative sample of participants from all provinces.

- The data obtained from this survey contributed to a major part of the discussion, debate and links made in this research.

- The scientific database, another fundamental part of this study was established with 419 products containing NNSs. The methods used to collect this information involved product label analysis through an online desktop study and in-person analysis at a wide range of Checkers, Woolworths and Dis-Chem stores over a period of five months. Research assistants were appointed and trained to conduct instore product label analysis and covered a wide range of stores. The product label data was evaluated for every 15th product in the scientific database by these trained researchers to ensure accuracy in the quality of data.

- This scientific product database design and development was formulated on the foundation of Regulation for Foodstuffs, Cosmetics and Disinfectants Act. which enforces labelling requirements (South Africa 1991) commonly referred to as the R146 in SA. This regulation was used as a guidance document to ensure that the scientific product database was constructed in a way that could compare to the requirements of labelling in this regulation, illustrating the type of sweeteners found in products, stating the label name of the sweetener as found on the product label, documenting any claims linked to sweetener use in products, all of which has been documented and available in one place. From the accumulated data, it was possible to illustrate which products contained NNSs, whether products contained sugar and NNSs and what claims were associated with each product relatively.

- Through the scientific product database, it can be confirmed that the use of NNS in formulations has expanded significantly into the snack food and dairy portfolio and is not limited to the beverage industry. Due to this finding, it now creates the opportunity to question if the sugar tax law that is limited to SSBs is enough to reduce obesity and diabetes in SA. This could be a further opportunity to probe into the reasons why so many manufacturers have introduced NNSs into products and why are consumers not being educated about this. From this finding it must be raised that, products illustrated in the database are not just products that are consumed by adults, but young children are also exposed to some of these products. This creates an opportunity to ask the question to SA regulators and DoH about how these products are regulated and monitored.

5.4 Limitations of the study

- The consumer survey was limited to those with mobile phones or computers with access to Wi-Fi or data. This was the only way you could participate if you wanted to. No face-to-face

interaction with participants due to COVID-19, being a limitation in this study. It also limited responses to those who could read and the uneducated did not have a voice.

- It was decided to limit product sampling to three stores to ensure the right level of accuracy and detail that was needed for the label analysis. Should the scope have expanded across more stores with more field workers to support the research, it could be assumed that more products would have been identified.
- Product sampling was also limited to specific categories: snack food, gum, confectionary, dairy, diabetic products, baby food, energy drinks and SSBs due to high volume of products that would have needed examination. Had this scope been wider, it could also be assumed here that more products containing NNSs could have been identified.
- Total number of products screened was not monitored and captured as part of the study.
- Products sampled at stores were available to researchers at that point in time. Taking the rapid changes in shelf space, new products containing NNSs could have been launched, and there may be some products examined that could have become discontinued.
- Had food manufacturer websites been up to date and contained the product information, the desktop study could have reached a wider selection of products for label analysis.
- Product labelling containing e-numbers make it even harder for consumers to know what these are. Although these are legally allowed to be used in labelling, consumers may not know which ingredients they represent.
- Through this research, it was observed that not all manufacturer websites were updated with ingredient declarations. This is a limitation for consumers as product labels were not available. Examples of some manufacturers/retailers that had very good websites which were easy to navigate and find the details needed for the desktop study were Simba, Clover, Woolworths, PepsiCo and Tiger Brands.
- Lastly, it must also be considered that the results of the survey are self-reported, including consumption of NNS. It can be argued that consumers with an interest in NNS completed the survey and could therefore have influenced the results reported.
- The survey also only obtained a self-reported consumption of NNS through yes and no questions to determine which products that could contain NNSs were being consumed. This could lead to an argument that consumers with an interest in NNS completed the survey and could therefore have influenced the results reported.

5.5 Recommendations

- There is great opportunity for regulators and the DoH to use this data to develop strategic systems and plans that could drive robust consumer education and support, tighten up controls on the use of NNSs in foodstuff.
- The DoH could also further investigate based on the product evidence in the scientific database whether the sugar tax law targeting the SSB industry should also be stretched across to food products with a high sugar content.

