THE

RELEVANCE OF SUCCUSSION IN THE

PREPARATION OF

HOMOEOPATHIC MEDICINES

By

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I, Natalie Nowell Christie, do hereby declare that in respect of the following dissertation/ thesis, "The Relevance of Succussion in the Preparation of Homoeopathic Medicines"; as far as I know and can ascertain no other dissertation/ thesis exists, and all references detailed in the dissertation are complete in terms of all personal communications engaged in and published works consulted.

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IN DEDICATION TO

the

future of homoeopathy

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ABSTRACT

The aim of this study was to determine the effect of succussion in the preparation of homoeopathic medicine in terms of the methods of succussion and cell culture growth, in order to identify the relevance of succussion in the preparation of homoeopathic medicine.

The experimental method single - variable design; after only with control was used to interpret the data. The yeast cell culture used was based on the in vitro model for testing homoeopathic medicine as suggested by Jones and Jenkins (1983). The homoeopathic medicines Pulsatilla, Kalium carbonicum, Natrum muriaticum and Psorinum, at 8CH potency, were used. Medicines were prepared firstly by hand succussion and then by mechanical succussion, using 0, 40, 60, 80, 100, 120, 140 and 160 succussions. Each medicine was added seperately to the Saccharomyces cerevisiae culture and the growth of the yeast was then determined, using the direct cell counting method. All experiments were conducted in duplicate.

Three subproblems were derived from the problem statement. The Analysis of Variance method, was used for statistically analysing the data.

The hypothesis of the first two subproblems were tested using:

1) independant sample T-test at a 95% confidence interval; and
2) Tukey's HSD multiple comparisons test.

The third subproblem's hypothesis is tested by integrating the results of subproblem one and two.

When testing the hypothesis of the first subproblem, the control and those medicines prepared with no succussion, that is only serial dilution, were compared to all four medicines prepared by hand succussion, producing the following results:

Pulsatilla 8CH was not significantly different to the control, thereby making the analysis of the results of Pulsatilla with the addition of succussion impossible.

The other three medicines were all significantly different to the control and also to those medicines prepared by serial dilution. Kalium carbonicum 8CH and Natrum muriaticum 8CH, although different to the controls, did not show any particular number of hand succussions to be more optimal than any other. While Psorinum 8CH showed it's optimal number of hand succussions to be 40.

On testing the hypothesis of the second subproblem, the following results were produced:

Once again the analysis of Pulsatilla 8CH was impossible, due to lack of sensitivity of the Saccharomyces cerevisiae to the Pulsatilla. Kalium carbonicum 8CH and Natrum muriaticum 8CH both showed optimal number of mechanical succussions to be 80. While Psorinum 8CH showed it's optimal number of succussions to be 40.

In the third subproblem, the data was integrated from the first two subproblems. This showed that both hand and mechanical succussion do play a statistically significant role in the preparation of homoeopathic medicine. But due to the varying results of the optimal number of succussions of each medicine, it is not possible from the current research to generalise and state the optimal number of succussions, both hand and mechanical, for all homoeopathic medicines. It is also not possible to state whether hand or mechanical succussion is more effective.

In the graphical representation, the results indicate that there is no significant difference between any of the variables. Microbiologically - given the inherent inaccuracy of the plate count method there should be a difference of at least two or more logs for a significant difference. The relevance of succussion in the preparation of Homoeopathic medicine requires further research

UITTREKSEL

Die doelwit van hierdie oefeningstuk was om die uitwerking van sukkussie op die voorbereiding van homeopatiese medisyne ingevolge die metode van sukkussie en sel-kweking groeikoers te bepaal, met die oogmerk om die toepaslikheid van sukkussie in die voorbereiding van homeopatiese medisyne vas te stel.

In die studie, die proefstelsel "enkel - wisselende vorm na slegs met kontrole" was gebruik om die data te verklaar.

Die gis-sel kweking wat gebruik was, was op die in vitro model vir die beproewing van homeopatiese medisyne soos deur Jones en Jenkins (1983) voorgestel, gebaseer. Die homeopatiese medisyne Pulsatilla, Kalium carbonicum, Natrum muriaticum en Psorinum, almal in die 8CH sterkte, was gebruik. Hierdie medisyne was eerstens deur middel van hand - sukkussie voorberei en toe deur middel van meganiese - sukkussie, met die gebruik van 0, 40, 60, 80, 100, 120, 140 en 160 sukkussies. Elkeen van die medisyne was afsonderlik tot die Saccharomyces cerevisiae kweking bygevoeg en die groeikoers van die gis was toe deur die navorser waargeneem met gebruik van die direk sel rekening stelsel. Hierdie uitslae was toe getabuleer. Alle proefneming was in tweevoud voltooi.

Drie sub - probleme was van die probleem opgawe afkomstig. Die hipotese van die eerste twee sub - probleme was getoets met die gebruik van:

1) Onafhanklike monster T - toets op 'n 95% sekerheid tussenruimte; en

2) Tukey's HSD veelsortig vergelykingstoets.

Die hipotese van die derde sub - probleem is getoets deur middel

van die uitslae van sub - probleme een en twee te integreer en hulle grafies te vertoe.

Gedurende die toets vir die hipotese van die eerste sub - probleem, die kontrole en daardie medisyne wat met geen sukkussie voorberei was, dit wil se reeks verdunning alleenlik, was vergelyk met al vier medisyne wat met hand - sukkussie voorberei was, met die uitslae soos volg:

Pulsatilla 8CH het statisties nie aansienlik van die kontrole verskil nie, daardeur is die oorsig van die resultate van Pulsatilla met die byvoeging van sukkussie, onmmontlik gemaak. Die ander drie medisyne was almal aansienlik verskillend van die kontrole, sowel as van daardie medisyne wat deur reeks verdunning voorberei was. Kalium carbonicum 8CH en Natrum muriaticum 8CH, alhoewel verskillend van die kontrole, het geen besondere getal hand - sukkussies as meer gunstig as enige ander, gewys nie, terwyl Psorinum 8CH het gewys dat sy gunstige getal hand - sukkussies 40 is.

Gedurende die toets vir hipotese van die tweede sub - probleem, was die volgende uitslae opgemerk:

Weer was die oorsig van Pulsatilla 8CH onmoontlik, toe te skrywe aan die gebrek aan sensitiwiteit van die Saccharomyces cerevisiae vir die Pulsatilla.

Kalium carbonicum 8CH en Natrum muriaticum 8CH het albei gewys dat die gunstige getal meganiese sukkussies 80 was, terwyl Psorinum 8CH weer sy gunstige getal sukkussies as 40 gewys het.

In die derde sub - probleem was die data van die eerst twee sub probleme ingeskakel. Dit het gewys dat beide hand en meganiese -

sukkussies 'n statisties betekenisvolle rol speel in die voorbereiding van homeopaties medisyne. Dit is ook nie moontlik om te verklaar of hand - of meganiese - sukkussie meer uitwerking as die ander het nie.

Meer navorsing oor die toepaslikheid van sukkussie in die voorbereiding van homoeopatiese medisyne behoort voltooi te word.

