THE EFFECTS OF ELEUTHEROCOCCUS SENTICOSUS ON EGG LAYING HENS

BY

Birgit Bölling

Dissertation submitted in partial compliance with the requirements for the Master's Degree in Technology in the Department of Homoeopathy at Technikon Natal.

I, Birgit Bölling, do hereby declare that this dissertation represents my own work both in conception and execution.

.....
SIGNATURE OF CANDIDATE

13/1/'98
DATE

Approved for final submission

.....
SIGNATURE OF SUPERVISOR
G.S. Strydom (M.Sc. Agric.)

13/1/98
DATE

DEDICATION

To both my parents who gave me all the love
and support I needed to complete my course,
and for making it possible to fulfill
a dream.

ACKNOWLEDGEMENTS

I would like to thank the following people for their invaluable help with my dissertation :

1. Golden Lay Farms a division of Tiger Food Industry Limited (Durban and Johannesburg) and all their staff for their effort, help and cooperation in the trial. Without them this study would have never taken place.

2. Mr. G.S. Strydom for making this research possible and for his patience and time.

3. Dr. F.J. Burger for his endless help and supervision.

4. Mr. Z. Worku for his help with the statistics and his patience in dealing with me.

5. Mr. and Mrs. Bölling for their support and financial assistance through the years.

6. Mrs. C. Anderson from Golden Lay, who was always polite and helpful.

7. Rocky Bowers for his generous support and motivation over the years.

8. Ross Gillett for helping me with computer difficulties.

9. Ashley Ross and Russel Hopkins.

ABSTRACT

The purpose of this investigation was to evaluate the effects of Eleutherococcus senticosus on the number of eggs, the weight of the eggs, the quality of the eggs (height of the albumin; colour of the egg yolk) laid, as well as the mortality of the hens fed Eleutherococcus senticosus for 28 days.

It was hypothesized that Eleutherococcus senticosus would increase the number of eggs, the weight of the eggs, improve the quality of the eggs laid and decrease the mortality rate of the hens.

The study design is a two by two experimental design. The 1440 egg laying hens, which all came from the same breeding farm, were housed by Golden Lay at Whitelodge. Seven hundred and twenty hens made up the treatment groups receiving Eleutherococcus senticosus. Seven hundred and twenty hens made up the placebo groups receiving normal water. In the first week no medication was given to the treatment group. In the second, third, fourth, fifth week 300 ml of Eleutherococcus senticosus was introduced daily into the drinking water of the treatment group. The eggs were collected, counted and weighed manually on a daily basis. Once a week 72 eggs were collected randomly for quality testing (height of the albumin, colour of the egg yolk). The height of the albumin was measured by means of a tripod. The colour of the egg yolk was compared to the Roche colour chart. In the sixth and seventh week the treatment group received no medication.

Intergroup comparisons for the parameters measured were made using the Mann-Whitney's U-test.

The Mann-Whitney U-test showed no statistical increase between the number of the eggs laid by the placebo and the treatment group.

There was no significant difference in the weight of eggs between the placebo and treatment group.

Weeks 1 to 7 showed no significant difference between the placebo and treatment group with respect to the quality of the eggs (height of the albumin).

There was no significant difference between the placebo and the treatment group in the colour of the egg yolk.

The Mann-Whitney U-test indicated no statistical difference in the mortality rate of the hens between the placebo and the treatment

Intragroup comparisons for the parameters measured were made using the Wilcoxon's signed rank test.

The Wilcoxon signed rank test showed that there was no increase in the number of eggs laid within the weeks of the placebo group. The treatment group also showed no increase in the number of the eggs.

With respect to the weight of the eggs the Wilcoxon signed rank test showed an increase in the weight of the eggs of the placebo group

when weeks 2 and 5 were compared. The weight of the eggs of the treatment group also showed an increase when weeks 2 and 5 were compared.

The placebo group showed no increase in the quality of the eggs (height of the albumin). There was an increase in the quality (height of the albumin) of the eggs of the treatment group when weeks 1 and 7, 2 and 5 were compared.

The placebo group showed no significant difference in the colour of the egg yolk. The treatment group showed a significant difference in the of colour the egg yolk when weeks 1 and 4, 2 and 5 were compared.

The Wilcoxon signed rank test showed a decrease in the mortality rate within the placebo group. This was seen when weeks 1 and 7 and 4 and 7 were compared. The treatment group showed the same decrease in mortality when the weeks stated above were compared.

Two-sample two-tailed t-tests were done to compare the means of 5 sets of groups.

No significant difference was found between the placebo and treatment group with respect to the % henday production, feed intake, egg weight, egg output per hen per day and mortality.

The statistical analysis revealed that Eleutherococcus senticosus 3x did not increase the number and the weight of the eggs. There is an

improvement in the quality (height of the albumin and colour of the egg yolk) of the eggs. There was no decrease in the mortality rate. However further studies of Eleutherococcus senticosus could reveal its benefit in the immunostimulation of hens, hereby limiting their risk of infection.

TABLE OF CONTENTS

APPENDICES

LIST OF TABLES

LIST OF GRAPHS

LIST OF PHOTOGRAPHS

LIST OF DIAGRAMS

CHAPTER ONE

INTRODUCTION

The growth and automation of the commercial egg production industry have developed faster and progressed further than any other type of livestock production during a period of only about 40 years (Parkhurst, 1988 : 193). The estimated national egg production in cases per week in 1997 up to September was 215270. In 1996 it was 222073 and in 1995, 210236 (Strydom (personal communication 1997).) Mass production of chicken eggs has become a competitive enterprise. Several egg production concerns in the United States now have over two million birds on a single farm (Parkhurst, 1988: 194.)

Much research has been done to improve egg production and to prevent disease in chickens. For example, research was carried out using total sulfur amino acid (TSAA) in rations. This had no effect on egg production and feed consumption (Hartman, 1997). However mannanoligosaccharides a new feed ingredient for poultry has claimed to block colonization of pathogens, modulate immune response and provide nutrients that cannot be used by pathogens (Verwoerd, 1997). Another research was done optimizing yolk colour with chili and leucaena (Singh and Kopinski, 1992).

Several studies have been done on Eleutherococcus senticosus in the mother tincture. Most of the research was done in Russia (Brekhman, 1969). Some research has been done on chickens using

Eleutherococcus. For example from 1 to 14 day old chickens were fed on a basal diet alone or with 0,2 ml of Eleutherococcus extract per head daily. With the Eleutherococcus extract the body weight at 10, 20,30 and 60 days old was greater than with a basal diet alone. (Popov, 1992.) Another research was done whereby the growth-promoting extract of Eleutherococcus extract was given at 0,1 mg per head daily. This enhanced the immune response of chicks to nasal instillation of the La Sota of Newcastle disease virus.(Nikolaenko, 1988.) In a further study the number of eggs laid by hens fed Eleutherococcus senticosus for a month increased by 133% (Lyaputsina, 1980). The studies mentioned above all used the mother tincture of Eleutherococcus senticosus.

No study was found using the Homeopathic application of Eleutherococcus. Thus, the objective of this study was to evaluate the effects of Eleutherococcus senticosus 3x on the number of eggs, the weight of the eggs, the quality of the eggs, as well as the mortality of the hens fed Eleutherococcus senticosus 3x for 28 days.

CHAPTER TWO

REVIEW OF THE RELATED LITERATURE

2. Introduction

The poultry industry is without doubt one of the most effective branches of animal production and one where genetic improvement has been optimized (Ramsay,1997). It is also the most widely used animal protein in South Africa today particular in the rural areas where only limited electricity and refrigeration facilities exist and where there is a need for a product that has a long shelf life and is relatively inexpensive (Msane, 1995). Much research has been done to further optimize egg production and decrease mortality rates of hens. For example since antimicrobial drugs are not effective against viral diseases the only cost effective option is to prevent disease conditions from affecting the flock. Researchers are now investigating utilizing the natural defense mechanisms of hens for maximum disease prevention (Understanding Disease iv, 1995, p.55). It is the aim of the Agricultural Research Council (ARC) to develop a five year strategic plan for research development for the poultry industry. The State funds 70% of the total cost of research projects, while the industry contributes the remaining 30% (Buys,1997.)

2.1. Egg production

Egg production is essentially reproduction. The avian egg consists of a minute reproductive cell which is surrounded by yolk, albumen, shell membranes, shell and cuticle. The rate of egg production is simply the number of eggs that a bird lays over a period of time. Chickens lay eggs on successive days known as clutches. Most commercial laying hens produce between three to eight eggs per clutch. Once the clutch length is reached, the hen skips a day or more of ovulation and resultant egg production, then produces another clutch. Poor egg producers have a longer rest period between clutches than good producers do. Most hens lay successive eggs with time intervals of twenty three to twenty six hours (North, 1984 : 29.) Sexual maturity or egg-laying stage occurs at about 20 weeks (Graves, 1985 : 78). The average egg production for a commercial layer is 285 eggs per hen per year (Fourie *et al,* 1997).

2.2. Factors that influence egg production

Light, either natural or artificial, has a stimulating effect on the pituitary gland, forcing it to secret an increased quantity of the follicle stimulating hormone and lutinising hormone, which in turn, activates the ovary. The light stimulus is initiated when light falls on the eye of the chicken. Both the duration and intensity of light are important. (Phelps, 1990.)

Age , as hens age, on average they lay fewer but larger eggs. By about 72 weeks of age , egg production has decreased to 60-70 % (Appleby, 1992:31.)

Feed, the composition of the feed will determine to a large extent the rate of production and body weight of hens (North, 1984 : 518).

Water, the body of the hen is largely made up of water, with averages ranging from 60 to 75 percent. The egg that the hen lays contains about 65 percent water. The amount of water consumed by the hens is influenced by the salt content in the feed. High temperatures also increase the water intake by the hens. (Graves, 1985 : 83)

Temperature, extremes of hot or cold will result in a high mortality rate and a loss of egg production (Billet, 1993).

Housing, the number of hens per cage also influences the production of eggs, overcrowding will result in a loss of production. (Central Bureau Report, 1992).

Genetics, to improve the economical potential of the hens (Crawford, 1990 : 705).

2.3. Weight of the egg

The size of the egg is proportional to the weight of the egg. The first eggs laid during the production period are smaller than those laid later, egg size and therefore egg weight gradually increases as the hens age. Since eggs are marketed by weight classifications, the producer is extremely interested in the standards for the percentage of the eggs that fall into each size as the bird ages (North, 1984 : 282.)

Factors affecting egg weight :

Body weight of the hens, hens that do not attain their ideal body weight lay eggs smaller then normal.

Laying house temperatures above 26,7 degrees Celsius, depress egg size and therefore egg weight.

Strain of birds, egg size is a genetic trait ; thus it is possible to develop strains of chickens laying large or small eggs.

Age at the first egg, the older the pullet is when she lays her first egg, the larger the eggs during the laying period.

Laying ration, certain components of the laying ration will affect egg weight. Increases in protein percentage usually are associated with increases in egg weight if their has been a protein deficit in the feeding ration.

Yolk size, the size of the completed egg is more closely associated with yolk size than with any other factor, although variations in albumen secretions in the oviduct have some influence. Of the eggs produced at the beginning of the laying cycle, 22 to 25% of their total weight is yolk, while yolk comprises 30 to 35% of the weight of eggs laid by hens well advanced in their laying period. As egg size increases, yolk size increases more than the quantity of albumen (North, 1990 : 35.)

2.4. Quality of the eggs (height of albumin and colour of egg yolk)

The most widely used measure of albumin quality is the Haugh unit, a measure of the height of the albumen after correcting the reading for difference in egg weight. The US department of Agriculture in classifying eggs according to quality, states that to be grade AA, the Haugh unit index must be 72 or above. The albumen quality

deteriorates during hot weather and during the latter part of the laying period (North, 1984 : 291).

More sensitive measures of quality can be achieved using ultrasonic and nuclear magnetic resonance (Solomon, 1991: 36).
The most widely used method for the evaluation of yolk colour is the Roche Colour Fan (Solomon, 1991 : 35).
Hereby the egg yolk colour is measured by visual comparison, matching the yolk colour with various colours in the Roche Yolk Colour Fan, a series of plastic paddles with reference numbers from 1 to 15 (North, 1984 : 533).
Causes of yolk colour variations:

- Dietary xanthophylls, the quality and type of dietary xanthophylls cause a variation in yolk colour.
- Stress, reduces the amount of xanthophylls getting to the ovary.
- Fat in the diet, there is an increase in the xanthophyll absorption as fat in the diet is increased.
- Morbidity, disease reduces the bird's ability to absorb xanthophylls from the intestinal tract.
- Individual bird variation, the genetic capability to absorb and deposit xanthophylls in the egg yolk varies between hens within a single strain (North, 1990 : 680.)