- Furthermore, the DoH should investigate why NNSs have become increasingly popular in food and dairy.
- Another recommendation would be for the DoH to investigate whether the use of e-numbers in product labelling law does justice for consumers. How would consumers know what these e-numbers are or which ingredients they represent?
- A study that focuses on young children and the level of consumption of NNSs should be explored based on the evidence from the product label analysis and the data presented in the scientific product database, several products containing NNSs in snack, dairy, SSBs and confectionary categories are also consumed by young children.
- Another recommendation to manufacturers and retailers to improve product websites and improve product specifications online so consumers can access ingredient declarations. Not all industry websites were updated to provide detail about product ingredients. This is essential and must be improved.
- It is strongly recommended that further research be conducted to expand the scientific product database to cover all foods and beverage lines that contain NNSs in SA.
- A recommendation for a further study to be carried out to investigate level of consumer consumption and frequency of NNSs through a FFQ.

5.6 Conclusion

The outcome of this research has highlighted key consumer insights, presenting sound data that brings to light the current consumer position on the topic of NNSs and its broad use in products in SA. The data highlighted the education gap confirming the initial assumption that there is a high probability that many South African consumers are consuming NNSs without being aware of it. While this research has created so many opportunities to improve consumer knowledge and investigate if there is a need to enforce stricter formulating measures with NNSs based on the evidence obtained through the NNSs survey and the scientific product database. These findings should be used to challenge manufacturers, the governmental guardians within the Department of Health and regulators in SA to guide consumer knowledge, awareness, perception and trust. There is a much bigger responsibility and significant role to play in protecting, sustaining and investing in consumer health and wellbeing, with a priority focuses on the consumer education.

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Appendix A – Letter of Information

LETTER OF INFORMATION

Title of the Research Study: Non-nutritive sweeteners: consumer awareness, consumption and inclusion in food and beverage products in South Africa

Principal Investigator/s/researcher: Shakun Naicker, B-Tech in Consumer Science: Food and Nutrition.

Co-Investigator/s/supervisor/s: Ashika Naicker, PhD (Nutrition) & Evonne Singh MEd (Education)

Brief Introduction and Purpose of the Study:
Good Day Mam/ Sir
My name is Shakun Naicker and I am a master's student in Applied Sciences in Food & Nutrition. I would like to take this opportunity to invite you to participate in this research study. The aim of the study is to investigate consumer awareness and consumption of NNSs in South Africa. This study further explores the widespread usage of NNSs through a sub-set of food and beverage products in the South African market.

Outline of the Procedures:

- You will be given an information letter stating facts regarding the study to be conducted.
- After being informed, I will request permission from you via a consent letter. You will required to complete an online NNSs consumer survey to determine your knowledge and awareness of the use of NNSs in products that you may consume. This survey will be administered to 384 adult participants in South Africa.

Risks or Discomforts to the Participant:
There are no potential risks to you, should you participate in this study.

Benefits:
If you participate in the consumer survey, you will be providing valuable insights on how aware you are about NNSs and the benefits and risks associated with the use of NNSs. This data can be used to guide the Department of Health on how to improve consumer knowledge on NNSs and how to regulate NNSs in the food and beverage industry so that the usage levels are safe and controlled.

Reason/s why the Participant May Be Withdrawn from the Study: You have the right to withdraw from the study at any time.

Remuneration:
You will not receive any renumeration for your participation.

Costs of the Study:
There will no costs incurred to you for participation in the study.

Confidentiality:

Your responses will be confidential, and we do not collect identifying information such as your name, email address or IP address. The academic property rights will belong to the Durban University of Technology (DUT) where the publication will be kept and made available to the public.

Research-related Injury:
This study poses no threats to your health nor does it inflict any in type of mental or physical injury should you choose to participate.

Storage of all electronic and hard copies including tape recordings:
Data will be stored in the Durban University of Technology: Department of Consumer Sciences: Food and Nutrition server. This information will only be available to the research team for a retention period of 5 year**Persons to contact in the Event of Any Problems or Queries:** Please contact the researcher (0739134396), my supervisor (.) or the Institutional Research Ethics Administrator on 031 373 2375. Complaints can be reported to the Director: Research and Postgraduate Support Dr L Linganiso on 031 373 2577 or researchdirector@dut.ac.za.