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LIST OF ABBREVIATIONS:

ANOVA - Analysis of Variance

CH - centisimal Hahnemanian

CFU/ML - colony forming units per millilitre

SD - significant difference

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CHAPTER ONE

1.0 THE PROBLEM AND ITS SETTING

1.1 PROBLEM STATEMENT

The purpose of this investigation was to determine the effect of succussion in the preparation of homoeopathic medicine in terms of the methods of succussion and cell culture growth, in order to identify the relevance of succussion in the preparation of homoeopathic medicine.

1.2 SUBPROBLEMS

1.2.1 SUBPROBLEM ONE

To evaluate the impact of succussion in the preparation of homoeopathic medicine with reference to hand succussion and cell culture growth in order to determine the effect of hand succussion.

1.2.2 SUBPROPLEM TWO

To evaluate the impact of succussion in the preparation of homoeopathic medicine with reference to mechanical succussion and cell culture growth in order to determine the effect of mechanical succussion.

1.2.3 SUBPROBLEM THREE

To integrate the findings of hand succussion and mechanical succussion in order to evaluate the relevance of succussion in the preparation of homoeopathic medicine.

1.3 HYPOTHESES

1.3.1 HYPOTHESIS ONE

Cell culture growth will increase when hand succussed substances are added to the growth medium.

1.3.2 HYPOTHESIS TWO

Cell culture growth will increase when mechanically succussed substances are added to the growth medium.

1.3.3 HYPOTHESIS THREE

Under certain circumstances hand succussion will have a greater impact than mechanical succussion in the preparation of homoeopathic medicine.

1.4 DELIMITATIONS

1.4.1 This study was not intended to extend its experimental results to cases involving humans.

1.4.2 This study was limited to the interactions of the Brewers Yeast, Saccharomyces cerevisiae, and four homoeopathic medicines, viz., Pulsatilla, Psorinum, Kali Carbonicum and Natrum muriaticum.

1.5 ASSUMPTIONS

1.5.1 The first assumption

All Saccharomyces cerevisiae yeast cultures used were grown under the same standardised duration of incubation, temperature and aeration and that these are the optimal growth conditions for this organism.

1.5.2 The second assumption

All procedures including preparation of the Homoeopathic medicines, as well as preparation of the yeast culture were performed under sterile conditions in order to avoid any contamination.

1.6 DEFINITIONS

1.6.1 HAND SUCCUSSION - the action of shaking up, or the condition of being shaken up, vigorously of a liquid dilution of a Homoeopathic medicine in its phial or bottle, where each stroke ends with a jolt, by pounding the hand engaged in the shaking action against the other palm. (Muzumdar, 1974)

1.6.2 MECHANICAL SUCCUSSION - the action of shaking up, or the condition of being shaken up, vigorously of a liquid dilution of a Homoeopathic medicine in its phial or bottle, using a machine designed specifically for this function. (Muzumdar, 1974)

1.6.3 SERIAL DILUTION - the process of progressively rendering a substance attenuated. (Muzumdar, 1974)

1.6.4 POTENTIZATION - involves both the processes of serial dilution and succussion. (Muzumdar, 1974)

1.6.5 HOMOEOPATHIC MEDICINE - a therapeutic form which obeys the Law of Similars of Homoeopathy and uses medically active substances at small or infinitesimal doses. These medicines are usually denoted by the Latin name of the product, substance or composition, followed by the indication of dilution.

1.6.6 PULSATILLA - a Homoeopathic medicine prepared from the Wind flower or Meadow Anemone, which belongs to the Ranunculacae family. (Jouanny, 1978)

1.6.7 PSORINUM - a Homoeopathic medicine prepared from the serous discharge of itch vesicles taken from several patients who have not yet been treated. (Jouanny, 1978)

1.6.8 KALI CARBONICUM - potassium carbonate in Homoeopathic potency. (Jouanny, 1978)

1.6.9 NATRUM MURIATICUM - sodium chloride or common salt prepared in Homoeopathic potency. (Jouanny, 1978)

1.6.10 CENTISIMAL POTENCY - this potency nomenclature refers to a one in one hundred dilution during the process of medicine manufacture. The terminology used to designate these potencies is either 'C' or 'CH' ,that is 'C' representing Centissimal and 'CH' representing Centissimal Hahnemanian. In the case of liquid potencies this refers to those potencies prepared in separate individual receptacles (phials) for each potency. This method of preparation of Homoeopathic medicine was developed by Samuel Hahnemann, the founder of Homoeopathy. (Muzumdar, 1974)

1.6.11 MOTHER TINCTURE - Homoeopathic mother tinctures are alcoholic solutions of the soluble constituent of Homoeopathic drugs such as chemicals, vegetables, animal substances or any other drug. (Muzumdar, 1974)

1.6.12 POTENCY - the process of deconcentration (dilution), with succussion, or by trituration of the medicinal substance which is brought to a state of diminutive or infinitesimal subdivision.

This process, if performed according to the mathematico-mechanical attenuation procedures for potentization, increases the physical solubility and the physiological assimilability of the drug, while also changing its therapeutic activity in its use as a Homoeopathic medicine. (Hahnemann, 1982)

1.7 IMPORTANCE OF THE STUDY

Scientifically, there are many challenges facing the field of Homoeopathy and the process of succussion and its 'energy giving' properties has possibly caused more problems in the acceptance of Homoeopathy by the allopathic medical profession and the scientific world than any other element of Homoeopathy.
Perhaps this could be due to the lack of understanding of the dynamics of the liquid state, in particular the molecular structure of water and its relation to biological systems.
Very little scientific research has been conducted in the field of Homoeopathy and succussion, and it is therefore of significant importance to the homoeopathic profession that succussion and its relevance in the preparation of homoeopathic medication be scientifically evaluated. After all the Homoeopath is only as strong as his weakest link and if this is the preparation of his medication, it is of relevance to determine, through scientific research, whether succussion does enhance the efficacy of the Homoeopathic medicine.
The health situation in our country is in need of critical attention and people need to start looking toward complementary health care such as Homoeopathy as an alternative, safer and cheaper form of treatment. If the 'mystical shaking' of the Homoeopathic medicine is what stands in their way, there is a need to scientifically evaluate the processes of succussion (both hand and mechanical succussion) and their contributions to the properties of the medicine.

Microorganisms, that is, a biological system under controlled conditions, as a growth medium or experimental group are important, because this eliminates the subjectivity and individuality of patients and by so doing makes this research reproducible and objective.

This study was formulated to determine whether both hand and mechanical succussion play a role and are in fact relevant to the preparation of Homoeopathic medicine. The optimal number of succussions, as well as the methods of succussion were studied. Hand and mechanical succussion were evaluated.

The microorganism selected was Brewers yeast and the Homoeopathic medicines used were Pulsatilla, Psorinum, Kalium carbonicum and Natrum muriaticum. The study was performed under controlled conditions of incubation, temperature, aeration and composition of the culture medium, all of which were the optimal growth conditions for the particular yeast culture.