The yolk colour must be deep enough to satisfy the consumer demand in the area and the albumin firm enough (Solomon, 1991: 35).

2.5. Mortality rate of hens

Disease is one of the factors causing a high mortality in hens.
Infectious coryza causes sneezing, watering of the eyes and discharge

from the nasal and sinus passages. Death loss from coryza is usually low, but continued infection in the laying flock creates a loss of appetite, and egg production drops (Cilliers, 1995.)

Newcastle disease, a highly contagious disease, results in respiratory difficulty, nervous disorder, reduction in egg production and egg shell quality and a high mortality rate (North, 1990 : 808). There are many more diseases causing a high mortality in hens.

Effective control measures to prevent disease can be accomplished by a rigid program of vaccination. A study showed that immunization can reduce the level of intestinal infection with Campylobacter jejuni (Widders, 1996). However, vaccines and vaccination procedures are highly variable and inefficiencies exist. Variations exist because :

- Season of the year influences the bird's acceptance of the vaccine
- Potency of the vaccine differs at the time of manufacture
- Strains of the virus differ with various vaccines
- Various vaccines differ in developmental stress of the birds
- Administration may not be uniform with each bird as the result of the method of administration
- Maternal immunity in the bird influences the degree of " take"
- Killed and live viruses are used to make vaccines
- Mode of administration of vaccine varies (spray, water, wing web, injection, eye drops)
- Newcastle disease vaccines are often mixed with vaccines used for other diseases, e.g., infectious bronchitis
- Deterioration of the vaccine causes wide variation in its efficacy

For the prevention of disease, regular procedures are required. These include stress prevention, good water supply, sanitation, dead bird

disposal, proper nutrition and parasite, lice, mite and rodent control (North, 1984 : 849.)

2.6. Eleutherococcus senticosus

Eleutherococcus senticosus is an Oriental plant, better known as Siberian Ginseng. It is a member of the family Araliaceae. Eleutherococcus senticosus grows in an area stretching from the Shansi and Habay provinces of North East China in the West to Sakhalin Island and Japan in the East, including Manchuria and Korea. (Collisson, 1991.)

The root contains glycosides, named eleutherosides, which are considered to be the principle active constituent responsible for the adaptogenic action. Their are seven main eleutherosides : A,B,B1,C,D,E,F. (Collisson, 1991.)

Adaptogens, first defined in the 1950's by Lazarev (cited by Wagner 1992) are substances that normalize body functions, strengthen systems and functions compromised by stress and have a protective effect against a wide variety of environmental and emotional stress. The principle action of an adaptogen is therefore its immunostimulant, anti-stressor, prophylactic and anti- toxic effect.

- Immunostimulant : specifically T lymphocytes, their production of y-interferon and activation of natural killer T cells and other components of the immune system.
- Antistressor : increases tolerance and endurance of stress, both physical and mental, as well as decreasing the incidence of the

harmful side-effects of the stress on the body.

- Prophylactic : has been demonstrated to reduce the incidence of many acute and chronic illnesses when taken regularly for prolonged periods of time.
- Anti-toxic : increases the body's tolerance of many of a chemical, biological and radioactive nature. (Collisson, 1991.)

2.7. Homoeopathic applications of Eleutherococcus senticosus

Much has been written about Eleutherococcus senticosus in its mother tincture. In an experiment a group of 54 miners working at the industrial association " Vorkuta-ugol " received Eleutherococcus extract (2 ml) before the shift daily over two months (June-July, 1976). The disease incidence dropped by 33.3% as regards the number of sick persons and by 45.6% as regards the number of disability days. (Kalashnikov, 1977.) Experiments were made on white mongrel male mice weighing 18-20 g on the effect of Eleutherococcus senticosus in mother tincture on physical endurance. The animals' working capacity was assessed according to the duration (min) of their climbing along an "endless" cord until complete exhaustion. Eleutherococcus senticosus in mother tincture was administered one hour before the experiment. The data obtained showed that Eleutherococcus extract (2.5 ml/kg) significantly increased the duration of the animals' working capacity to 145,8% as compared to control. (Kaplan [s.a.]). Lyaputsina (1980)(cited by Collisson 1991) found that Eleutherococcus senticosus increased sexual fertility. In experimental bulls given ground Eleutherococcus root in their feed, the volume of ejaculate increased by 10-35%. It was noticed that the number of eggs laid by hens fed Eleutherococcus

senticosus for a month increased by 133%. In the above stated cases the mother tincture of Eleutherococcus senticosus was given. No reference could be found using Eleutherococcus senticosus in potency.

CHAPTER THREE

MATERIALS AND METHODS

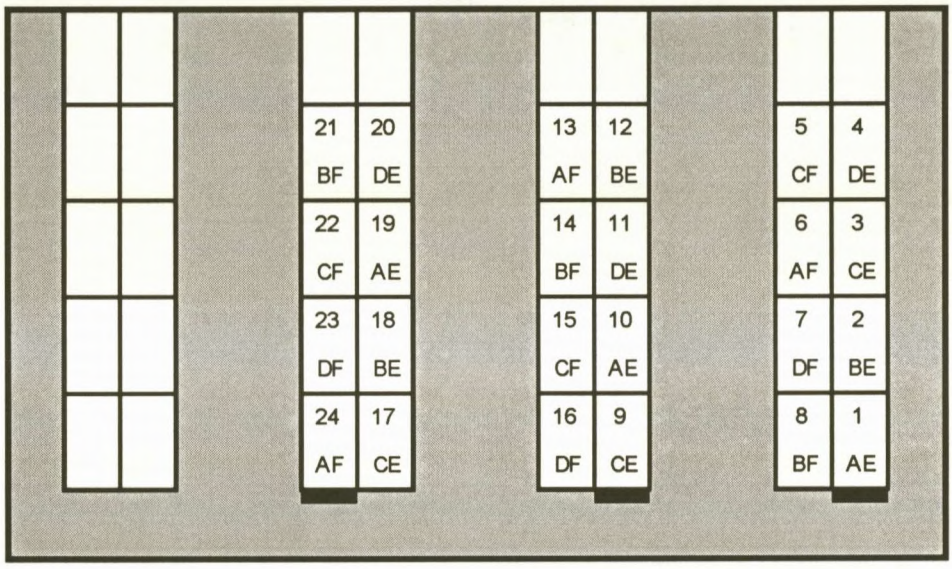
3.1. Study design

The objectives were to evaluate the effects of Eleutherococcus senticosus on the number of eggs, the weight, the quality of the eggs (height of the albumin; colour of the yolk) laid by the hens, as well as the mortality of the hens fed Eleutherococcus senticosus for 28 days.

One thousand four hundred and forty hens were housed by Golden Lay in a shed at Whitelodge. Three hens were housed in one cage. Sixty hens made up one block. Therefore, twenty cages each housing three hens, made up a block. The study consisted of twenty-four blocks. Of these twenty-four blocks, twelve blocks received Eleutherococcus senticosus 3x in their drinking water, while the remaining twelve blocks received normal water, thus being the placebo group. Each block of sixty hens was numbered. Blocks 1-4, 9-12, 17-20 made up the treatment groups receiving Eleutherococcus senticosus. Blocks 5-8, 13-16, 21-24 made the placebo groups receiving normal water. The treatment blocks were provided with six water tanks (i.e. one for the top row and one for the bottom row), in order to facilitate treatment of water with Eleutherococcus senticosus. One cage was left open between blocks. (See diagram 3.1.1.)

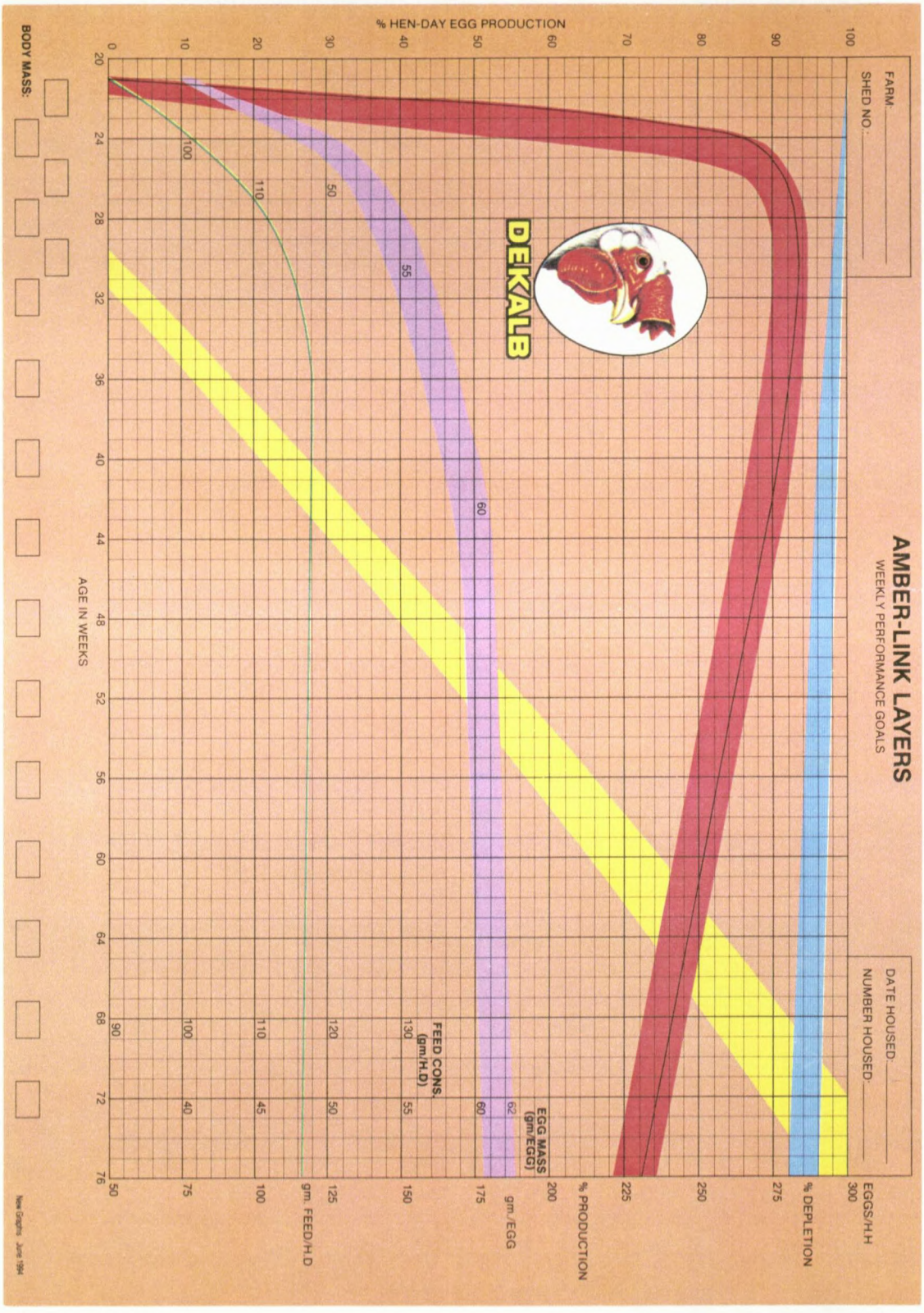
Diagram 3.1.1. shows the arrangement of the blocks in shed 5.

- E : Treatment group (Eleutherococcus senticosus)
- F : Placebo group
- A : Meadow : Pietermaritzburg - standard rations
- B : Epol : Pietermaritzburg - standard rations
- C : Moreland : Maidstone - standard rations
- D : Meadow : Pietermaritzburg - standard rations
- ▬ : Water tanks



The period (8 weeks) between housing the hens and the commencement of the research was used for the hens to settle in their new environment and for the egg production to stabilize. The other reason being, that at the age of 27 weeks or older the hens egg production was expected to lie within certain parameters of a standard graph used by Golden Lay. (See graph 3.1.2.)

Graph 3.1.2. Show the expected weekly performance goals of the number of eggs, weight of the eggs and the feed intake.



3.2. The subjects

For the purpose of this study hens meant those egg laying hens that were 27 weeks and older. All the 1440 hens came from the same breeding farm. The breed is Amber-link.

3.3. Interventions

The treatment groups (blocks 1-4, 9-12, 17-24) received no Eleutherococcus senticosus in the first week, so that a base for the study could be established. The week was also used for the preparation of the first batch of medication. Eleutherococcus senticosus was introduced in the second, third , fourth and fifth week into the water of the treatment groups. No medication was given to the treatment blocks in the sixth and seventh week. This was done to establish whether Eleutherococcus senticosus had any long term effects on the number, weight, quality of the eggs laid, as well as the mortality of the hens once Eleutherococcus senticosus was discontinued. The placebo groups (blocks 5-8, 13-16, 21-24) received no medication in their water throughout the study.