Appendix B - Consent

CONSENT

Full Title of the Study: Non-nutritive sweeteners: consumer awareness, consumption and inclusion in food and beverage products in South Africa

Names of Researcher/s: Shakun Naicker

Statement of Agreement to Participate in the Research Study:

- I hereby confirm that I have been informed by the researcher, Shakun Naicker about the nature, conduct, benefits and risks of this study - Research Ethics Clearance Number: **136/21**
- I have also received, read and understood the above written information (Participant Letter of Information) regarding the study.
- I am aware that the results of the study, including personal details regarding my sex, age, date of birth, initials and diagnosis will be anonymously processed into a study report.
- In view of the requirements of research, I agree that the data collected during this study can be processed in a computerised system by the researcher.
- I may, at any stage, without prejudice, withdraw my consent and participation in the study.
- I have had sufficient opportunity to ask questions and (of my own free will) declare myself prepared to participate in the study.
- I understand that significant new findings developed during the course of this research which may relate to my participation will be made available to me.

I, (name of researcher) herewith confirm that the above participant has been fully informed about the nature, conduct and risks of the above study.

Full Name of Participant	**Date**	**Time & Signature**
_____	_____	_____
Full Name of Researcher	**Date**	**Signature**
_____	_____	_____
Full Name of Witness (If applicable)	**Date**	**Signature**
_____	_____	_____
Full Name of Legal Guardian (If applicable)	**Date**	**Signature**
_____	_____	_____

Appendix C – Non-Nutritive Sweetener Survey: Pilot Questionnaire

DUT
DURBAN UNIVERSITY OF TECHNOLOGY
INYUVESI YASETHEKWINI YEZOBUCHWEPHESHE

Dear Participant,

By participating in this survey, you will be volunteering to contribute to the research study on non-nutritive sweeteners (NNSs) and its usage in the food and beverage industry and consumer awareness levels. Your assistance in the completion of this survey is deeply appreciated. It will take approximately 15 minutes of your time. Your responses will be confidential, and we do not collect identifying information such as your name, email address or IP address.

Your participation in this research study is voluntary. If you decide to participate in this research survey, you may withdraw at any time and can choose not to answer specific questions. If you decide not to participate in this study or if you withdraw from participating at any time, you will not be penalized. Should you wish to participate in this study, your answers will not be shared with anyone but will be used anonymously for only scholarly purposes by the research team.

Therefore, please select your choice below from the electronic consent:

☐ I provide informed consent and agree to participate. (Thank you! Please respond to the questions and statements below).
Clicking on this check box indicates that:

- you have read the above information
- you voluntarily agree to participate
- you are at least 18 years of age

☐ I do not provide consent and therefore do not agree to participate. (Thank you for your time. Please close this web page. No information will be recorded).

Thank you for accepting to take part in the survey.

- There is no 'Back' button in the survey.
- You can skip questions that do not suit you.

Background:

Non-nutritive sweeteners, also commonly known as artificial sweeteners or low calorie or non-caloric sweeteners. They are sugar alternatives used to sweeten foods, beverages, and other products. Non-nutritive sweeteners have fewer or no kilojoules/calories.

Gender:

Man: ☐ **Woman:** ☐

Select your Age Group:

- ☐ 18-24
- ☐ 25-34
- ☐ 35-44
- ☐ 44-54
- ☐ 55-64
- ☐ 65-74
- ☐ 75+
- ☐ **Prefer not to say**

Ethnicity:

- ☐ White
- ☐ Indian/Asian
- ☐ Black African
- ☐ Coloured

Education:

- ☐ No formal qualification
- ☐ High school
- ☐ Primary school
- ☐ Postgraduate
- ☐ Tertiary Education
- ☐ Degree
- ☐ Other (please specify)

Do you have OR have had any of these diseases?

- [ ] No formal qualification
- [ ] High school
- [ ] Primary school
- [ ] Postgraduate
- [ ] Tertiary Education
- [ ] Degree
- [ ]

- [ ] Type-2 Diabetes
- [ ] High blood pressure
- [ ] Heart disease
- [ ] Cancer

- [ ] No, I don't/haven't had any of these

Do you use non-nutritive sweeteners in your everyday routine?