It has, in previous studies (Jones et al 1981, 1982, 1983) been shown that yeast culture can be used as a reliable model for testing Homoeopathic medicine, thereby making this study both practical and practicable in terms of present knowledge and scope.

CHAPTER TWO

2.0 REVIEW OF THE RELATED LITERATURE

2.1 INTRODUCTION

Samuel Hahnemann, the founder of Homoeopathy, introduced the method of making medicinal preparations by alternating dilutions and succussions or triturations (potentization with decimal potencies 1:10 and centesimal potencies 1:100).

There has been controversy as to whether these potencies are therapeutically active or not, but the situation is different when it comes to demonstrating the effects of potencies on plants. The idea of conducting this type of research was originated by Rudolf Steiner. Other researchers, including Kolisko (1923), Schwenk and Pelikan et. al., (1971), have confirmed that the action of potentized substances can be demonstrated on plant growth, including both higher and lower plants. Pelikan (1971) used a series of two hundred and forty growth trials and the effects of a singular substance, silver nitrate, on the growth of wheat and provided statistically significant evidence that potentized substances have the effect of increasing plant growth. Nicholson (1961) said,"with regard to succussion and the preparation of Homoeopathic medicine, we are not dealing with simple solutions, or ordinary dilutions. We are doing something to them - we are forcing them to behave in a special way, but all the time we are making use of natural phenomena."

2.2 PREPARATION OF HOMOEOPATHIC MEDICINE

Nicholson (1961) felt that succussion is the most remarkable and characteristic feature of the manufacturing of potencies. Succussion is fundamental and the keystone of our argument and method, if we are to use anything more than mother tincture. He stated that the molecules undergo a violent experience in comparison to their minute size, causing an increase in work done and therefore raising the internal kinetic energy of each solution by increasing molecular collisions, thus declaring that succussion is not just to ensure rapid and perfect mixing.

By using infra-red absorption spectra, Heintz (1941) showed that simple dilution showed no peaks of activity and thus deduced that the effects of Homoeopathic medicines were related to succussion and concluded that he was dealing with a molecular 'clustering effect' in the solvent. Gay (1951), by using electrical conductivity, showed changes in the capacitance of succussed solutions.

Watson and Crick (1953) and Miselson and Stahl (1958) showed that by varying the length and sequence of the deoxy ribonucleic acid bases (light and heavy) nature can carry the total 'blue print' of a human being at cellular level. And this is why in Homoeopathic dilutions beyond Avogadro's number (12CH), when no original solute remains, biological effects have been noted in succussed and serially diluted substances.

Nicholson (1961) suggested that beyond Avogadro's number the solvent is only a vehicle for the energy which would spread spontaneously and perhaps succussion is not necessary.

Symons (1967) summarized his data about water by commenting that X-ray diffraction data, viscosity, ultra-violet studies on iodide dissociation and studies on temperature all strongly suggested that water is a discontinuous fluid, or a fluid containing clusters of water molecules of varying sizes. He further suggested that the clustering or grouping of water molecules will have its effect on any biological material containing it; thus the complex shapes taken up Homoeopathic medicine may be due to the structural effects determined by water.

If a substance is dissolved in water or a water - alcohol mixture then the water molecules surround the solute molecules in a configuration specific for each solute, and that if free energy (this could be in the form of succussion) is introduced into such a system then these specific configurations could join to form polymers retaining the original imprint and shape specificity (Barnard,1965). It was suggested that serial succussion caused long shaped specific configurations to undergo 'severe shearing stresses'.When they reach a certain length, they fracture and then start to grow if given more energy (succussion)(Barnard,1965). Barnard and Stephenson's (1967,1968) imprint theory suggests that pharmaceutical substances imprint a water molecule polymer structure of various size and configurations during the exogenous energy of succussion.

Nicholson (1961) stated that succussion is not an external influence of additional power to the molecule, but rather causes the alteration of the environment to the molecule and McCrae (1952) suggested that these influences persist throughout all the stages of the process of potentization.

Gibson (1967) attempted to relate our knowledge of molecular biology to the succussion process in Homoeopathy. He stated that for every shape or configuration there is an equal and opposite shape or configuration and suggested that the solvent itself plays an important role. Boyd (1941), in his work on starch diastase inhibition by Mercuric chloride and Kolisko (1923) and Wannemaker (1966) indicated that substances prepared by serial dilution and succussion (potentization) have points of maximal and minimal activity related to the potency or the number of serial succussions.

It is believed that the practise of potentizing a Homoeopathic remedy is using the 'Mirror Principle' operating between positive and negative space time frames (Tiller, 1979). This method allows the etheric substance to increases in density as the physical substance decreases in density (Tiller, 1979).

2.3 METHODS OF SUCCUSSION

Hahnemann, the founder of Homoeopathy, claimed that there is an optimum number of succussions and that if the process was extended, the potency was drastically affected. Boyd (1941) confirmed these studies.

Whichever method of succussion employed, the important aspect is to impart movement to the fluid, that is the addition of energy causing alteration in the electromagnetic state of the whole solution.

2.3.1 PREPARATIONS USING HAND SUCCUSSION

The preparation of Homoeopathic medicines using hand succussion appears to have been very poorly researched. Few research studies that have been undertaken have concentrated on mechanical succussion rather than hand succussion. But a study was investigated in 1983 by Jones and Jenkins, the yeast model was used, with Pulsatilla in 4CH and 8CH potencies. Hand succussion was used to test the growth responses of the yeast. The following number of impacts: 1; 2; 4; 8; 30; 32; and 64 were used. A gradual but marked increase in the growth responses was shown as the number of impacts increased up to 60 and thereafter no further development was seen, there was perhaps even a negative effect.

2.3.2 PREPARATIONS USING MECHANICAL SUCCUSSION

Jones and Jenkins (1981) studied the effects of mechanical succussion on plant growth. Using wheat coleoptile growth responses and Kalium carbonate in 13CH to 17CH with 30 impacts (succussions), showed that plant responses are related to the number of serial succussions with serial dilutions, rather than dilutions only. After 30 days the potencies showed a loss of activity but once resuccussed, values comparable with the initial effects were obtained. It was postulated that succussion does appear to be of vital importance in the process of potentization. A cam-operated machine was used to perform the succussions.

Jones and Jenkins (1983) utilised a yeast model and investigated Pulsatilla in 4CH and 8CH potencies. They reported that by using the unrestricted machine (ie, it was not fixed to the table) there was an increase in the effect up to 140 impacts (succussions) and thereafter no effect was observed. By using the restricted machine (ie, it was fixed to the table) an unexpected finding was that there was a steady increase of inhibition with the number of impacts. It was stated that rhythmic factors may play an important role in the impact of succussion.

As a result of the anomolous findings by Jones and Jenkins (1983), the workers were unable to draw any conclusions with regard to the relative merits of hand succussion versus mechanical succussion, but stated that the phenomena certainly merits further study and that it would be to the benefit of Homoeopathy as a whole if basic scientific research into the

nature of the preparation of Homoeopathic medicines be actively encouraged.