Twice a week the medication was brought to the farm. This had to be done as water and not alcohol was used in the final preparation of the medication.

For the purpose of the preparation of Eleutherococcus senticosus 3x from mother tincture, 150 ml amber bottles were used throughout. Thirty ml of Eleutherococcus senticosus mother tincture was placed into each of the two 150 ml amber bottles. Seventy ml of 30 % alcohol was

then added to both the bottles containing 30 ml of Eleutherococcus senticosus mother tincture. Both bottles were succussed 100x. This resulted in two bottles of Eleutherococcus senticosus 1x. The bottles were labeled 1x. Fifteen 150 ml bottles were then filled with each 10 ml of 1x and 90 ml of 15 % alcohol and then each succussed 100x. This resulted in 15 bottles of 2x that were labeled. Finally, 126 bottles were each filled with 10 ml of Eleutherococcus senticosus 2x and 90 ml of distilled water and succussed 100x resulting in Eleutherococcus senticosus 3x. The bottles were labeled 3x.

Three hundred ml of Eleutherococcus senticosus 3x was introduced daily into each of the six three liter tanks for four weeks. Water consumption exceeds the capacity of the six three liter tanks per day. The mother tincture was prepared according to method 19 e of the German Homoeopathic Pharmacopoeia. (British Homoeopathic Association, 1991 : 401)

3.4. Measurements and other observations

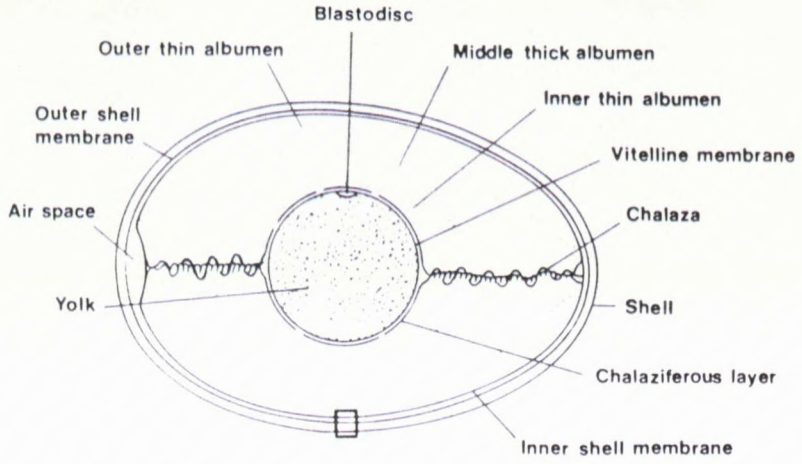
During the weeks prior to the commencement of the study only the number of eggs and the weight of the eggs was noted by the Golden Lay staff. This study began when the hens reached the age of 27 weeks. For the first week the number, the weight and the quality of the eggs (height of the albumin; colour of the yolk) was measured. The number of eggs laid by the hens in their respective blocks were counted manually every day throughout the 7 weeks of the study. The eggs of each block were then weighed on a scale. Once a week over the period of the 7 weeks, 72 eggs were collected for the measurement of the quality of the eggs. Three eggs were randomly collected from each

block. The same day the fresh eggs were brought to the Golden Lay pack station where their quality was tested [height of the albumin and colour of the yolk] based on the method of Haugh (1937) (cited by Stadelman 1986). This was done by weighing each egg first. After the weight was noted, the egg was cracked open on a rectangular mirror. The colour of the egg yolk was measured by visual comparison, matching the yolk colour with various colours in the Roche Yolk Colour Fan, a series of plastic paddles with reference numbers from 1 to 15 (North, 1984 : 533).

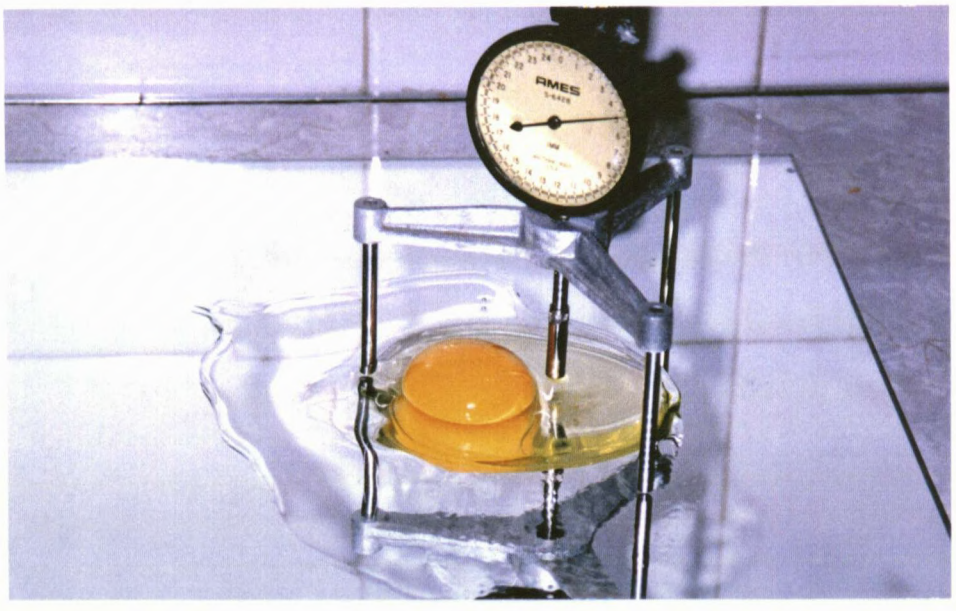
Photograph 3.4.1. shows the Roche Yolk Colour Fan which is used to test the quality of the egg yolk.

The height of the albumin was measured by placing a tripod over the egg albumin and lowering the contact arm of the tripod on to the albumin. Care had to be taken not to get a reading with the contact arm touching the chalaza, otherwise the reading would be too high.

Diagram 3.4.2. shows the egg shell formation and quality including the chalaza (Wells *et al*, 1987 : 124).



Photograph 3.4.3. shows a tripod which is used to measure the height of the albumin.



The Haught unit is an expression relating egg weight and height of thick albumin. The higher the Haught value, the better the albumin quality of the egg.

$$\text{Haugh units} = 100\log\left[H - \frac{\sqrt{G}\left(30\text{W}^{0.37}\right)}{100} + 1.9\right]$$

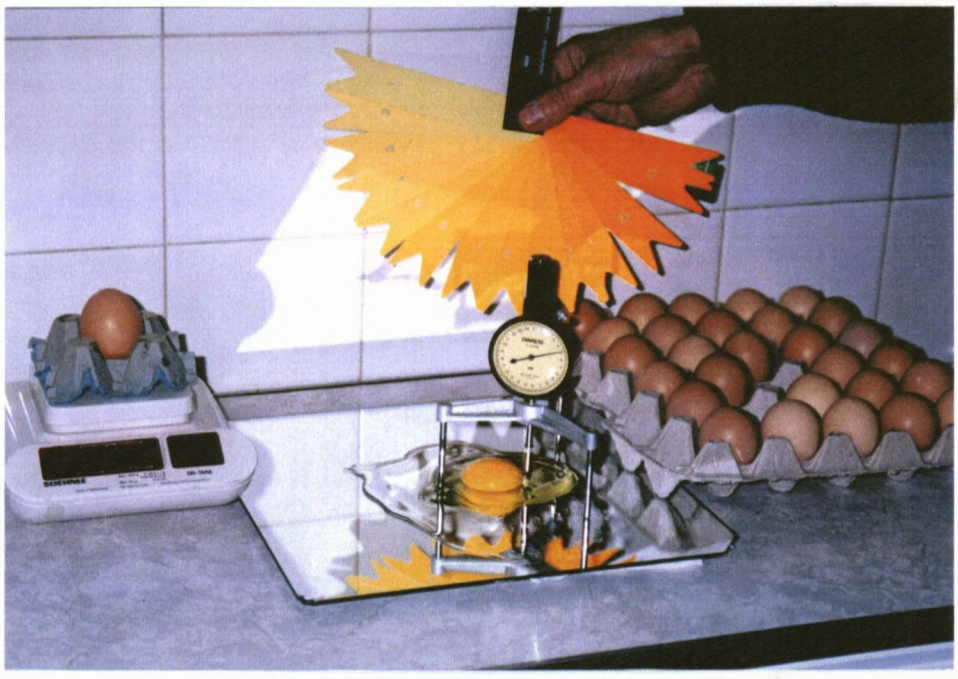
H : albumin height (millimeters)

G : 32.2

W : weight of egg (grams)

The expression $\frac{\sqrt{G}(30W^{0.37})}{100} + 1.9$ equals zero when the egg weight is 56.7g. (Stadelman, 1986 : 55 - 57)

Photograph 3.4.4. depicts the objects used for quality testing (scale, rectangular mirror, tripod and Roche Yolk Colour Fan).



3.5. Statistical procedures for assessment of data are selected

The sampling units were 24 groups of 60 hens. Twelve groups made up the placebo group, and the remaining groups made up the treatment group. The sample size per group was small (12< 30), in which case non-parametric tests had to be used for the analysis.

Procedure 1:

Comparison between groups 1 and 2

The Mann-Whitney Unpaired test was used to compare groups 1 and 2. The two groups were treated as being independent of one another (unpaired). The purpose was to find out whether there was significant difference between the two groups at the alpha = 0.05 level of significance.

Hypothesis testing and decision rule :

The null hypothesis H_o states that there is no significant difference between the placebo and the treatment group with respect to the variable of interest. The alternative hypothesis H_1 states the contrary of what the null hypothesis does.

$H_o : \mu_1 = \mu_2$

$H_1 : \mu_1$ and μ_2 are significantly different from each other.

$\alpha = 0.05$ = level of significance of test

Decision rule :

Reject H_o if $P < \frac{\alpha}{2} = 0.05 = 0.025$

Accept H_o if $P \geq \frac{\alpha}{2} = 0.05 = 0.025$

P is the observed probability value (Gulezian, 1979 : 335.)

Procedure 2 :

Wilcoxon's signed rank test was used within group 1 to find out whether there was any significant increase or decrease with respect to the variable of interest. All tests were done at the alpha = 0.05 level.

Hypothesis testing and decision rule :

The null hypothesis H_o states that there is no significant improvement between weeks 1 and 4, 1 and 7, 2 and 5, and 4 and 7, within the placebo group with respect to the variable of interest.
The alternative hypothesis H_1 states the contrary of what the null hypothesis does.

$H_o : \mu_1 = \mu_2$

$H_1 : \mu_1$ and μ_2 are significantly different from each other.

$\alpha = 0.05$ = level of significance of test

Decision rule :

Reject H_o if $P < \frac{\alpha}{2} = 0.05 = 0.025$

Accept H_o if $P \geq \frac{\alpha}{2} = 0.05 = 0.025$

P is the observed probability value (Gulezian, 1979 : 335.)

Procedure 3 :

Wilcoxon's signed rank test was used within group 2 to find out whether there was any significant increase or decrease with respect to the variable of interest. All tests were done at the alpha = 0.05 level.

Hypothesis testing and decision rule :

The null hypothesis H_o states that there is no significant improvement between weeks 1 and 4, 1 and 7, 2 and 5, and 4 and 7, within the treatment group with respect to the variable of interest.
The alternative hypothesis H_1 states the contrary of what the null hypothesis does.

$H_o : \mu_1 = \mu_2$

$H_1 : \mu_1$ and μ_2 are significantly different from each other.

$\alpha = 0.05$ = level of significance of test

Decision rule :

Reject H_o if $P < \frac{\alpha}{2} = 0.05 = 0.025$

Accept H_o if $P \geq \frac{\alpha}{2} = 0.05 = 0.025$

P is the observed probability value (Gulezian, 1979 : 335.)

Procedure 4 :

Two-sample unpaired two-tailed t-tests were done to compare the means (average values) of five sets of groups at the = 0.05 level of significance. These five sets of groups include only data gathered from the number of live hens in each group.

Ho : The two samples come from the same parent population.

H1 : Not Ho

$\alpha = 0.05$

Decision rule

1. Reject Ho if the observed p-value < = 0.025
2. Accept Ho if p 0.025

Procedure 5 :

Summery statistics (mean, mode, median, standard error, the coefficient of variation) was obtained.