- [ ] Yes
- [ ] No
- [ ] I am not sure

Which non-nutritive sweeteners are you aware of? (list as many as you know)

- [ ] Saccharin
- [ ] Aspartame
- [ ] Stevia
- [ ] Neotame
- [ ] Xylitol
- [ ] Malitol
- [ ] Sucralose
- [ ] Acelsulfame k
- [ ] Other (please specify)

How often do you consume products containing non-nutritive sweeteners?

- [ ] Never
- [ ] Rarely
- [ ] Once a week
- [ ] 2-4 Times per week
- [ ] Daily

How often do you consume products labelled "sugar-free" or "diet"?

- [ ] Never
- [ ] Rarely
- [ ] Once a week
- [ ] 2-4 Times a week

- ☐ Daily

In which foods and drinks do you think you usually consume non-nutritive sweeteners? (Tick as many answers that apply)

- ☐ In soft/fizzy drinks

In cakes and desserts
In tea and coffee and hot beverages
In baking and cooking
Chewing gum
Other foods and drinks (please specify)

You consume non-nutritive sweeteners because they are: (tick as many that apply to you)
Tasty
Healthier than sugars
Low in kilojoules/calories
Satisfy your sweet cravings
Are ingredients in food and drink that you consume

Are you aware of any health concerns related to consumption of non-nutritive sweeteners?

Other please specify)

Yes
No
I use it occasionally so i am not too concerned

Would you like to know more about non-nutritive sweeteners?

Yes
No
Not sure
Not interested

Approval and Regulation

South Africa has regulated the use of Sweeteners in Regulations Related to the use of Sweeteners in Foodstuff Published Under Government Notice No. R. 3128 of 20 December 1991. The regulation governs the types of non-nutritive sweeteners that can be used in manufacturing of foodstuff in the country. It also governs the amount that can be added to food and drink.

Where do you get information relating to the benefits and safety of non-nutritive sweeteners? (Tick as many answers as apply).

TV/radio

- ☐ Twitter
- ☐ Instagram
- ☐ Facebook
  - ☐ Scientific reports and research papers
  - ☐ Government health agencies website
  - ☐ Government food regulator's website – e.g. Department of Health Never looked for information
- ☐ Other (please specify)

Non-nutritive sweeteners: acceptance, benefit, and risk perceptions How strongly you agree/disagree with the following statements?

	Strongly Disagree	Disagree	Neither Disagree Nor Agree	Agree	Strongly Agree	I Don't Know
I don't consume foods and drinks that contain non-nutritive sweeteners	☐	☐	☐	☐	☐	☐
I check the labels on food & drink packaging for non-nutritive sweeteners	☐	☐	☐	☐	☐	☐
I think that non-nutritive sweeteners are not natural and therefore harmful	☐	☐	☐	☐	☐	☐
I think calling them "artificial" makes me sceptical about their safety	☐	☐	☐	☐	☐	☐
I think that non-nutritive sweeteners are bad for health	☐	☐	☐	☐	☐	☐
I worry about the **effects** non-nutritive sweeteners could have on my body	☐	☐	☐	☐	☐	☐
I have concerns about non-nutritive	☐	☐	☐	☐	☐	☐

sweeteners and the risk of cancer						
I think non-nutritive sweeteners can cause people to gain weight	☐	☐	☐	☐	☐	☐
I think non-nutritive sweeteners can cause diabetes	☐	☐	☐	☐	☐	☐
Non-nutritive sweeteners can	☐	☐	☐	☐	☐	☐
cause allergic reactions						
Pregnant women should not consume non-nutritive sweeteners	☐	☐	☐	☐	☐	☐

Non-nutritive sweeteners: acceptance

How strongly you agree/disagree with the following statements?