2.4 MEDIUMS FOR TESTING HOMOEOPATHIC MEDICINES

It is of importance to the success of Homoeopathic research that all possibilty of bias and subjectivity be removed. Research has been conducted to determine the most suitable methods for testing Homoeopathic medicines. Jones and Jenkins (1981) described a biological method for monitoring aqueous Homoeopathic potencies. In addition Jones and Jenkins (1981) investigated the growth of yeast cultures in a simple sugar medium as affected by the addition of such potencies, comparing responses in all cases with control additions of distilled water. A parallel set of experiments was conducted by using wheat coleoptiles as a test medium. The results were statistically analysed and indicated that either yeast or wheat can be used as a model against which Homoeopathic medications may be studied. However it was stated that the sensitivity of the yeast method is about five times greater than that of the wheat coleoptile. Jones and Jenkins (1983) thus concluded that further studies of remedy properties in vitro could well make use of this technique, and stated that the question of the nature of succussion and the role of serial dilution as a cyclical factor in the development of the dynamic qualities said to be released from the parent substance need to be answered.

Both W A Steffen(1985) and E Hagelberg(1987) found that with the yeast strain Schizosacchromyces pombe there was no significant differences between the growth rate of the test and control

samples. According to available research up until now it appears that the most reliable type of yeast to use for an in vitro study of Homoeopathic medicines is the Brewers yeast, Saccharomyces cerevisiae.

2.5 DISCUSSION OF RELATED RESEARCH AND ASSOCIATED LITERATURE

After reviewing the appropriate literature, it appears that the area of succussion and its relevance in the preparation of Homoeopathic medicines has not been thoroughly investigated. The need for research in this area has been highlighted by several authors (Kumar et al 1979, Jones et al 1981, 1982, 1983, Hagelberg 1987).

According to the afore mentioned researchers the preparation of Homoeopathic medicines cannot be ignored and it is a very complex matter. It is important not to disregard the physics and the nature of water as well as properties of the Homoeopathic medicines themselves. Irrespective of whether the clustering effect, or molecular collisions increase the effectiveness of the Homoeopathic medicine, it is undisputed that these medicines have very special and specific energies, and the actual preparation procedures of the Homoeopathic medicines (namely succussion) play a vital role in the formation of these energies.

Maximal and minimal points of succussion have been observed, as well as the fact that succussion is not just performed in order to ensure the mixing of a solute and solvent, but rather to

impart the addition of energy, thus causing a significant alteration in the electromagnetic state of the solution.

Emphasis has previously been placed on mechanical succussion, with the result being that minimal research has been conducted to determine the effect of hand succussion in the preparation of a Homoeopathic medicine. In addition, the results of experiments involving hand succussion appear more consistent than those involving mechanical succussion. The optimal number of hand succussions appears to be 60 succussions (Jones et. al., 1983), whereas with mechanical succussion the optimal number may be as high as 140 succussions (Jones et. al., 1983). It has been suggested (Jones et. al., 1983) that the effect of the Homoeopathic medicines is perhaps decreased if the optimal number of succussions is surpassed. Rhythmic factors appear to play an important role in the succussion process.

Previous research indicates that the most reliable and successful media for testing Homoeopathic medicines is the yeast culture and more specifically the Brewers yeast, Saccharomyces cerevisiae. Although higher plants such as wheat coleoptiles have been investigated, yeast still appears to be more sensitive as a model for testing the preparation of Homoeopathic medicines.

The current state of literature and research into the testing of Homoeopathic medicines lacks conformity, with various wheat coleoptile and yeast models being used, thus making the comparison of results difficult. During this research project it was intended to standardise the results by using one yeast culture, namely Saccharomyces cerevisiae as suggested by Jones and Jenkins (1983), thus having a comparative effect of those

remedies being tested. The selection of Homeopathic medicines, shown below, for this research study, has been conducted with a specific rationale in mind viz., to facilitate a comparative study incorporating strong standardisation of methods and treatments. This approach has been lacking in previous studies, viz., Pulsatilla - this Homeopathic medicine was shown by Jones and Jenkins (1983) to produce a marked potentiation of yeast growth. Kali Carbonicum - Jones and Jenkins (1981), showed that with the addition of this Homoeopathic medicine, wheat coleoptile growth differed significantly to the controls.
Natrum Muriaticum - Steffen (1985) used this Homoeopathic medicine in his study using the yeast model Schizosaccharomyces pombe, and concluded that this model did not prove to sensitive to the potency treatments applied. Psorinum - this Homoeopathic medicine has been selected for current research due to the fact that no previous research has been conducted on this medicine.

The need for research into the field of the preparation of Homoeopathic medicine and more specifically the impact of succussion in the preparation of Homoeopathic medicines, with special reference to the methods of succussion (hand and mechanical succussion) and their effect on yeast cell culture growth rates, so as to identify the relevance of succussion in the preparation of Homoeopathic medicine, is therefore apparent.

CHAPTER THREE

3.0 THE DATA, THEIR TREATMENT AND THEIR INTERPRETATION

3.1 THE DATA

The data emanating from this study were of two types; primary and secondary data. The nature of each of these two types of data will be presented below.

3.1.1 THE PRIMARY DATA

Two types of primary data were needed:

a) The impact of the hand succussion method in the preparation of Homoeopathic medicine, with reference to its effect on yeast cell culture growth,

b) The impact of the mechanical succussion method in the preparation of Homoeopathic medicine, with reference to its effect on yeast cell culture growth.

3.1.2 THE SECONDARY DATA

The secondary data includes current documentation on the findings of the relevance of succussion in the potentization process in the preparation of Homeopathic medicine. Published reports and journal articles on the methodologies and equipment suggested on undertaking *in vitro* studies on Homoeopathic medicine.

3.2 THE CRITERIA GOVERNING THE ADMISSIBILITY OF THE DATA

Only the data from the experimentation conducted by the researcher, were used.

The secondary data from reputable journals and researchers on the *in vitro* experimentation of Homoeopathic medicine were considered.

3.3 RESEARCH METHODOLOGY

Since the objective of this study was to identify the impact of succussion in the preparation of Homoeopathic medicine, the performance of the medicines was technically evaluated.

The experimental method using the single - variable design; after - only with control to interpret the afore mentioned data, was used.

The yeast cell culture used was based on the *in vitro* model for testing Homoeopathic medicine as suggested by Jones and Jenkins (1983).

3.4 THE SPECIFIC TREATMENT OF EACH SUBPROBLEM

3.4.1 SUBPROBLEM ONE

To evaluate the impact of succussion in the preparation of Homoeopathic medicine with reference to hand succussion and cell culture growth in order to determine the effect of hand succussion.

THE DATA NEEDED

The data needed for testing the hypothesis of subproblem one was used in laboratory experimental procedures using the single - variable design; after - only with control.

The following data was needed:

a) Preparation of a yeast culture

b) Means of determining the yeast cell culture growth - direct cell counting technique

c) Hand succussion methodology

d) Effectiveness and properties of Pulsatilla 8CH

e) Effectiveness and properties of Psorinum 8CH

f) Effectiveness and properties of Kali Carbonicum 8CH

g) Effectiveness and properties of Natrum Muriaticum 8CH

LOCATION AND CAPTURING OF THE DATA

Preparation of the yeast cell culture as well as the means of determining the yeast cell culture growth was obtained from the literature. Specifically the methodology proposed by Jones and Jenkins (1983), for using yeast cell culture as an *in vitro* model for testing Homoeopathic medicine, was studied.