Procedure 6:

Bar charts were constructed to present major findings of the study as a visual summary. The bar charts were able to give a visual summery of the results obtained from the Mann-Whitney and Wilcoxon's signed rank tests. Barcharts were made using the package Microsoft works.

Statistical package

The statistical package STATGRAPHICS version 6 + was used for data entry and analysis.

CHAPTER FOUR

RESULTS

4.1. Criteria for the admissibility of the data

Only the data collected by the Golden Lay staff and the researcher was used.

4.2. The summary statistics of the variable of interest is found in the appendix.

4.3. The number of eggs

The values in Table 4.3.1. represent the difference in the number of eggs laid within the placebo group. (Wilcoxon signed rank test)

WEEKS	P-Value	$\frac{\alpha}{2}$	Decision Made
1&4	0.38	0.025	accept Ho
1&7	0.78	0.025	accept Ho
2&5	0.04	0.025	accept Ho
4&7	0.1	0.025	accept Ho

Note : The treatment group received no Eleutherococcus senticosus in weeks 1,6,7.

Ho : Null hypothesis

The results from Table 4.3.1. show :

There is no significant increase in weeks 1 and 4, 1 and 7, 2 and 5 and 4 and 7 with respect to the number of eggs laid by the placebo group.

The values in this Table 4.3.2. represent the difference in the number of eggs within the treatment group. (Wilcoxon signed rank test)

WEEKS	P-Value	$\frac{\alpha}{2}$	Decision Made
1&4	0.1	0.025	accept Ho
1&7	0.14	0.025	accept Ho
2&5	0.78	0.025	accept Ho
4&7	0.38	0.025	accept Ho

Note : The treatment group received no Eleutherococcus senticosus in weeks 1,6,7.

Ho : Null hypothesis

The results from Table 4.3.2. show :

There is no significant increase in the number of eggs between weeks 1 and 4, 1 and 7, 2 and 5, and 4 and 7 with respect to the treatment group.

The values in Table 4.3.3. represent the difference in the number of eggs laid between the placebo and treatment group. (Mann-Whitney Unpaired T-test)

Weeks	P-Value	$\frac{\alpha}{2}$	Decision Made
1	0.98	0.025	accept Ho
2	0.48	0.025	accept Ho
3	0.84	0.025	accept Ho
4	0.8	0.025	accept Ho
5	1	0.025	accept Ho
6	0.42	0.025	accept Ho
7	0.1	0.025	accept Ho

Note : The treatment group received no Eleutherococcus senticosus in weeks 1,6,7.

Ho : Null hypothesis

The results from Table 4.3.3. show :

There is no statistical significance between the number of eggs laid by the placebo and the treatment groups in weeks 1,2,3,4,5,6,7.

The values in Table 4.3.4. represent the % henday production and the egg output per hen per day. (Two-sample unpaired two-tailed t-test)

	P-Value	$\frac{\alpha}{2}$	Decision Made
% henday production	0.84	0.025	accept Ho
egg output per hen per day	0.72	0.025	accept Ho

The results from table 4.3.4. show :

i) There is no significant difference between the % henday production of the placebo and treatment group.

ii) There is no significant difference between the egg output per hen per day of the placebo and treatment group.

WEEKS		AVERAGE	MEDIAN	MODE	STANDARD ERROR	MIN	MAX	RANGE
1	P	18555.5	19026.5	18797	506.8	15128	20710	5582
	T	18241.42	18594.5	18011	451.72	14913	20034	5121
2	P	18338.42	18186.5	17654	417.05	16333	20390	4057
	T	18181.66	17953.5	17865	246.12	17077	19733	2656
3	P	18713.92	18953.5	18918	400.3	16333	20750	4417
	T	18689.33	19034.5	18806	299.61	16815	19870	3055
4	P	18263.75	18498	18392	661.09	14049	21675	7626
	T	18576.58	19121	19029	358.52	15568	19812	4244
5	P	19287.16	19351.5	19268	223.23	17580	20290	2710
	T	19287.16	19351.5	19268	223.23	17580	20290	2710
6	P	18559.16	18650	18516	359.17	15705	20312	4607
	T	17396	18252.5	18208	793.05	11402	20126	8724
7	P	19397.16	19406	19347	301.64	17794	21268	3474
	T	18147.92	18582	18493	539.35	14930	20551	5621

P: Placebo T: Treatment

Summary Statistics-Weight of Eggs

4.4 The weight of the eggs

The following Table 4.4.1. shows the difference in the weight of the eggs within the placebo group. (Wilcoxon signed rank test)

WEEKS	P-Value	$\frac{\alpha}{2}$	Decision Made
1&4	0.78	0.025	accept Ho
1&7	0.78	0.025	accept Ho
2&5	0.00	0.025	reject Ho
4&7	0.38	0.025	accept Ho

Note : The treatment group received no Eleutherococcus senticosus in weeks 1,6,7.

Ho : Null hypothesis

The results from Table 4.4.1. show :

i) There is no significant increase in the weight of the eggs between weeks 1 and 4, 1 and 7, and 4 and 7 with respect to the placebo group.

ii) There is a significant increase in the weight of the eggs between weeks 2 and 5 with respect to the placebo group.

The following Table 4.4.2. shows the difference in the weight of the eggs within the treatment group. (Wilcoxon signed rank test)

WEEKS	P-Value	$\frac{\alpha}{2}$	Decision Made
1&4	0.78	0.025	accept Ho
1&7	0.78	0.025	accept Ho
2&5	0.00	0.025	reject Ho
4&7	0.78	0.025	accept Ho

Note : The treatment group received no Eleutherococcus senticosus in weeks 1,6,7.

Ho : Null hypothesis

The results from Table 4.4.2. show :

i) There is no significant increase in the weight of the eggs between weeks 1 and 4, 1 and 7, and 4 and 7 with respect to the treatment group.

ii) There is a significant increase in the weight of the eggs between weeks 2 and 5 with respect to the treatment group.

The values in Table 4.4.3. represent the difference in the weight of eggs laid between the placebo and treatment group. (Mann-Whitney Unpaired T-test)

Weeks	Mann-Whitney	α 2	Decision Made
1	0.62	0.025	accept Ho
2	1	0.025	accept Ho
3	0.1	0.025	accept Ho
4	0.8	0.025	accept Ho
5	0.88	0.025	accept Ho
6	0.5	0.025	accept Ho
7	0.12	0.025	accept Ho

Note : The treatment group received no Eleutherococcus senticosus in weeks 1,6,7.

Ho : Null hypothesis

The results from Table 4.4.3. show :

There is no statistical significance between the weight of eggs laid by the placebo and the treatment groups in weeks 1,2,3,4,5,6,7.

The values from Table 4.4.4. represent the comparison with respect to the egg weight of the placebo and treatment group. (Two-sample unpaired two-tailed t-test)

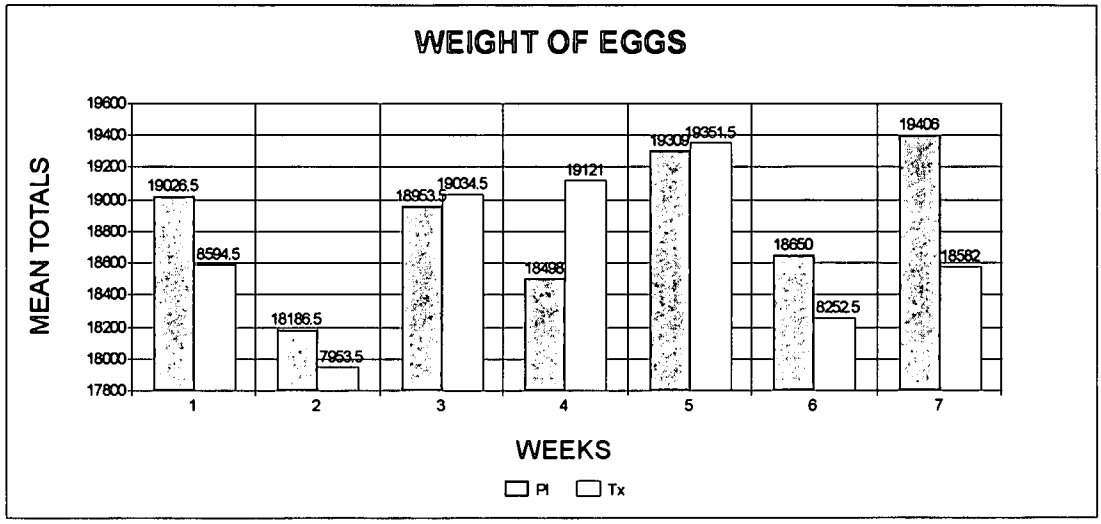
	P-Value	$\frac{\alpha}{2}$	Decision Made
egg weight	0.04	0.025	accept Ho

The results from Table 4.4.4. show :

There is no significant difference between the placebo and treatment group with respect to the weight of the eggs.

The following Figure 4.4.5. is derived from the median values in the summery statistics and it demonstrates the difference in the weight of the eggs between the placebo and treatment groups.

Note: The treatment groups in weeks 1,6,7 received no Eleutherococcus.



4.5. Quality of the eggs

4.5.1. Height of The Albumin

Table 4.5.1.1. below shows the difference in the quality of the eggs within the placebo group. (Wilcoxon signed rank test)

WEEKS	P-Value	$\frac{\alpha}{2}$	Decision Made
1&4	0.38	0.025	accept Ho
1&7	0.14	0.025	accept Ho
2&5	0.78	0.025	accept Ho
4&7	0.14	0.025	accept Ho

Note : The treatment group received no Eleutherococcus senticosus in weeks 1,6,7.

Ho : Null hypothesis

The results from Table 4.5.1.1. show :

There is no improvement in the quality (height of the albumin) of the eggs between weeks 1 and 4, 1 and 7, 2 and 5, and 4 and 7 with respect to the placebo group.

The following Table 4.5.1.2. shows the difference in the quality of the eggs within the treatment group. (Wilcoxon signed rank test)

WEEKS	P-Value	$\frac{\alpha}{2}$	Decision Made
1&4	0.78	0.025	accept Ho
1&7	0.00	0.025	reject Ho
2&5	0.00	0.025	reject Ho
4&7	0.14	0.025	accept Ho

Note : The treatment group received no Eleutherococcus senticosus in weeks 1,6,7.

Ho : Null hypothesis

The results from Table 4.5.1.2. show :

i) There is no improvement in the quality (height of the albumin) of the eggs between weeks 1 and 4,and 4 and 7 with respect to the treatment group.

ii) There is a significant improvement in the quality (height of the albumin) of the eggs between weeks 1 and 7, and 2 and 5 with respect to the treatment group.

The values in Table 4.5.1.3. represent the difference in the quality (height of the albumin) of eggs laid between the placebo and treatment group.

(Mann-Whitney Unpaired T-test)

Weeks	Mann-Whitney	$\frac{\alpha}{2}$	Decision Made
1	0.34	0.025	accept Ho
2	0.48	0.025	accept Ho
3	0.06	0.025	accept Ho
4	0.5	0.025	accept Ho
5	0.66	0.025	accept Ho
6	0.06	0.025	accept Ho
7	0.44	0.025	accept Ho

Note : The treatment group received no Eleutherococcus senticosus in weeks 1,6,7.

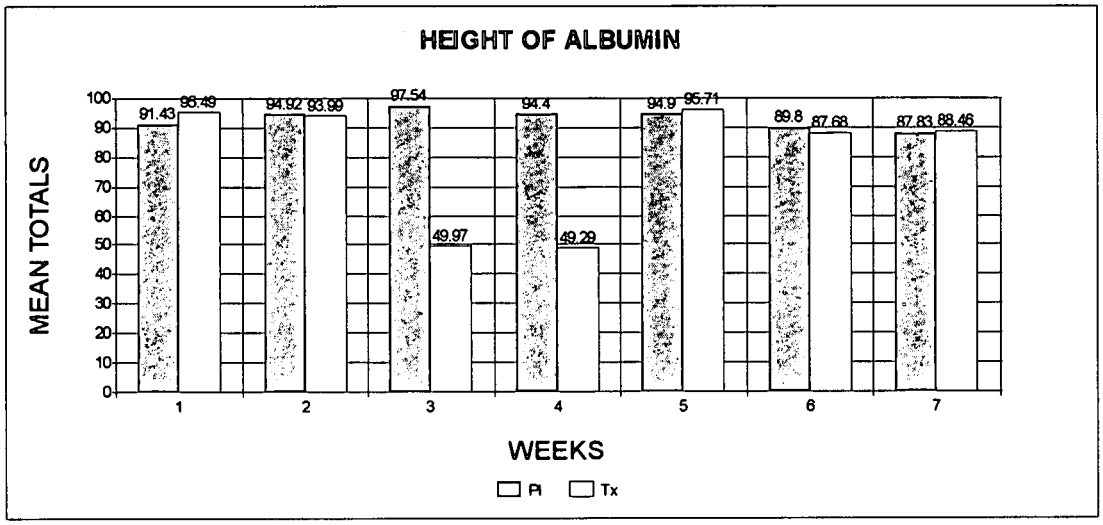
H_o : Null hypothesis

The results from Table 4.5.1.3. show :

There is no statistical significance between the quality (height of the albumin) of eggs laid by the placebo and the treatment groups with respect to weeks 1,2,3,4,5,6,7.