	Strongly Disagree	Disagree	Neither Disagree Nor Agree	Agree	Strongly Agree	I Don't Know
I am fine with foods and drinks containing non-nutritive sweeteners	☐	☐	☐	☐	☐	☐
I think that non-nutritive sweeteners are absolutely safe for health	☐	☐	☐	☐	☐	☐
Non-nutritive sweeteners are helpful for someone who wishes to lose weight	☐	☐	☐	☐	☐	☐
Non-nutritive sweeteners are helpful for someone who has diabetes	☐	☐	☐	☐	☐	☐

Non-nutritive sweeteners bring more benefit than risks to consumers	☐	☐	☐	☐	☐	☐
I find non-nutritive sweeteners to benefit me personally	☐	☐	☐	☐	☐	☐
Non-nutritive sweeteners allow me to control and reduce calories in my diet	☐	☐	☐	☐	☐	☐
Non-nutritive sweeteners allow for a little indulgence without feelings of guilt	☐	☐	☐	☐	☐	☐
Non-nutritive sweeteners allow for diet products to be available option for those looking to lose weight and/or control their sugar intake	☐	☐	☐	☐	☐	☐

How strongly do you agree/disagree with these statements on trust worthiness of information sources?

	Strongly Disagree	Disagree	Neither Disagree Nor Agree	Agree	Strongly Agree	I Don't Know
I trust information coming from Government health agencies (such as the DOH)	☐	☐	☐	☐	☐	☐
I trust information coming from food regulatory authorities (DOH)	☐	☐	☐	☐	☐	☐
I trust information coming from research/scientific papers	☐	☐	☐	☐	☐	☐
I trust information coming from health and wellness blogs	☐	☐	☐	☐	☐	☐
I trust information coming from social media	☐	☐	☐	☐	☐	☐

How strongly you agree/disagree with the following statements on regulation of sweeteners?

	Strongly Disagree	Disagree	Neither Disagree Nor Agree	Agree	Strongly Agree	I Don't Know
I am aware of the regulations surrounding the use of non-nutritive sweeteners	☐	☐	☐	☐	☐	☐
I am not aware of these regulations as I am not motivated	☐	☐	☐	☐	☐	☐

enough to look for them						
I trust the regulatory bodies as their aim is to protect consumers' health	☐	☐	☐	☐	☐	☐
I trust the regulators' position (DOH) regarding the safety and benefits of Non-nutritive sweeteners	☐	☐	☐	☐	☐	☐
Regulations mean that only a safe amount of these sweeteners are available in food and drinks	☐	☐	☐	☐	☐	☐
All non-nutritive sweeteners have been vigorously tested before being allowed on to the market	☐	☐	☐	☐	☐	☐

Product Consumption

Below is a list of products. Please indicate with an X whether you consume any of the products in the list provided.

Beverages	Yes	No
Fruit Juice & Concentrates (excluding fresh juice)		
Ice-Tea		
Diet Cooldrinks		
Flavoured Sparkling Water		
Flavoured Carbonated Water		

Milkshakes		
Energy Drinks		
Protein Drinks		
Smoothies		
Hot Beverages		
Sweeteners	**Yes**	**No**
Aspartame		
Sucralose		
Saccharin		
Xylitol		
Sorbitol		
Snacks	**Yes**	**No**
Crisps		
Biscuits/Rusks		
Chocolate Bars		
Energy Bars		
Sugar-free Chewing Gum		
Sugar-Free Gum Drops, Gummy Worms/Bears		
Sugar-Free Chocolate		
Cakes		
Ice-creams		
Yoghurts - Lite		
Yoghurts – Fat Free		
Yoghurt – Sugar-free		

Yoghurt – Low Fat		
Yoghurt – Full Cream		

PILOTING QUESTIONS

1. Could you understand the questions?

☐ Yes

☐ No, please specify in the table below:

Question no	Explanation

2. Was the flow of questions correct?

☐ Yes

☐ No, please specify in the table below:

Question no	Explanation

3. Please add any further comments/suggestions you have regarding the survey questionnaire.

Appendix D-Ethics Approval Letter

Institutional Research Ethics Committee
Research and Postgraduate Support Directorate
2nd Floor, Berwyn Court
Gate 1, Steve Biko Campus
Durban University of Technology

P O Box 1334, Durban, South Africa, 4001

Tel: 031 373 2375
Email: lavishad@dut.ac.za
http://www.dut.ac.za/research/institutional_research_ethics

www.dut.ac.za

6 September 2021

Ms S Naicker
16 Sandton Glen
3 View Road
Buccleuch
Sandton
2191

Dear Ms Naicker

Non-nutritive sweeteners: consumer awareness, consumption and inclusion in food and beverage products in South Africa.
Ethics Clearance Number: 136/21

The Institutional Research Ethics Committee acknowledges receipt of your final data collection tool for review.