The established method of hand succussion was obtained through Homoeopathic literature (Hahnemann, 1982).

Information regarding Pulsatilla, Psorinum, Kali Carbonicum and Natrum Muriaticum was obtained from published reports and journal articles as well as Homoeopathic books.

Materials for preparation of the yeast culture was obtained from appropriate suppliers.

The mother tinctures of the Homoeopathic medicines Pulsatilla, Psorinum, Kalium carbonicum and Natrum muriaticum were obtained from Natura Laboratories in Pretoria.

THE TREATMENT (PROCESSING AND REPORTING) OF THE DATA

PROCESSING THE DATA

The yeast cell culture was prepared in the following manner as suggested by Jones and Jenkins(1983):

The culture medium was 2% glucose, 0.2% malt extract, in distilled water, sterilised by autoclaving.

The sterile culture medium was kept at 30 C for one hour. The test tube was then placed on a vortex mixer (fifteen seconds at

6000rpm) and returned to the incubator for a total of 24 hours.

Preparation of each of the Homoeopathic medicines was conducted as described in Appendix 1.

The number of hand succussions used in the study were:
(0) no succussions to be performed, only serial dilutions 40, 60, 80, 100, 120, 140, 160. Succussions were performed on each potency where 'hand succuss' is mentioned in Appendix 1. The experiments were conducted on the 8CH potency of each medicine. These experiments were performed in duplicate.

Using aseptic techniques 1ml of potentized remedy was added to 8ml of the sterile culture medium in a sterile test tube. For the controls, 1ml of saline water was added to 8ml of sterile culture medium. No medication was added to the controls. A standard (ie, with an optical density of 1.2) Saccharomyces cerevisiae innoculum of 0,1ml was asseptically added to all tubes. The prepared tubes were be incubated at 30 C without agitation, for 24 hours.
Quantification of yeast cells was by 10 fold serial dilution and spread plating 1ml on solid yeast media. Plates were incubated for 48 hours at 30 C. Only those plates showing between 30 and 300 colonies were counted and the cell densities computed by taking into account appropriate dilution factors. All experiments were conducted in duplicate. Counts were then normalised as means against the controls and tabulated (Appendices 2.1 to 2.4), and then graphically represented.

The dilution plating method quantifies viable cells only. This method has been selected to overcome the limitations of the direct cell count viz., the counting chamber method utilised by Jones and Jenkins (1983). The direct cell count method quantifies viable and non-viable cells and therefore its accuracy at quantifying growth is doubtful.

REPORTING THE DATA

Counts were tabulated and represented against the number of succussions (Appendices 2.1 to 2.4). These results are then graphically represented ie, Figures 1 to 5.

INTERPRETATION OF THE DATA

The data was interpreted using statistical analysis viz., analysis of variance (ANOVA) method, which involves calculating both the mean and standard variation for the data. This is shown in Tables 9, 10, 11 and 12 (Appendices 3.1, 3.2, 3.3, 3.4). The independent samples T-test was used to establish the effect of hand succussion. Tukey's HSD Multiple Comparisons test with a probability level of 90% was used, thereby determining the relationship between the number of succussions and yeast cell growth (Appendices 4.1 to 4.8).

A probability of < 0.05 shows a significant difference.

3.4.2 THE SECOND SUBPROBLEM

To evaluate the impact of succussion in the preparation of Homoeopathic medicine with reference to mechanical succussion and cell culture growth rates in order to determine the effect of mechanical succussion.

THE DATA NEEDED

The data needed for testing the hypothesis of subproblem two was obtained from the laboratory experimental procedures using the single - variable design; after - only with control.

The following data was needed:

a) Method of preparation of the yeast cell culture.

b) Means of determining yeast cell culture growth.

c) Method of mechanical succussion and the equipment needed to perform it.

d) Effectiveness and properties of Pulsatilla in a 8CH.

e) Effectiveness and properties of Psorinum in a 8CH.

f) Effectiveness and properties of Kali Carbonicum in a 8CH.

g) Effectiveness and properties of Natrum Muriaticum in a 8CH.

LOCATION AND CAPTURING OF THE DATA

Preparation of the yeast culture and the method of determining yeast cell culture growth was conducted as in subproblem one.
The information regarding Pulsatilla, Psorinum, Kali Carbonicum, and Natrum Muriaticum was gathered as presented in the first subproblem.
The methodologies of mechanical succussion were obtained from the literature (Jones and Jenkins, 1983).
The succussion machine to be used was borrowed from the Department of Homoeopathy, Technikon Natal, Berea campus.
The yeast cell culture and Homoeopathic medicine mother tinctures were obtained as was already mentioned in subproblem one.

THE TREATMENT (PROCESSING AND REPORTING) OF THE DATA

PROCESSING THE DATA

The yeast culture was prepared in the same manner as mentioned in subproblem one.
With regards to the preparation of the Homoeopathic medicine, it was performed in the same manner as mentioned in subproblem one with the exception of the succussion steps, where mechanical succussion was used instead of the hand succussion method (Appendix 1).
The number of succussions used in the first subproblem were repeated, but were performed by the mechanical method.
The addition of potentized remedy to the culture medium was executed in the same manner as mentioned in subproblem one.

Measurement of the yeast cell growth was by viable cell count, as mentioned in subproblem one.

REPORTING THE DATA

Counts were tabulated and represented against the number of succussions (Appendices 2.5 to 2.8).

These results are then represented graphically in Figures 6 to 10.

INTERPRETATION OF THE DATA

The data was interpreted using statistical analysis, the same method mentioned in subproblem one was used. Thus using ANOVA to determine the means and standard deviations shown in Tables 13, 14, 15 and 16 (Appendices 3.5 to 3.8)

Tukey's HSD Multiple Comparison Test was again used to determine the relationship between the number of succussions and yeast cell growth (Appendices 4.1 to 4.8). A probability level of <0.05 shows a significant difference.

3.2.4 THE THIRD SUBPROBLEM

To integrate the findings of hand and mechanical succussions in order to evaluate the relevance of succussion in the preparation of Homoeopathic medicine.

THE DATA NEEDED

The data needed to test the hypothesis of subproblem three was obtained from the integration of the goals and results of the investigations of subproblem one (the impact of hand succussion on yeast cell growth) and subproblem two (the impact of mechanical succussion on yeast cell culture growth).

THE LOCATION AND CAPTURING OF THE DATA

The data captured in the Tables 1 to 16 (Appendices 2 and 3) and the data obtained from Figures 1 to 10 was used.

THE TREATMENT (PROCESSING AND REPORTING) OF THE DATA

All the information which is applicable from Tables 1 to 16 (Appendices 2 and 3) and Figures 1 to 10 was necessary in the processing and reporting of the data.
By comparison the strengths and weaknesses of all the groups became visible, and this information was integrated and analysized in order to produce Figures 11 to 14.