The following Figure 4.5.1.4. is derived from the median values in the summary statistics and it demonstrates the difference in the quality of the eggs (height of the albumin) of the placebo and treatment groups.

Note: The treatment groups of week 1,6,7 received no Eleutherococcus.



4.5.2 Colour of egg yolk

The values in this Table 4.5.2.1. reflect the difference in the colour of the yolk within the placebo group. (Wilcoxon signed rank test)

WEEKS	P-Value	$\frac{\alpha}{2}$	Decision Made
1&4	0.78	0.025	accept Ho
1&7	0.54	0.025	accept Ho
2&5	0.76	0.025	accept Ho
4&7	0.54	0.025	accept Ho

Note : The treatment group received no Eleutherococcus senticosus in weeks 1,6,7.

Ho : Null hypothesis

The results from Table 4.5.2.1. show :

There is no improvement in the quality (colour of the albumin) of the eggs between weeks 1 and 4, 1 and 7, 2 and 5, and 4 and 7 with respect to the placebo group.

The values in this Table 4.5.2.2. reflect the difference in the colour of the yolk within the treatment group. (Wilcoxon signed rank test)

WEEKS	P-Value	$\frac{\alpha}{2}$	Decision Made
1&4	0.78	0.025	accept Ho
1&7	0.00	0.025	reject Ho
2&5	0.00	0.025	reject Ho
4&7	0.14	0.025	accept Ho

Note : The treatment group received no Eleutherococcus senticosus in weeks 1,6,7.

Ho : Null hypothesis

The results from Table 4.5.2.2. show :

i) There is no improvement in the quality (colour of the albumin) of the eggs between weeks 1 and 4, and 4 and 7 with respect to the treatment group.

ii) There is an improvement in the quality (colour of the albumin) of the eggs between weeks 1 and 7, and 2 and 5 with respect to the treatment group.

The values in Table 4.5.2.3. represent the difference in the quality (colour of the egg yolk) of eggs laid between the placebo and treatment group.

(Mann-Whitney Unpaired T-test)

Weeks	Mann-Whitney	α 2	Decision Made
1	0.16	0.025	accept Ho
2	0.3	0.025	accept Ho
3	0.2	0.025	accept Ho
4	0.78	0.025	accept Ho
5	0.08	0.025	accept Ho
6	0.42	0.025	accept Ho
7	0.56	0.025	accept Ho

Note : The treatment group received no Eleutherococcus senticosus in weeks 1,6,7.

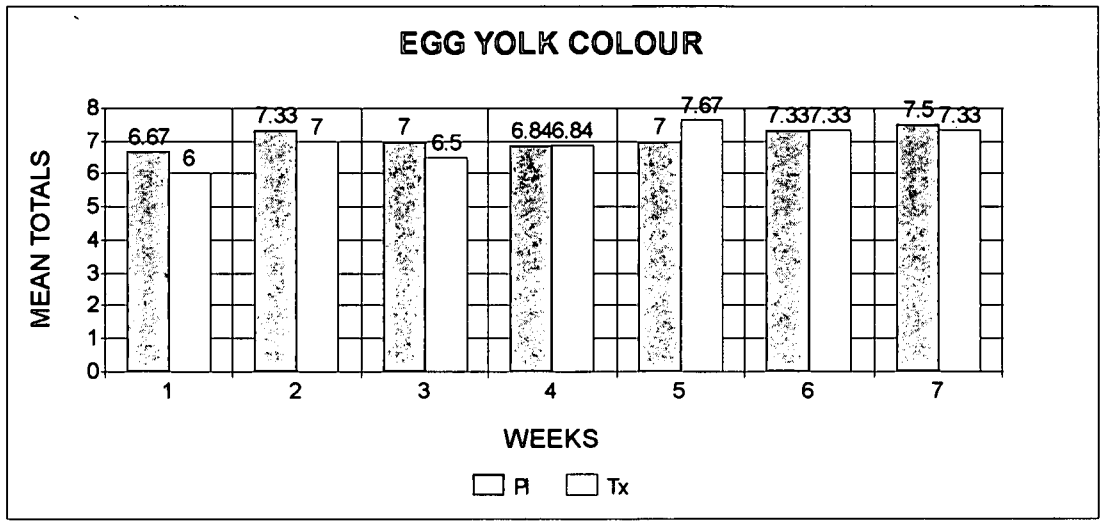
Ho : Null hypothesis

The results from Table 4.5.2.3. show :

There is no statistical significance between the quality (colour of the egg yolk) of the eggs laid by the placebo and the treatment groups with respect to weeks 1,2,3,4,5,6,7.

The following Figure 4.5.2.4. is derived from the median values in the summary statistics and it reflects the difference in the colour of the egg yolk of the placebo and treatment group.

Note: The treatment groups in weeks 1,6,7 received no Eleutherococcus senticosus



4.6 Mortality rate

Table 4.6.1. shows the difference in the mortality rate within the placebo group. (Wilcoxon signed rank test)

WEEKS	P-Value	$\frac{\alpha}{2}$	Decision Made
1&4	0.04	0.025	accept Ho
1&7	0.00	0.025	reject Ho
2&5	0.04	0.025	accept Ho
4&7	0.00	0.025	reject Ho

Note : The treatment group received no Eleutherococcus senticosus in weeks 1,6,7.

Ho : Null hypothesis

The results from Table 4.6.1. show :

There is an increase in the mortality rate of the placebo group between weeks 1 and 4, 1 and 7, 2 and 5, and 4 and 7.

Table 4.6.2. shows the difference in the mortality rate within the treatment group. (Wilcoxon signed rank test)

WEEKS	P-Value	$\frac{\alpha}{2}$	Decision Made
1&4	0.04	0.025	accept Ho
1&7	0.00	0.025	reject Ho
2&5	0.04	0.025	accept Ho
4&7	0.02	0.025	reject Ho

Note : The treatment group received no Eleutherococcus senticosus in weeks 1,6,7.

Ho : Null hypothesis

The results from Table 4.6.2. show :

There is an increase in the mortality rate of the treatment groups between weeks 1 and 4, 1 and 7, 2 and 5 , 4 and 7.

The values in Table 4.6.3. represent the difference in the mortality rate of the hens between the placebo and treatment group. (Mann-Whitney Unpaired T-test)

Weeks	Mann-Whitney	$\frac{\alpha}{2}$	Decision Made
1	0.58	0.025	accept Ho
2	0.74	0.025	accept Ho
3	0.8	0.025	accept Ho
4	0.98	0.025	accept Ho
5	1	0.025	accept Ho
6	0.48	0.025	accept Ho
7	0.62	0.025	accept Ho

Note : The treatment group received no Eleutherococcus senticosus in weeks 1,6,7.

Ho : Null hypothesis

The results from Table 4.6.3.show :

There is no statistical significance in the mortality rate of the hens between the placebo and the treatment groups with respect to weeks 1,2,3,4,5,6,7.

The values from Table 4.6.4. represent the comparison with respect to the mortality rates of the placebo and the treatment group. (Two-sample two-tailed t-test)

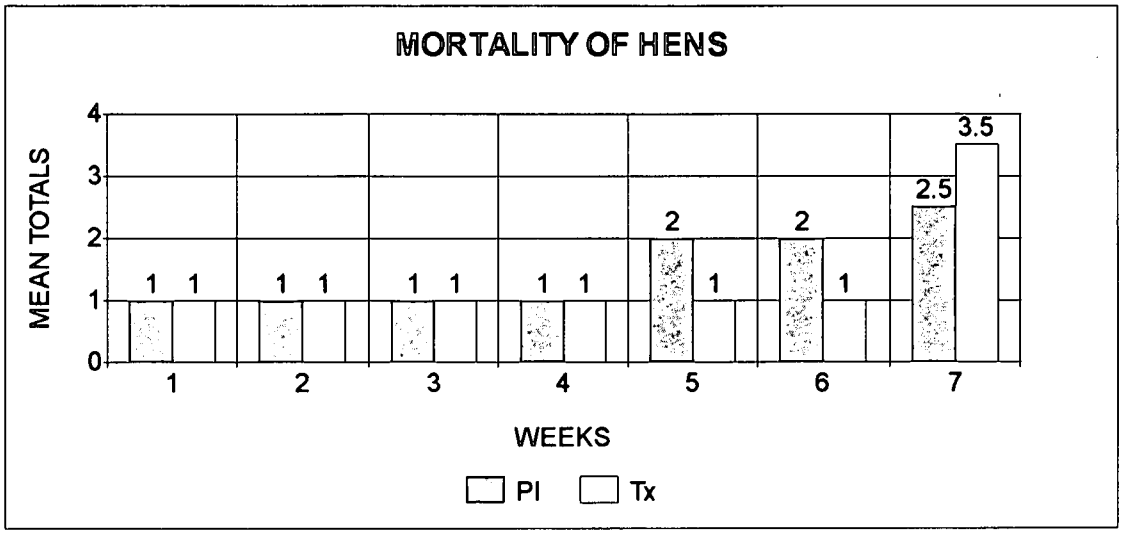
	P-Value	$\frac{\alpha}{2}$	Decision Made
mortality	0.85	0.025	accept Ho

The results from Table 4.6.4. show :

There is no significant difference between the mortality of the placebo and treatment group.

The following Figure 4.6.5. is derived from the median values in the summery statistics and it compares the mortality of the hens of the treatment and placebo groups.

Note: The treatment groups of weeks 1,6,7 received no Eleutherococcus senticosus.



CHAPTER FIVE

DISCUSSION

The study was designed to evaluate the effects of Eleutherococcus senticosus 3x on the number of eggs, the weight, the quality of the eggs (height of the albumin; colour of the yolk) laid by the hens, as well as the mortality of the hens fed Eleutherococcus senticosus for 28 days.

5.1. The number of eggs

The results of the Mann Whitney Unpaired T-test, the Wilcoxon signed rank test and the % henday production showed that there was no significant difference between the placebo and treatment group with respect to the number of eggs laid by the hens. (see table 4.3.1., 4.3.2. and 4.3.3.) The study does thus not support the hypothesis. The ability of Eleutherococcus extract to produce a beneficial effect on sexual cells and embryogenesis of agricultural animals and poultry is of a great scientific and practical importance (Lyaputsina, 1980). Eleutherococcus senticosus has shown to increase sexual vitality when used in the mother tincture (Collisson, 1991). The possible reason that there was no substantial increase in the number of eggs laid by the treatment group is that Eleutherococcus was administered in potency. Another possible reason is that the battery hens in South Africa are laying close to their physiological limit. It can be speculated that this was not the case in Russia where the egg production increased 133%

when hens were fed Eleutherococcus for a month.

Weight of eggs

The Wilcoxon signed rank test showed that there was an increase in the weight of the eggs for both the placebo and treatment groups between the second and fifth week (see table 4.4.1. and 4.4.2.) .The reason for this is that the first eggs laid during the production period are smaller than those laid later, egg size and therefore egg weight gradually increases as the hens continue to lay (North, 1990 : 345). The Mann Whitney Unpaired T-test and the two sample two-tailed t-test showed that there was no significant difference between the weight of the eggs of the placebo and treatment group. (see table 4.4.3. and) The study does thus not support the hypothesis.

Height of albumin

There was no change in the height of the albumin for the placebo group (see table 4.5.1.1.). The treatment group showed a significant change in the height of the albumin when weeks one and seven, two and five were compared (see table 4.5.1.2.). It is not known that Eleutherococcus senticosus has an affect on the height of the albumin. However Eleutherococcus has been proven as a stimulant of protein synthesis in the pancreas, liver and adrenal cortex (Wagner, !992). The solid portion of the albumin is almost entirely protein. (North, 1984 : 37)

Colour of the egg yolk

The placebo group showed no change in the yolk colour of the eggs (see table 4.4.2.1.). There was a change in the yolk colour of the

treatment group when weeks one and seven and two and five were compared (see table 4.4.2.2.). It is not known that Eleutherococcus senticosus has an affect on the egg yolk colour. The quantity and type of dietary xanthophylls in the feed are the main contributors to yolk colour (North, 1984 : 531)

Mortality rate

The Wilcoxon signed rank test showed that there was a decrease in the mortality rate of both the placebo and treatment group when weeks one and seven and weeks four and seven were compared. (see table 4.5.1. and 4.5.2.). As both the placebo and the treatment group showed a decrease in the mortality in the above mentioned weeks it cannot be deduced that Eleutherococcus senticosus 3x had an effect on the mortality rate. The Mann Whitney Unpaired T-test and the two sample two-tailed t-test showed that there was no significant difference in the mortality rate between the placebo and treatment group (see table 4.5.3.). The hypothesis with respect to the mortality rate is therefore rejected.