We are pleased to inform you that the data collection tool has been approved. Kindly ensure that participants used for the pilot study are not part of the main study.

Please note that FULL APPROVAL is granted to your research proposal. You may proceed with data collection.

Any adverse events [serious or minor] which occur in connection with this study and/or which may alter its ethical consideration must be reported to the IREC according to the IREC Standard Operating Procedures (SOP's).

Please note that any deviations from the approved proposal require the approval of the IREC as outlined in the IREC SOP's.

Yours Sincerely,

Prof J K Adam
Chairperson: IREC

Appendix E-Non-Nutritive sweetener Consumer Survey

Non-Nutritive Sweetener Survey

Dear Participant,

By participating in this survey, you will be volunteering to contribute to the research study on non-nutritive sweeteners and its usage in the food and beverage industry and consumer awareness levels.

Your assistance in the completion of this survey is deeply appreciated. It will take approximately 15 minutes of your time. Your responses will be confidential, and we do not collect identifying information such as your name, email address or IP address.

Your participation in this research study is voluntary. If you decide to participate in this research survey, you may withdraw at any time and can choose not to answer specific questions. If you decide not to participate in this study or if you withdraw from participating at any time, you will not be penalized. Should you wish to participate in this study, your answers will not be shared with anyone but will be used anonymously for only scholarly purposes by the research team.

Therefore, please select your choice below from the electronic consent:

☐ **I provide informed consent and agree to participate. (Thank you! Please respond to the questions and statements below).**

Clicking on this check box indicates that:

- **you have read the above information**
- **you voluntarily agree to participate**
- **you are at least 18 years of age**

☐ **I do not provide consent and therefore do not agree to participate. (Thank you for your time. Please close this web page. No information will be recorded).**

Thank you for accepting to take part in the survey.

- **There is no 'Back' button in the survey.**
- **You can skip questions that do not suit you.**

Background:

Non-nutritive sweeteners, also commonly known as artificial sweeteners or low calorie or non-caloric sweeteners. They are sugar alternatives used to sweeten foods, beverages, and other products. Non-nutritive sweeteners have fewer or no kilojoules/calories.

How will you ensure that my contribution is anonymous?

You won't be asked to share any unique traceable information (e.g. date of birth, email etc.). In addition, all data collected will be kept in online software with a protected password that is only accessible to the researcher(s). Data will be transferred to a password-protected computer at the end of the survey and deleted once the project is complete.

Gender:

Man: ☐ **Woman:** ☐

Select your Age Group:

- ☐ 18-24
- ☐ 25-34
- ☐ 35-44
- ☐ 44-54
- ☐ 55-64
- ☐ 65-74
- ☐ 75+
- ☐ **Prefer not to say**

Ethnicity:

- ☐ White
- ☐ Indian/Asian
- ☐ Black African
- ☐ Coloured

Education:

- ☐ No formal qualification
- ☐ High school
- ☐ Primary school
- ☐ Postgraduate
- ☐ Tertiary Education
- ☐ Degree
- ☐ Other (please specify)

Do you have OR have had any of these diseases?

- ☐ Type 2 Diabetes
- ☐ High blood pressure
- ☐ Heart disease
- ☐ Cancer

- [ ] No, I don't/haven't had any of these

Do you use non-nutritive sweeteners in your everyday routine?

- [ ] Yes
- [ ] No
- [ ] I am not sure

Which non-nutritive sweeteners are you aware of? (list as many as you know)

- [ ] Saccharin
- [ ] Aspartame
- [ ] Stevia
- [ ] Neotame
- [ ] Xylitol
- [ ] Malitol
- [ ] Sucralose
- [ ] Acesulfame k
- [ ] Other (please specify)

How often do you consume products containing non-nutritive sweeteners?

- [ ] Never
- [ ] Rarely
- [ ] Once a week
- [ ] 2-4 Times per week
- [ ] Daily

How often do you consume products labeled "sugar-free" or "diet"?