INTERPRETATION OF THE DATA

Interpretation of the data was facilitated by statistically analysing all data from Tables 1 to 8 (Appendix 2) and Figures 1 to 10, including the ANOVA calculations (Appendices 3 and 4), these results were then graphically illustrated. Thereby objectively determining the impact of the hand and mechanical methods of succussion on the preparation of Homoeopathic medicine and thus concluding the actual relevance of succussion in the preparation of Homeopathic medicine.

CHAPTER FOUR

4.0 THE RESULTS

4.1 SUBPROBLEM ONE

This subproblem proposed to determine the impact of succussion in the preparation of homoeopathic medicine with reference to hand succussion and cell culture growth rates in order to determine the effect of hand succussion.

The tables 1 to 4 and 9 to 12 (Appendix 2 and 3) show growth of the yeast Saccharomyces cerevisiae with the addition of the various medicines. Figures 1 to 5 below graphically illustrate these results. Microbiologically, given the inherent inaccuracy of the plate count method there should be a difference of two or more logs for a significance. The graphical results thus indicate that there is no significant difference between any of the variables.

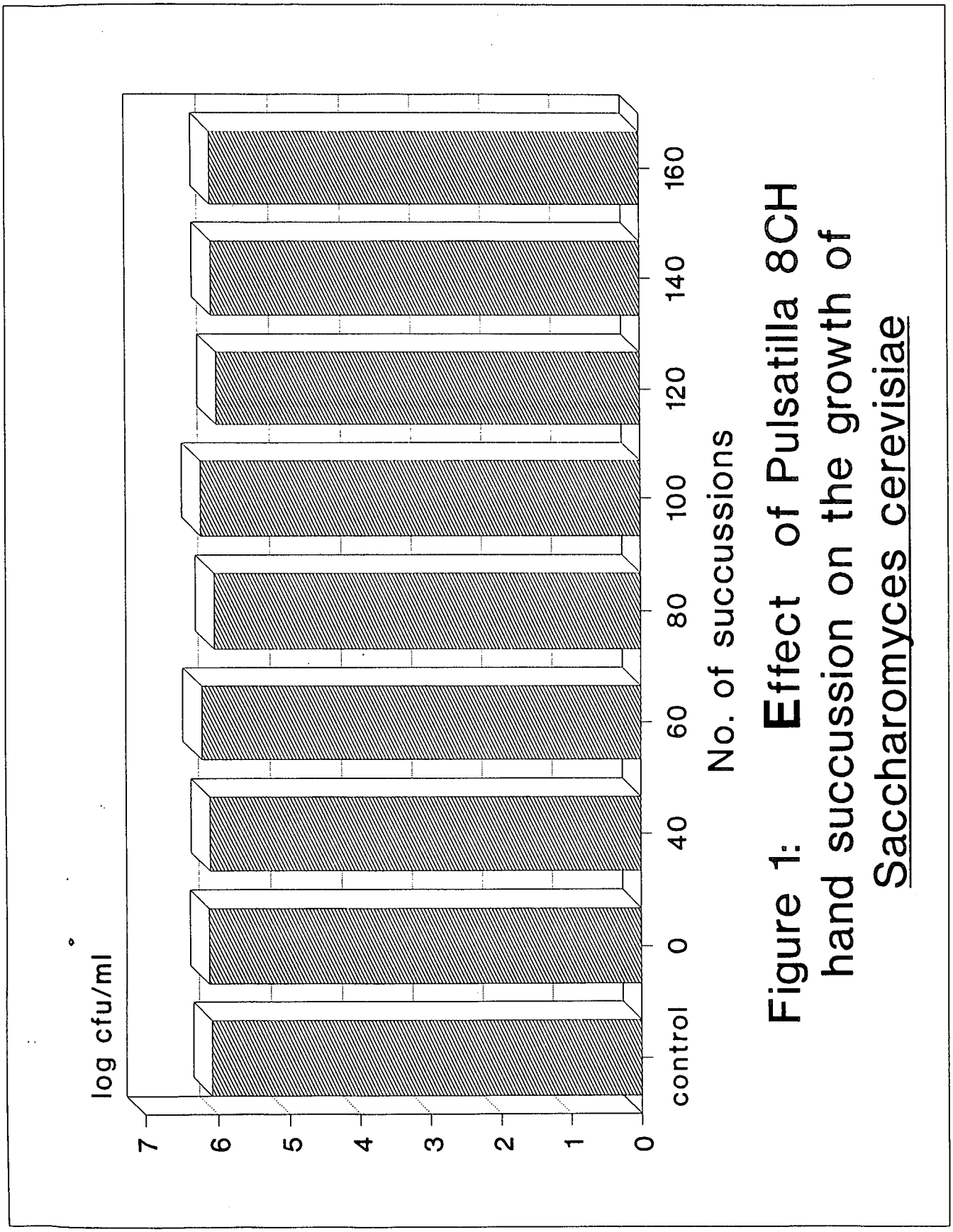

Figure 1: Effect of Pulsatilla 8CH hand succussion on the growth of Saccharomyces cerevisiae