Eleutherococcus senticosus's principal action is to increase the biological resistance of the body in the face of adverse conditions, such as in infections (Collisson, 1991). It is said to have a direct antivirus activity which is manifested in the capacity of the drug to retard the growth of viruses in mammalian cell cultures (Wacker and *et al*, 1978). The hypothesis is therefore rejected. Eleutherococcus senticosus did not decrease the mortality rate of the hens. The results can be

explained as Eleutherococcus senticosus was not administered in mother tincture, but in potency. The length of administration (four weeks) was possibly too short. Eleutherococcus senticosus has been used prophylactically to reduce the incidence of many acute and chronic illnesses when taken regularly for prolonged periods of time (Collinson, 1991).

CHAPTER SIX

CONCLUSION AND RECOMMENDATIONS

6.1. Conclusion

Eleutherococcus senticosus 3x was not found to be effective in increasing the number of eggs, the weight of the eggs and decreasing the mortality rate of the hens when administered over a period of 28 days.

There was an improvement in the quality of the eggs (height of albumin and colour of the egg yolk) of the treatment group when weeks 1 and 7 and 2 and 5 were compared.

Eleutherococcus senticosus 3x may therefore not be considered an effective method of increasing the number of eggs, the weight of the eggs and decreasing the mortality rate.

6.2. Recommendations

As the phytotherapeutic dilution of Eleutherococcus senticosus 3x was not effective in increasing the number of eggs laid, it is not recommended as a potency for the stimulation and increase of sexual fertility. However future studies could increase the length of administration to provide a deeper and more complete action. Such studies could also include a comparison of Eleutherococcus mother tincture and that of a 1x,2x,3x potency.

With respect to the mortality rate, Eleutherococcus senticosus 3x was not effective in reducing the number of hens that died. Again it is not recommended to use a dilution of Eleutherococcus senticosus 3x in the prevention of disease. However longer periods of administration of Eleutherococcus senticosus 3x could be monitored to establish whether a dilution of 3x has a prophylactic potential. Further studies could include a comparison between the mother tincture and the potency of Eleutherococcus in treating diseased chickens.

REFERENCES

Appleby, M.C.,B.O. Hughes and H.A. Elson 1992. Poultry Production Systems (Behavior ,Management and Welfare) Wallingford, Oxon. : Commonwealth Agricultural Bureaux. 238 p. (ISBN : 0-85198-797-4)

Billet, R. 1993. Keep stress low for better profits. Farmer's Weekly. 29 Jan. , 45

Brekhman, I.I. 1968. Eleutherococcus. Leningrad : Nauka Publishers, 186 p.

Buys, S.B. 1997. Research Priorities for the Poultry Industry. Poultry Bulletin. Feb., 66

Central Bureau Report. 1992. Why hens don't lay enough. Farmer' Weekly. 17 July, 41

Cilliers, J.A. 1995. Drops in egg production and poor layer performance : a systematic approach. Poultry Bulletin. March, 90-93

Collisson, R.J. 1991. Siberian Ginseng (Eleutherococcus senticosus Maxim.). British Journal of Phytotherapy, 2 (2) : 42-54

Crawford, R.D. 1990. Poultry Breeding and Genetics : Elsevier Science Publishers B.V. 1123 p. (ISBN : 0-444-88557-9)

Fourie, P.C. *et al.* 1997. Overview of the poultry industry. Poultry Bulletin. March,100

Graves,W. 1985. Raising Poultry Successfully.1st ed. Charlotte, Vermont: Williamson Publishing. 192p. (ISBN: 0-7234-1647-8)

Gulezian,R.C. 1979. Statistics for decision making. USA : W.B. Saunders Company, 643 p. (ISBN : 0-7216-4350-7)

Hartman,R.1997. Feed efficiency had little effect on profits. Poultry Digest. July, 10

Kalashnikov, B.N. 1977. Effects of Eleutherococcus on the disease incidence among miners in the arctic. Abstracts of the reports made at the 2nd All-Union Conference on adaptation of man to different geological, climatic and industrial conditions. Siberian branch, USSR Academy of medical sciences. Novosibirsk. 2: 43-44

Kaplan, E. Ya. [s.a.] Study of the range of the adaptogenic action of Eleutherococcus senticosus rupr. et maxim. Prime Quest physician and health professional information, 1-2

Msane, T., 1995. Poultry and Egg production in a New South Africa. Poultry Bulletin. July. 302

Nikolaenko,V.P. 1988. Extract of the plant Eleutherococcus for preventing vaccination stress in chicks. CAB Abstract, no. 1, 56-57

North, M.O. 1984. Commercial Chicken Production Manual. 3rd ed. Westport, Connecticut: The Avi Publishing Company, INC. 710 p. (ISBN: 0-87055-446-8)

North, M.O. 1990. Commercial chicken production manual. 4th ed. New York : Van Nostrand Reinhold, 913 p. (ISBN: 0-442-31881-2)

Parkhurst, C.R. 1988. Poultry meat and egg production. New York : Van Nostrand Reinhold. 294 p. (ISBN: 0-442-27497-1)

Phelps, A. 1990. Longer Light- More Eggs. Farmer's Weekly. 16 Nov. , 24

Popov, L. 1992. Eleutherococcus extract improves the growth of chickens. CAB Abstract, no. 3, 17-19

Ramsay, K. 1997. Livestock improvement Act. Poultry Bulletin. August, 349

Singh, D.N. and Kopinski, J.S. 1992. Australian Poultry Science Symposium. 4 : 140

Stadelman, W. 1986. Egg Science and Technology. 3rd ed. Westport, Connecticut: The Avi Publishing Company, INC. . (ISBN: 0-333-42886-2).

Strydom, G.S. 1997. Poultry Industry, 5 September 1997

Solomon, S.E. 1991. Egg and Eggshell quality. London, England: Wolfe Publishing limited. 149p. (ISBN : 0-7234-16478).

Understanding Disease vi. 1995. Poultry Bulletin, Feb., p.55

Verwoerd, D.J. 1997. Mannanoligosaccharides, the new feed ingredient for poultry. Poultry Bulletin. July, 321

Wacker,A. and Eilmes, H.G. 1978. Virushemmung mit Eleutherokokk Fluid-Extract. Erfahrungsheilkunde. 6 : 346-351

Wagner, H. 1992. Drugs with Adaptogenic Effects for strengthening the powers of resistance. Zeitschrift fuer Phytotherapie, 13:42-54

Wells, R.G. 1987. Egg Quality - Current Problems and Recent Advances. Oxfordshire, England : Corfax Publishing Company. 302 p. (ISBN : 0-407-00470-X)

Widders, P.R. 1996. Immunization of chickens to reduce intestinal colonization with campylobacter jejuni. British Poultry Science, 37 : 765 - 778

Week No. : 720

AGE : 27 (weeks)

Date : 3.02.97

No.	TMT	O/S	EGGS	MON	TUES	WED	THU	FRI	SAT	SUN	E/wk	GM/wk
1	A		NUMBER	103	47	43	45	39	44	79.1	321	17218
			GRAM	5525	2536	2263	2406	2114	2374			
2	B		NUMBER	104	55	53	52	53	46	87.9	363	19276
			GRAM	5539	2948	2774	2777	2795	2443			
3	C		NUMBER	110	53	48	54	51	47	86.4	363	19178
			GRAM	5808	2832	2522	2853	2668	2495			
4	D		NUMBER	108	50	47	50	45	36	80	336	18011
			GRAM	5773	2694	2525	2638	2409	1972			
5	C		NUMBER		56	54	57	55	47	91.9	356	20710
			GRAM	6267	3042	2822	3082	2965	2532			
6	A		NUMBER	103	44	44	45	43	34	75.8	313	16396
			GRAM	5463	2322	2266	2340	2236	1769			
7	D		NUMBER	102	49	47	48	40	39	80	325	17566
			GRAM	5533	2675	2506	2546	2164	2142			
8	B		NUMBER	103	54	47	54	49	48	84.5	355	18797
			GRAM	5452	2879	2484	2850	2558	2574			
9	C		NUMBER	92	49	44	45	41	45	75.2	316	18636
			GRAM	4909	2622	2248	2390	2167	2300			
10	A		NUMBER	105	48	49	43	40	31	78	322	17152
			GRAM	5625	2507	2554	2284	2138	2041			
11	D		NUMBER	107	55	42	44	46	34	79.4	328	17698
			GRAM	5757	2957	2227	2401	2504	1853			
12	B		NUMBER	108	60	56	53	47	50	90.6	374	19860
			GRAM	5543	3206	2866	2822	2513	2710			

Appendix A

Week no. : 720

AGE : 27 (weeks)

Date : 3.02.97

No.	TMT	O/S	EGGS	MON	TUES	WED	THU	FRI	SAT	SUN	E/wk	GM/wk
13	A	57	NUMBER	102	53	49	47	36	44		331	17634
			GRAM	5412	2826	2599	2488	1933	2376			
14	B	59	NUMBER	110	49	52	50	47	45		381	19256
			GRAM	5748	2530	2823	2743	2660	2792			
15	C	59	NUMBER	114	53	53	49	48	51		368	20201
			GRAM	6164	2939	2894	2656	2714	2834			
16	D	58	NUMBER	97	44	47	39	46	49		322	17304
			GRAM	5143	2345	2522	2119	2521	2654			
17	C	59	NUMBER	113	55	54	51	49	46		368	20034
			GRAM	6022	3009	2862	2801	2782	2558			
18	A	57	NUMBER	107	54	52	51	47	47		358	19708
			GRAM	5632	2921	2786	2716	2566	2587			
19	D	57	NUMBER	93	37	44	42	32	36		354	14913
			GRAM	4851	1976	2292	2187	1684	1923			
20	B	59	NUMBER	107	52	53	52	47	49		360	19413
			GRAM	5678	2833	2859	2798	2598	2684			
21	C	59	NUMBER	110	55	51	53	45	51		385	19857
			GRAM	5905	3028	2738	2856	2493	2837			
22	A	60	NUMBER	108	50	54	47	48	52		359	19471
			GRAM	5728	2747	2954	2521	2678	2863			
23	D	56	NUMBER	96	42	43	39	35	34		289	15128
			GRAM	4970	2218	2227	1998	1881	1834			
24	B	58	NUMBER	112	50	57	52	52	50		373	20643
			GRAM	6122	2828	3156	2842	2905	2790			

Appendix A cont.