- [ ] Never
- [ ] Rarely
- [ ] Once a week
- [ ] 2-4 Times a week
- [ ] Daily

In which foods and drinks do you think you usually consume non-nutritive sweeteners? (Tick as many answers that apply)

- [ ] In soft/fizzy drinks
- [ ] In cakes and desserts
- [ ] In tea and coffee and hot beverages
- [ ] In baking and cooking
- [ ] Chewing gum
- [ ] Other foods and drinks (please specify)

You consume non-nutritive sweeteners because they are: (tick as many that apply to you)

- [ ] Tasty
- [ ] Healthier than sugars
- [ ] Low in kilojoules/calories

- [ ] Satisfy your sweet cravings
- [ ] Are ingredients in food and drink that you consume

Are you aware of any health concerns related to consumption of non-nutritive sweeteners?

- [ ] Yes
- [ ] No
- [ ] I use it occasionally so i am not too concerned
- [ ] Other (please specify)

Would you like to know more about non-nutritive sweeteners?

- [ ] Yes
- [ ] No
- [ ] Not sure
- [ ] Not interested

Approval and Regulation

South Africa has regulated the use of Sweeteners in Regulations Related to the use of Sweeteners in Foodstuff Published Under Government Notice No. R. 3128 of 20 December 1991. The regulation governs the types of non-nutritive sweeteners that can be used in manufacturing of foodstuff in the country. It also governs the amount that can be added to food and drink.

Where do you get information relating to the benefits and safety of non-nutritive sweeteners? (Tick as many answers as apply).

- [ ] TV/radio
- [ ] Twitter
- [ ] Instagram
- [ ] Facebook
- [ ] Scientific reports and research papers
- [ ] Government health agencies website
- [ ] Government food regulator's website – e.g. Department of Health
- [ ] Never looked for information
- [ ] Other (please specify)

Non-nutritive sweeteners: acceptance, benefit, and risk perceptions
How strongly you agree/disagree with the following statements?

	Strongly Disagree	Disagree	Neither Disagree Nor Agree	Agree	Strongly Agree	I Don't Know

I don't consume foods and drinks that contain non-nutritive sweeteners	☐	☐	☐	☐	☐	☐
I check the labels on food & drink packaging for non-nutritive sweeteners	☐	☐	☐	☐	☐	☐
I think that non-nutritive sweeteners are not natural and therefore harmful	☐	☐	☐	☐	☐	☐
I think calling them "artificial" makes me sceptical about their safety	☐	☐	☐	☐	☐	☐
I think that non-nutritive sweeteners are bad for health	☐	☐	☐	☐	☐	☐
I worry about the effects non-nutritive sweeteners could have on my body	☐	☐	☐	☐	☐	☐
I have concerns about non-nutritive sweeteners and the risk of cancer	☐	☐	☐	☐	☐	☐
I think non-nutritive sweeteners can cause people to gain weight	☐	☐	☐	☐	☐	☐

I think non-nutritive sweeteners can cause diabetes	☐	☐	☐	☐	☐	☐
Non-nutritive sweeteners can cause allergic reactions	☐	☐	☐	☐	☐	☐
Pregnant women should not consume non-nutritive sweeteners	☐	☐	☐	☐	☐	☐

How strongly you agree/disagree with the following statements?

	Strongly Disagree	Disagree	Neither Disagree Nor Agree	Agree	Strongly Agree	I Don't Know
I am fine with foods and drinks containing non-nutritive sweeteners	☐	☐	☐	☐	☐	☐
I think that non-nutritive sweeteners are absolutely safe for health	☐	☐	☐	☐	☐	☐
Non-nutritive sweeteners are helpful for someone who wishes to lose weight	☐	☐	☐	☐	☐	☐
Non-nutritive sweeteners are helpful for someone who has diabetes	☐	☐	☐	☐	☐	☐

Non-nutritive sweeteners bring more benefit than risks to consumers	☐	☐	☐	☐	☐	☐
I find non-nutritive sweeteners to benefit me personally	☐	☐	☐	☐	☐	☐
Non-nutritive sweeteners allow me to control and reduce calories in my diet	☐	☐	☐	☐	☐	☐
Non-nutritive sweeteners allow for a little indulgence without feelings of guilt	☐	☐	☐	☐	☐	☐
Non-nutritive sweeteners allow for diet products to be viable option for those looking to lose weight and/or control their sugar intake	☐	☐	☐	☐	☐	☐

How strongly do you agree/disagree with these statements?