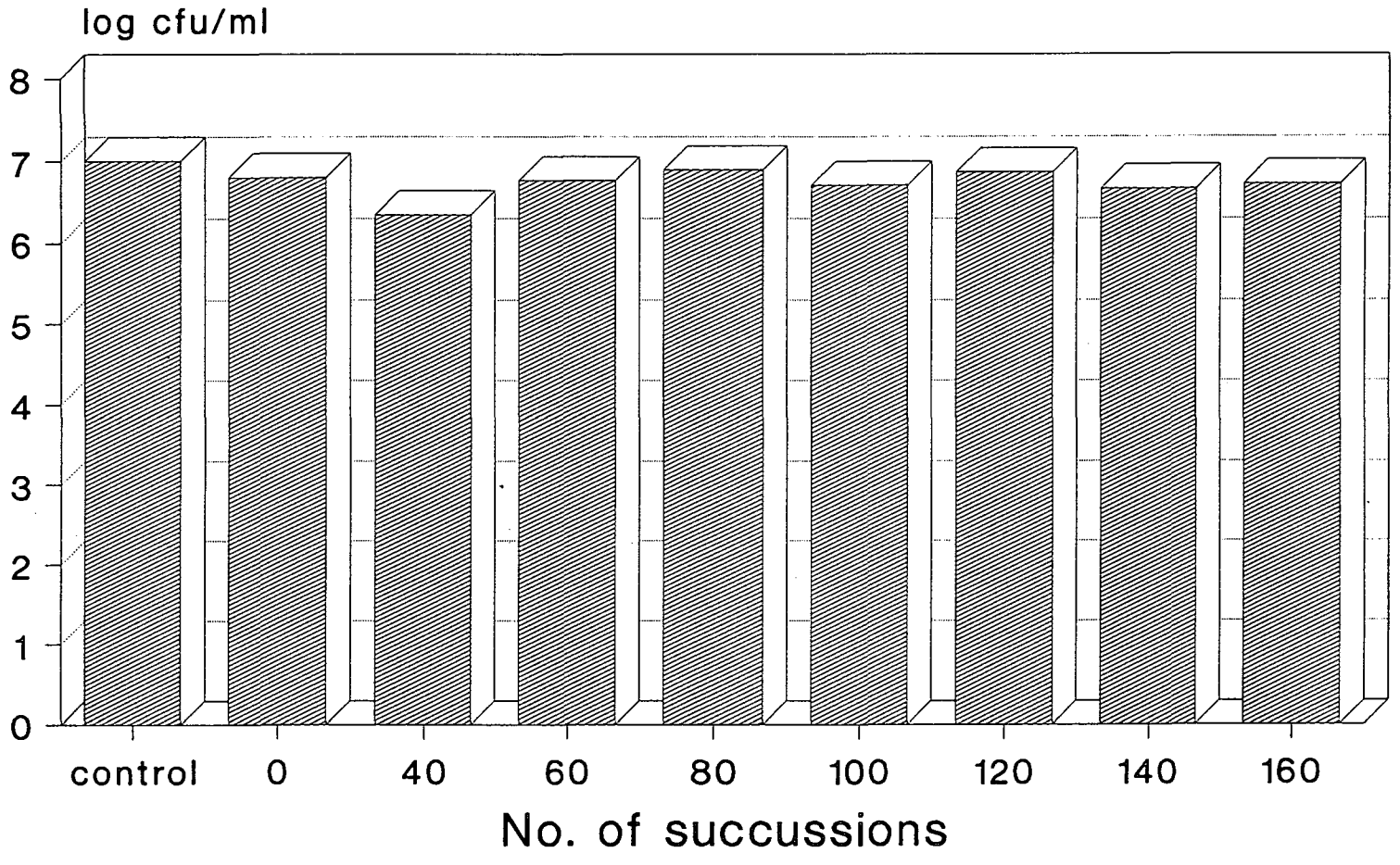

Figure 2: Effect of Kalium carbon 8CH hand succussion on the growth of Saccharomyces cerevisiae

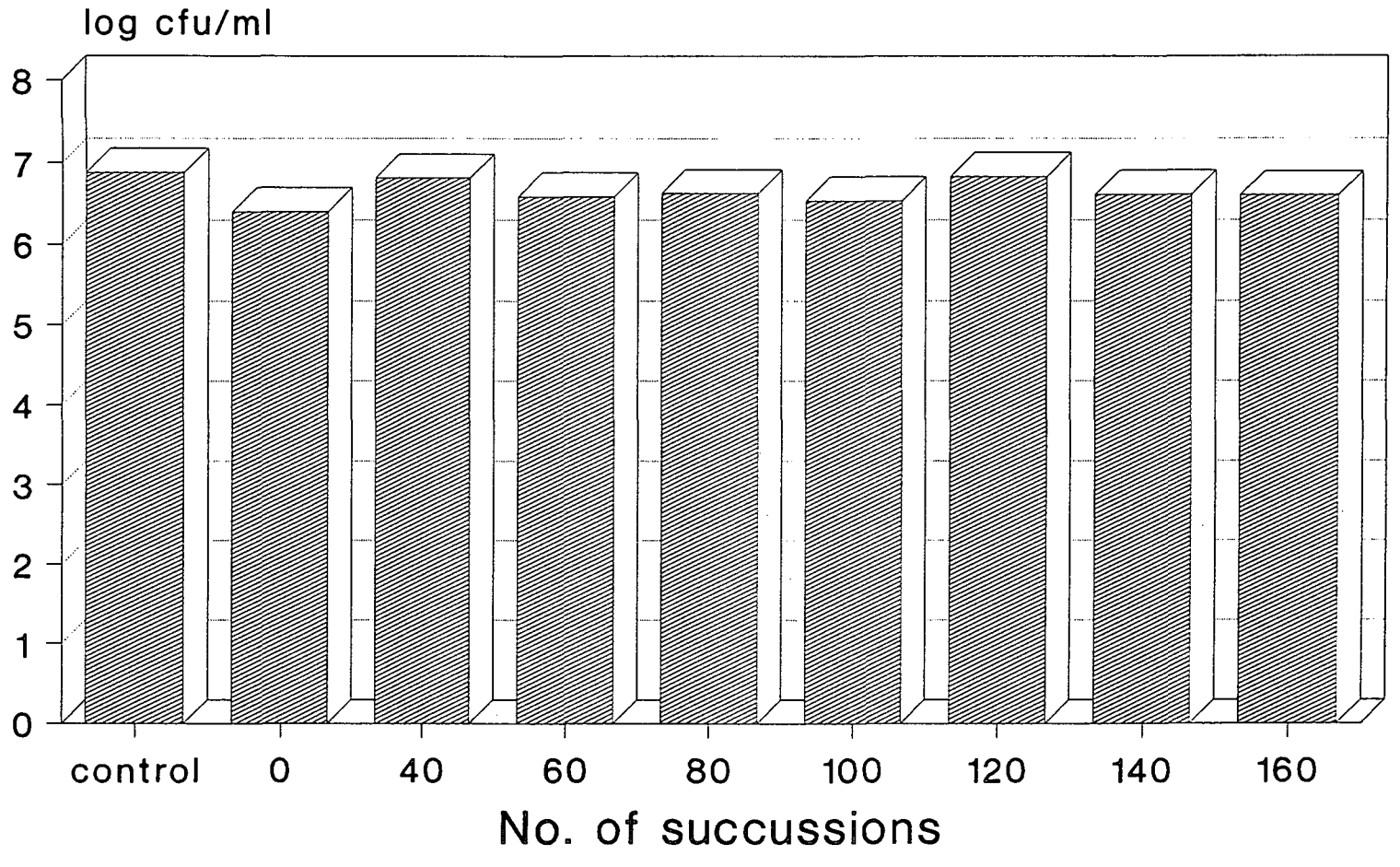

Figure 3: Effect of Natrum muriaticum 8CH hand succussion on the growth of Saccharomyces cerevisiae