Week No. : 721

AGE : 28 (weeks)

Date : 10.02.97

No.	TMT	O/S	EGGS	MON	TUES	WED	THU	FRI	SAT	SUN	E/wk	GM/wk
1	A	58	NUMBER	100	46	45	47	47	46		331	17841
			GRAM	5338	2480	2438	2507	2582	2296			
2	B	59	NUMBER	109	52	54	53	49	52		369	19753
			GRAM	5691	2828	2888	2828	2703	2815			
3	C	59	NUMBER	116	47	52	52	46	50		363	19146
			GRAM	6032	2464	2735	2745	2495	2675			
4	D	60	NUMBER	105	44	46	45	45	48		333	17834
			GRAM	5556	2370	2463	2444	2409	2592			
5	C	60	NUMBER	117	54	51	54	50	51		377	20390
			GRAM	6218	2922	2784	2878	2768	2820			
6	A	59	NUMBER	97	45	47	47	44	44		324	17246
			GRAM	4970	2428	2516	2472	2400	2460			
7	D	57	NUMBER	94	48	45	42	43	41		313	16920
			GRAM	5038	2591	2418	2251	2386	2236			
8	B	60	NUMBER	107	54	55	52	51	56		375	20099
			GRAM	5614	2909	2956	2841	2810	3173			
9	C	60	NUMBER	94	52	44	42	45	46		323	17339
			GRAM	5038	2591	2418	2251	2386	2236			
10	A	59	NUMBER	99	49	48	47	45	50		338	18222
			GRAM	5244	2628	2566	2509	2494	2781			
11	D	59	NUMBER	102	46	40	43	46	45		322	17245
			GRAM	5309	2368	2138	2354	2547	2532			
12	B	59	NUMBER	110	50	49	50	43	44		346	18466
			GRAM	5774	2654	2638	2652	2338	2410			

Appendix B

Week No. : 721

AGE : 28 (weeks)

Date : 10.02.97

No.	TMT	O/S	EGGS	MON	TUES	WED	THU	FRI	SAT	SUN	E/wk	GM/wk
13	A	56	NUMBER	94	45	42	31	53	44		309	16717
			GRAM	4999	2442	2218	1704	2914	2440			
14	B	59	NUMBER	102	50	48	44	49	46		339	18989
			GRAM	5559	2825	2672	2501	2834	2598			
15	C	59	NUMBER	104	52	46	39	54	39		334	18919
			GRAM	5855	2875	2522	2244	3131	2292			
16	D	58	NUMBER	97	48	44	38	49	40		316	17654
			GRAM	5323	2695	2425	2163	2776	2270			
17	C	59	NUMBER	100	48	49	38	49	42		321	17865
			GRAM	5553	2625	2396	2139	2756	2396			
18	A	57	NUMBER	108	52	50	44	54	41		349	19370
			GRAM	5960	2910	2713	2465	3025	2297			
19	D	57	NUMBER	91	48	47	44	52	42		304	17017
			GRAM	4876	2574	2511	2407	2886	2363			
20	B	59	NUMBER	107	50	51	39	52	44		343	18642
			GRAM	5755	2715	2749	2088	2896	2439			
21	C	58	NUMBER	103	49	51	45	54	46		348	19539
			GRAM	5738	2783	2790	2553	3062	2613			
22	A	60	NUMBER	109	52	51	41	54	42		349	19724
			GRAM	6045	2922	2850	2400	3087	2420			
23	D	56	NUMBER	90	43	44	42	45	37		301	16333
			GRAM	4801	2311	2368	2309	2494	2050			
24	B	57	NUMBER	89	47	46	40	50	43		315	17531
			GRAM	4896	2634	2483	2270	2845	2403			

Appendix B cont.

Week No. : 722

AGE : 29 (weeks)

Date : 17.02.97

Appendix C

No.	TMT	O/S	EGGS	MON	TUES	WED	THU	FRI	SAT	SUN	E/wk	GM/wk
1	A	57	NUMBER	102	51	51	47	54	46		351	19450
			GRAM	5560	2819	2808	2626	3014	2623			
2	B	59	NUMBER	103	52	52	49	52	49		357	19798
			GRAM	5644	2918	2843	2720	2929	2744			
3	C	59	NUMBER	108	50	52	37	56	40		343	18806
			GRAM	5838	2713	2784	2026	3170	2285			
4	D	57	NUMBER	108	49	52	39	52	45		345	19763
			GRAM	5952	2733	2844	2186	2961	2587			
5	C	60	NUMBER	116	55	51	45	60	41		368	20750
			GRAM	6453	3090	2826	2570	3455	2356			
6	A	59	NUMBER	104	52	51	42	57	46		352	19354
			GRAM	5601	2866	2733	2308	3162	2584			
7	D	57	NUMBER	100	48	45	46	49	41		329	18732
			GRAM	5693	2762	2414	2656		2845	2362		
8	B	60	NUMBER	112	51	52	47	57	50		369	20326
			GRAM	6052	2802	2852	2611	3205	2804			
9	C	60	NUMBER	94	42	45	40	47	37		305	16815
			GRAM	5175	2282	2448	2234	2690	1986			
10	A	59	NUMBER	97	53	51	45	54	48		348	19454
			GRAM	5319	2941	2852	2546	3048	2748			
11	D	57	NUMBER	94	50	41	36	52	37		310	17282
			GRAM	5105	2786	2270	2020	2957	2124			
12	B	59	NUMBER	104	53	55	42	54	50		358	19870
			GRAM	5639	2962	3034	2412	3008	2820			

Week No. : 722

AGE : 29 (weeks)

Date : 17.02.97

No.	TMT	O/S	EGGS	MON	TUES	WED	THU	FRI	SAT	SUN	E/wk	GM/wk
13	A	56	NUMBER	94	45	42	31	53	44		309	16717
			GRAM	4999	2442	2218	1704	2914	2440			
14	B	59	NUMBER	102	50	48	44	49	46		339	18589
			GRAM	5559	2825	2672	2501	2834	2598			
15	C	59	NUMBER	104	52	46	39	54	39		334	18919
			GRAM	5855	2875	2522	2244	3131	2292			
16	D	58	NUMBER	97	48	44	38	49	40		316	17654
			GRAM	5323	2695	2425	2163	2776	2270			
17	C	59	NUMBER	100	48	44	38	49	42		321	17865
			GRAM	5553	2625	2396	2139	2756	2396			
18	A	57	NUMBER	108	52	50	44	54	41		309	19370
			GRAM	5960	2910	2713	2465	3025	2297			
19	D	57	NUMBER	91	48	47	44	52	42		304	17677
			GRAM	4876	2574	2511	2407	2886	2363			
20	B	59	NUMBER	107	50	51	39	52	44		343	18642
			GRAM	5755	2715	2749	2088	2896	2439			
21	C	58	NUMBER	103	49	51	49	54	46		348	19539
			GRAM	5738	2783	2790	2553	3062	2613			
22	A	60	NUMBER	109	52	51	41	54	42		349	19724
			GRAM	6045	2922	2850	2400	3087	2420			
23	D	56	NUMBER	90	43	44	42	45	37		301	16333
			GRAM	4801	2311	2368	2309	2494	2050			
24	B	57	NUMBER	89	47	46	40	50	43		315	17513
			GRAM	4896	2634	2483	2270	2845	2403			

Appendix C cont.

Week No. : 723

AGE : 30 (weeks)

Date : 24.02.97

No.	TMT	O/S	EGGS	MON	TUES	WED	THU	FRI	SAT	SUN	E/wk	GM/wk
1	A		NUMBER	105	53	49	31	49	44		351	19213
			GRAM	5736	2908	2690	2815	2699	2365			
2	B		NUMBER	107	50	54	53	50	48		362	19812
			GRAM	5870	2801	2940	2888	2713	2600			
3	C		NUMBER	110	52	49	53	49	52		365	19708
			GRAM	5878	2835	2630	2892	2604	2869			
4	D		NUMBER	97	42	46	52	48	51		336	18238
			GRAM	5290	2336	2558	2588	2638	2828			
5	C		NUMBER	115	59	55	52	57	53		391	21675
			GRAM	6377	3300	3010	2886	3132	2970			
6	A		NUMBER	93	47	46	45	46	39		316	17054
			GRAM	5025	2535	2506	2429	2444	2115			
7	D		NUMBER	93	42	49	45	45	50		324	18271
			GRAM	5181	2403	2750	2577	2554	2806			
8	B		NUMBER	114	56	56	52	49	51		378	20813
			GRAM	6229	3166	3112	2850	2659	2797			
9	C		NUMBER	99	45	49	44	41	39		317	17279
			GRAM	5318	2347	2688	2441	2231	2154			
10	A		NUMBER	96	49	51	49	49	46		340	18797
			GRAM	5284	2732	2802	2762	2684	2533			
11	D		NUMBER	90	46	51	48	40	45		320	17473
			GRAM	4895	2837	2750	2558	2235	2498			
12	B		NUMBER	107	53	51	49	45	45		350	19029
			GRAM	5796	2962	2794	2694	2337	2446			

Appendix D

Week No. : 723

AGE : 30 (weeks)

Date : 24.02.97

No.	TMT	O/S	EGGS	MON	TUES	WED	THU	FRI	SAT	SUN	E/wk	GM/wk
1	A		NUMBER	93	36	41	40	35	29		274	14747
			GRAM	5046	1932	2154	2189	1867	1554			
2	B		NUMBER	99	49	50	52	44	43		337	18604
			GRAM	5452	2747	2786	2807	2452	2350			
3	C		NUMBER	106	53	50	51	49	47		356	19894
			GRAM	5900	3029	2805	2826	2702	2632			
4	D		NUMBER	106	49	51	46	45	37		334	18392
			GRAM	5806	2716	2807	2531	2466	2066			
5	C		NUMBER	103	53	49	51	45	45		346	19225
			GRAM	5778	2971	2718	2779	2429	2550			
6	A		NUMBER	107	52	52	51	46	44		352	19301
			GRAM	5878	2874	2820	2800	2524	2405			
7	D		NUMBER	82	38	44	40	42	42		288	15568
			GRAM	4843	2058	2352	2190	2316	2265			
8	B		NUMBER	108	51	54	47	49	42		351	19276
			GRAM	5958	2826	2965	2568	2671	2242			
9	C		NUMBER	106	54	48	52	50	48		358	19764
			GRAM	5922	2996	3034	2765	2746	2321			
10	A		NUMBER	83	41	38	38	37	27		264	14049
			GRAM	4423	2212	1988	2008	1966	1452			
11	D		NUMBER	112	49	49	50	44	39		343	19118
			GRAM	6266	2733	2709	2788	2453	2169			
12	B		NUMBER									
			GRAM									

Appendix D cont.

Wee Week no. : 724

AGE : 31 (weeks)

Date Date : 3.03.97

No.	TMT	O/S	EGGS	MON	TUES	WED	THU	FRI	SAT	SUN	E/wk	GM/wk
1	A		NUMBER	102	52	50	51	51	48		354	19864
			GRAM	5658	2892	2790	2895	2954	2675			
2	B		NUMBER	110	54	55	50	46	50		365	20290
			GRAM	6072	2984	3078	2794	2564	2798			
3	C		NUMBER	112	53	53	46	46	44		354	19889
			GRAM	6305	2941	2976	2536	2656	2475			
4	D		NUMBER	108	52	52	47	46	42		337	19573
			GRAM	6095	2899	2949	2654	2609	2337			
5	C		NUMBER	119	54	52	55	43	55		378	21372
			GRAM	6733	3023	2980	3124	2392	3120			
6	A		NUMBER	112	56	54	48	35	53		358	20015
			GRAM	6302	3107	3012	2695	1952	2947			
7	D		NUMBER	99	48	49	45	48	45		334	19272
			GRAM	5737	2737	2851	2574	2752	26621			
8	B		NUMBER	111	51	56	55	44	54		371	20759
			GRAM	6165	2901	3118	3064	2468	3043			
9	C		NUMBER	97	44	49	45	36	43		314	17580
			GRAM	5411	2462	2667	2505	2068	2467			
10	A		NUMBER	108	53	51	46	43	41		342	19226
			GRAM	6094	2896	2842	2605	2413	2376			
11	D		NUMBER	93	48	46	45	45	42		319	18130
			GRAM	5229	2711	2629	2552	2568	2441			
12	B		NUMBER	107	51	51	50	43	48		350	19435
			GRAM	5883	2819	2809	2802	2426	2686			

Appendix E

Week No. : 724

Date : 3.03.97

AGE : 31 (weeks)

No.	TMT	O/S	EGGS	MON	TUES	WED	THU	FRI	SAT	SUN	E/wk	GM/wk
13	A		NUMBER	97	48	47	50	48	45		335	18508
			GRAM	5288	2657	2608	2779	2692	2484			
14	B		NUMBER	103	51	49	47	45	47		342	19303
			GRAM	5754	2860	2768	2644	2576	2691			
15	C		NUMBER	108	50	49	50	46	46		349	198241
			GRAM	6110	2821	2802	2876	2678	2534			
16	D		NUMBER	96	49	49	50	47	47		338	18912
			GRAM	5271	2741	2783	2814	2640	2663			
17	C		NUMBER	100	49	47	49	50	47		342	19248
			GRAM	5567	2730	2665	2778	2848	2660			
18	A		NUMBER	104	51	54	49	47	52		357	19944
			GRAM	5689	2846	3042	2782	2663	2922			
19	D		NUMBER	104	50	49	46	46	44		339	18999
			GRAM	5832	2772	2751	2575	2592	2487			
20	B		NUMBER	105	53	51	52	36	45		342	192245
			GRAM	5742	2910	2814	2888	2038	2853			
21	C		NUMBER	100	49	50	51	48	46		344	19315
			GRAM	5514	2710	2830	2868	2723	2670			
22	A		NUMBER	109	48	51	48	44	51		351	19861
			GRAM	6120	2690	2962	2715	2553	2921			
23	D		NUMBER	98	47	45	43	40	44		317	17542
			GRAM	5360	2578	2461	2367	2303	2473			
24	B		NUMBER	96	48	50	48	41	49		332	18739
			GRAM	5444	2681	2807	2701	2342	2764			

Appendix E cont.