	Strongly Disagree	Disagree	Neither Disagree Nor Agree	Agree	Strongly Agree	I Don't Know
I trust information coming from Government health agencies	☐	☐	☐	☐	☐	☐

(such as the DOH)						
I trust information coming from food regulatory authorities (DOH)	☐	☐	☐	☐	☐	☐
I trust information coming from research/scientific papers	☐	☐	☐	☐	☐	☐
I trust information coming from health and wellness blogs	☐	☐	☐	☐	☐	☐
I trust information coming from social media	☐	☐	☐	☐	☐	☐

How strongly you agree/disagree with the following statements on regulation of sweeteners?

	Strongly Disagree	Disagree	Neither Disagree Nor Agree	Agree	Strongly Agree	I Don't Know
I am aware of the regulations surrounding the use of non-nutritive sweeteners	☐	☐	☐	☐	☐	☐
I am not aware of these regulations as I am not motivated enough to look for them	☐	☐	☐	☐	☐	☐
I trust the regulatory bodies as their aim is to protect consumers'	☐	☐	☐	☐	☐	☐

health						
I trust the regulators' position (DOH) regarding the safety and benefits of Non-nutritive sweeteners	☐	☐	☐	☐	☐	☐
Regulations mean that only a safe amount of these sweeteners are available in food and drinks	☐	☐	☐	☐	☐	☐
All non-nutritive sweeteners have been vigorously tested before being allowed on to the market	☐	☐	☐	☐	☐	☐

Product Consumption
Below is a list of products. Please indicate with an X whether you consume any of the products in the list provided.

Beverages	Yes	No
Fruit Juice & Concentrates (excluding fresh juice)		
Ice-Tea		
Diet Cooldrinks		
Flavoured Sparkling Water		
Flavoured Carbonated Water		
Milkshakes		
Energy Drinks		
Protein Drinks		

Smoothies		
Hot Beverages		
Sweeteners	**Yes**	**No**
Aspartame		
Sucralose		
Saccharin		
Xylitol		
Sorbitol		
Snacks	**Yes**	**No**
Crisps		
Biscuits/Rusks		
Chocolate Bars		
Energy Bars		
Sugar-free Chewing Gum		
Sugar-Free Gum Drops, Gummy Worms/Bears		
Sugar-Free Chocolate		
Cakes		
Ice-creams		
Yoghurts - Lite		
Yoghurts – Fat Free		
Yoghurt – Sugar-free		
Yoghurt – Low Fat		
Yoghurt – Full Cream		

Appendix F-Turnitin Digital Receipt

turnitin

Digital Receipt

This receipt acknowledges that Turnitin received your paper. Below you will find the receipt information regarding your submission.

The first page of your submissions is displayed below.

Submission author:	Shakun Naicker
Assignment title:	Thesis (complete)
Submission title:	Thesis Complete
File name:	Shakun_Thesis_14.06.2022.docx
File size:	3.15M
Page count:	214
Word count:	46,646
Character count:	264,440
Submission date:	14-Jun-2022 05:29PM (UTC+0200)
Submission ID:	1855409065

Appendix G-Editors Certificate

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sathsgovender4@gmail.com

Dr Saths Govender

20 JUNE 2022

TO WHOM IT MAY CONCERN

LANGUAGE CLEARANCE CERTIFICATE

This serves to inform that I have read the final version of the dissertation titled:

Non-nutritive sweeteners: consumer awareness, consumption and inclusion in food and beverage products in South Africa, by Shakun Naicker.

To the best of my knowledge, all the proposed amendments have been effected and the work is free of spelling and grammatical errors. I am of the view that the quality of language used meets generally accepted academic standards.

Yours faithfully

DR S. GOVENDER
B Paed. (Arts), B.A. (Hons), B Ed.
Cambridge Certificate for English Medium Teachers
MPA, D. Admin.