Week No. : 725

AGE : 32 (weeks)

Date : 10.03.97

Appendix F

No.	TMT	O/S	EGGS	MON	TUES	WED	THU	FRI	SAT	SUN	E/wk	GM/wk
1	A	56	NUMBER	103	42	50	45	50	39		329	18478
			GRAM	5760	2302	2822	2528	2820	2246			
2	B	59	NUMBER	100	42	43	40	46	42		313	17554
			GRAM	5593	2360	2454	2203	2580	2374			
3	C	59	NUMBER	77	35	19	27	34	23		215	11402
			GRAM	4059	1952	790	1461	1851	1279			
4	D	59	NUMBER	71	32	32	32	35	27		229	12642
			GRAM	3780	1788	1822	1726	1974	1546			
5	C	60	NUMBER	108	52	42	47	47	52		348	19622
			GRAM	6133	2990	2378	2610	2597	2919			
6	A	58	NUMBER	112	53	51	43	49	49		357	20054
			GRAM	6284	2941	2844	2426	2759	2800			
7	D	56	NUMBER	103	49	46	45	49	36		328	18296
			GRAM	5323	2775	2671	2598	2824	2105			
8	B	58	NUMBER	104	54	55	50	47	50		360	20312
			GRAM	5802	3060	3129	2821	2651	2849			
9	C	57	NUMBER	98	3	42	44	44	43		318	17964
			GRAM	5454	2718	2412	2458	2462	2460			
10	A	59	NUMBER	99	56	54	45	55	58		357	20126
			GRAM	5607	3107	3080	2527	3128	2727			
11	D	56	NUMBER	108	45	51	39	51	45		339	19149
			GRAM	6080	2482	2890	2240	2877	2580			
12	B	59	NUMBER	111	49	49	45	53	46		353	19643
			GRAM	6076	2700	2758	2502	2993	2614			

Week No. : 725

AGE : 32 (weeks)

Date : 10.03.97

No.	TMT	O/S	EGGS	MON	TUES	WED	THU	FRI	SAT	SUN	E/wk	GM/wk
13	A	56	NUMBER	101	52	52	45	49	47		346	19068
			GRAM	5535	2846	2880	2539	2682	2566			
14	B	58	NUMBER	101	44	54	45	45	43		332	18784
			GRAM	5716	2479	3030	2554	2527	2478			
15	C	59	NUMBER	99	48	39	44	53	36		319	18164
			GRAM	5620	2779	2213	2522	2978	2052			
16	D	58	NUMBER	91	50	48	42	46	44		327	18516
			GRAM	5430	2827	2732	2346	2614	2625			
17	C	59	NUMBER	96	44	37	32	40	32		281	15900
			GRAM	5358	2478	2170	1776	2248	1870			
18	A	56	NUMBER	102	47	50	45	47	49		340	19189
			GRAM	5706	2620	2852	2513	2654	2844			
19	D	56	NUMBER	97	49	49	48	45	42		328	18297
			GRAM	5409	2598	2727	2669	2530	2369			
20	B	59	NUMBER	101	49	46	42	50	42		328	18208
			GRAM	5572	2557	2545	2365	2821	2348			
21	C	58	NUMBER	100	47	49	45	50	43		334	18964
			GRAM	5632	2694	2726	2554	2839	2519			
22	A	59	NUMBER	100	43	27	36	40	35		281	15705
			GRAM	5674	2435	1497	1966	2190	1943			
23	D	55	NUMBER	91	43	47	44	48	45		318	17694
			GRAM	5001	2385	2696	2433	2659	2520			
24	B	56	NUMBER	89	49	49	42	43	42		314	17551
			GRAM	4876	2708	2749	2381	2401	2436			

Appendix F cont.

Week No. : 726

AGE : 33 (weeks)

Date : 17.3.97

No.	TMT	O/S	EGGS	MON	TUES	WED	THU	FRI	SAT	SUN	E/wk	GM/wk
1	A		NUMBER	105	46	51	46	38	56		342	19085
			GRAM	5874	2547	2757	2548	2146	3171			
2	B		NUMBER	97	44	41	45	45	49		328	18366
			GRAM	5394	2439	26	2500	2546	2799			
3	C		NUMBER	78	40	36	38	36	46		274	15388
			GRAM	4325	2274	2001	2129	2038	2621			
4	D		NUMBER	72	38	40	37	35	43		265	14930
			GRAM	4108	2138	22	2068	1980	2408			
5	C		NUMBER	110	53	41	49	48	59		365	20631
			GRAM	6131	3005	27	2762	2739	3278			
6	A		NUMBER	105	50	54	46	46	53		349	19899
			GRAM	5969	2838	3031	2668	2358	3035			
7	D		NUMBER	97	45	50	48	42	47		329	19184
			GRAM	5586	2659	2945	2780	2456	2759			
8	B		NUMBER	109	51	54	52	51	56		373	21268
			GRAM	6140	2943	3063	2934	2952	3233			
9	C		NUMBER	98	40	50	43	47	48		326	18493
			GRAM	5558	2272	282	2416	2692	2743			
10	A		NUMBER	111	55	54	48	41	54		273	20351
			GRAM	6313	3075	3055	2680	2310	3118			
11	D		NUMBER	90	43	51	46	40	54		324	18671
			GRAM	5184	2485	2913	2628	2290	3171			
12	B		NUMBER	98	53	51	45	48	51		346	19637
			GRAM	5454	3081	2880	2553	2747	2922			

Appendix G

Week No. : 726

AGE : 33 (weeks)

Date : 17.03.97

No.	TMT	O/S	EGGS	MON	TUES	WED	THU	FRI	SAT	SUN	E/wk	GM/wk
13	A		NUMBER	102	50	53	49	40	52		346	19347
			GRAM	5708	2816	2910	2752	2209	2952			
14	B		NUMBER	99	49	50	45	42	52		337	19225
			GRAM	5591	2786	2868	2521	2452	3007			
15	C		NUMBER	100	48	51	49	45	50		343	19742
			GRAM	5720	2799	2929	2785	2575	2934			
16	D		NUMBER	98	50	53	47	42	56		346	20031
			GRAM	5630	2902	3036	2732	2450	3281			
17	C		NUMBER	88	46	45	45	44	5		317	17858
			GRAM	4935	2613	2495	2522	2333	2962			
18	A		NUMBER	105	51	51	49	43	54		353	20007
			GRAM	6010	2882	2854	2750	2438	3073			
19	D		NUMBER	99	50	47	46	39	50		331	15600
			GRAM	5492	2786	2633	2602	2213	2874			
20	B		NUMBER	102	51	49	47	40	51		340	19189
			GRAM	5723	2852	2728	2602	2332	2952			
21	C		NUMBER	102	49	49	47	42	51		340	19465
			GRAM	5834	2790	2786	2720	2386	2949			
22	A		NUMBER	89	46	42	45	40	52		314	17794
			GRAM	4980	2580	2376	2508	2267	3083			
23	D		NUMBER	93	48	49	47	34	48		319	17820
			GRAM	5187	2714	2724	2592	1905	2698			
24	B		NUMBER	97	44	47	42	45	50		325	18560
			GRAM	5488	2512	2670	2385	2615	2890			

Appendix G cont.

WEEKS		AVERAGE	MEDIAN	MODE	STANDARD ERROR	MIN	MAX	RANGE
1	P	342.25	353	351	7.47	289	373	84
	T	341.08	347	363	7.9	284	374	90
2	P	333.83	329	324	7.05	307	377	70
	T	338.5	335.5	333	4.63	321	369	48
3	P	336.25	336.5	334	6.25	307	369	62
	T	337.93	344	343	5.23	305	358	53
4	P	335.75	340	337	10.88	264	391	127
	T	341.5	350.5	351	6.68	288	366	78
5	P	345.75	343	342	4.93	317	378	61
	T	342.92	342	342	4.3	314	365	51
6	P	330.33	330	328	6.25	281	360	79
	T	310.83	328	328	13.29	215	357	142
7	P	340.5	341.5	346	5.03	314	373	59
	T	318.25	327	326	8.79	265	353	88

P: Placebo T: Treatment

Summary Statistics-Number of Eggs

WEEKS		AVERAGE	MEDIAN	MODE	STANDARD ERROR	MIN	MAX	RANGE
1	P	18555.5	19026.5	18797	506.8	15128	20710	5582
	T	18241.42	18594.5	18011	451.72	14913	20034	5121
2	P	18338.42	18186.5	17654	417.05	16333	20390	4057
	T	18181.66	17953.5	17865	246.12	17077	19733	2656
3	P	18713.92	18953.5	18918	400.3	16333	20750	4417
	T	18689.33	19034.5	18806	299.61	16815	19870	3055
4	P	18263.75	18498	18392	661.09	14049	21675	7626
	T	18576.58	19121	19029	358.52	15568	19812	4244
5	P	19287.16	19351.5	19268	223.23	17580	20290	2710
	T	19287.16	19351.5	19268	223.23	17580	20290	2710
6	P	18559.16	18650	18516	359.17	15705	20312	4607
	T	17396	18252.5	18208	793.05	11402	20126	8724
7	P	19397.16	19406	19347	301.64	17794	21268	3474
	T	18147.92	18582	18493	539.35	14930	20551	5621

P: Placebo T: Treatment

Summary Statistics-Weight of Eggs

Appendix J

WEEKS		AVERAGE	MEDIAN	MODE	STANDARD ERROR	MIN	MAX	RANGE
1	P	92.08	91.43	90.25	1.35	84.61	98.64	14.03
	T	94.12	95.49	93.71	1.24	85.46	98.37	12.91
2	P	95.22	94.92	94.76	0.99	88.99	101.91	12.92
	T	94.21	93.99	93.64	0.7	90	97.68	7.68
3	P	97.12	97.54	97.49	0.77	92.25	101.52	9.27
	T	95.08	49.97	49.86	0.89	90.97	103.26	12.29
4	P	93.52	94.4	93.8	0.76	89.61	98.01	8.4
	T	94.51	49.29	49.12	0.89	90.75	102.53	11.78
5	P	94.96	94.9	94.79	1.02	88.64	100.33	11.69
	T	96.09	95.71	95.2	0.85	91.76	101.75	9.99
6	P	89.78	89.8	89.56	1.2	80.21	96.21	16
	T	87.35	87.68	87.6	0.75	81.68	90.65	8.79
7	P	87.74	87.83	87.39	1.32	79.68	93.51	13.83
	T	89.46	88.46	88.42	1.03	84.36	94.87	10.51

P: Placebo T: Treatment

Summary Statistics-Height of Albumin

Appendix K

WEEKS		AVERAGE	MEDIAN	MODE	STANDARD ERROR	MIN	MAX	RANGE
1	P	6.36	6.67	6.67	0.19	5.33	7.33	2
	T	6.03	6	6	0.16	5	7	2
2	P	6.95	7.33	7.67	0.3	5	8	3
	T	6.67	7	7	0.26	5	7.67	2.67
3	P	6.67	7	7	0.21	4.67	7.33	2.66
	T	6.5	6.5	6.67	0.2	5.33	8	2.67
4	P	6.58	6.84	7.33	0.35	4	8	4
	T	6.78	6.84	6.67	0.29	4.67	8	3.33
5	P	6.97	7	7	0.23	5.33	8	2.67
	T	7.44	7.67	7.67	0.27	5.33	8.33	3
6	P	6.94	7.33	7.33	0.39	4	8	4
	T	6.75	7.33	7.67	0.34	4.67	7.67	3
7	P	6.81	7	7.67	0.38	4.33	3	3.67
	T	6.72	7.33	7.33	0.35	4.33	8	3.67

P: Placebo T:Treatment

Summary Statistics-Colour of egg yolk

WEEKS		AVERAGE	MEDIAN	MODE	STANDARD ERROR	MIN	MAX	RANGE
1	P	1	1	1	0.28	0	3	3
	T	0.75	1	0	0.22	0	2	2
2	P	1.08	1	1	0.31	0	3	3
	T	1.25	1	1	0.33	0	3	3
3	P	1.42	1	1	0.38	0	4	4
	T	1.25	1	1	0.33	0	3	3
4	P	1.67	1	1	0.43	0	4	4
	T	1.58	1	1	0.38	0	4	4
5	P	1.92	2	2	0.45	0	4	4
	T	1.92	1	1	0.45	0	4	4
6	P	2.42	2	2	0.43	0	5	5
	T	2.16	1	1	0.42	1	4	3
7	P	2.92	2.5	2	0.62	0	8	8
	T	3.25	3.5	1	0.57	1	7	6

P: Placebo T: Treatment

Summary Statistics-Mortality rate