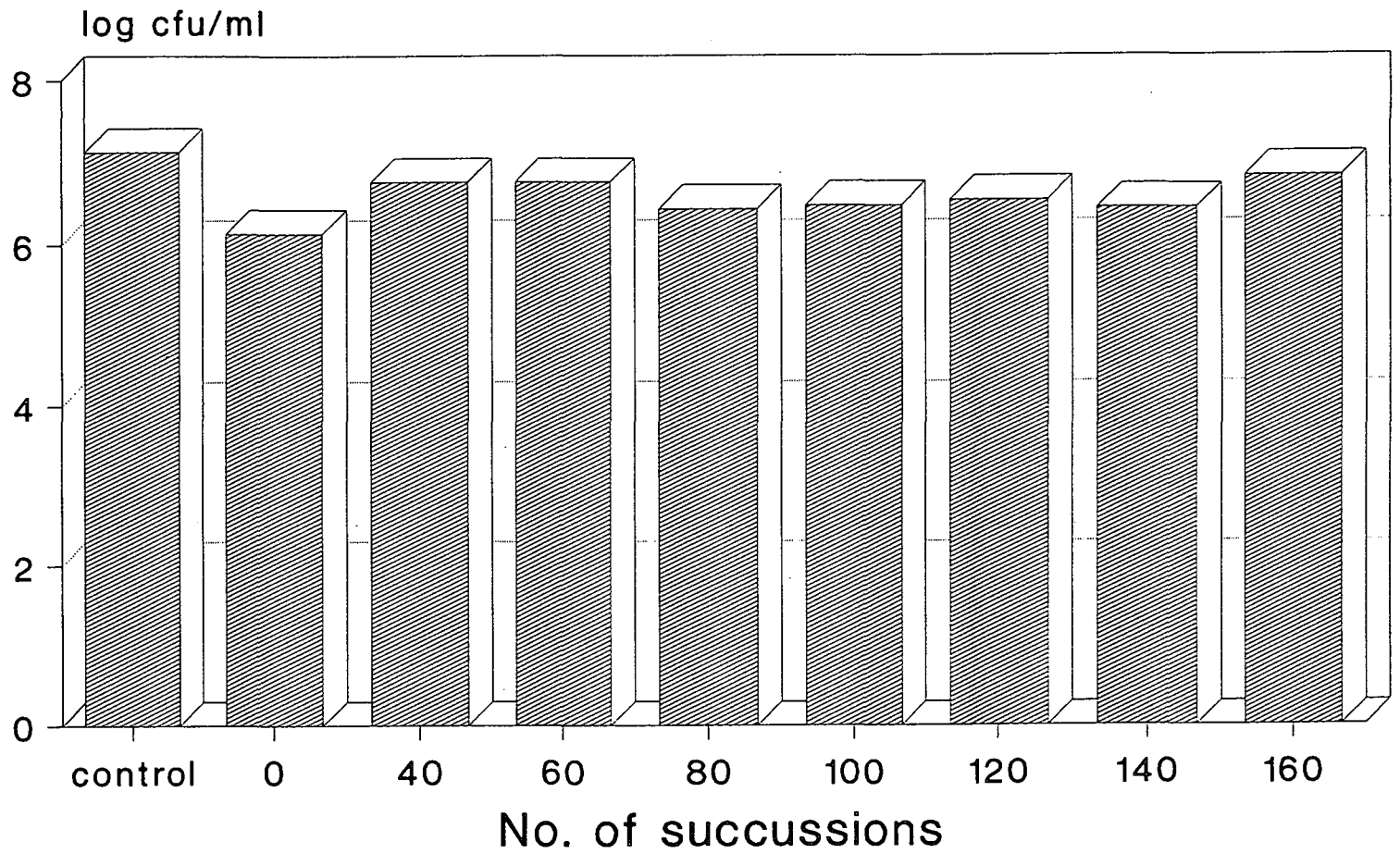

Figure 4: Effect of Psorinum 8CH hand succussion on the growth of Saccharomyces cerevisiae

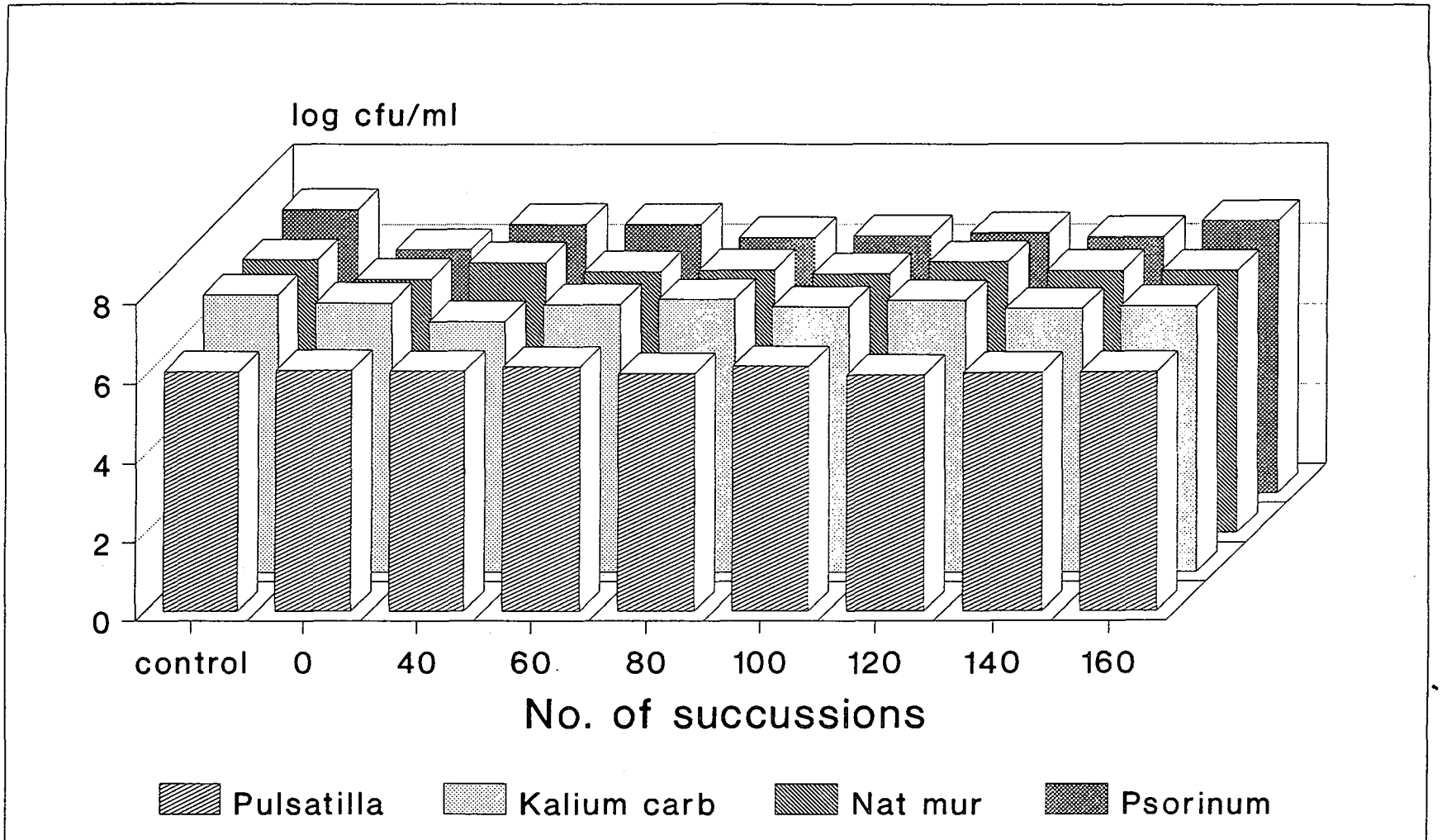

Figure 5: Effect of different medicines and hand succussions on the growth of Saccharomyces cerevisiae

4.2 SUBPROBLEM TWO

This subproblem proposed to determine the impact of succussion in the preparation of homoeopathic medicine with reference to mechanical succussion and cell culture growth rates in order to determine the effect of mechanical succussion.

The tables 5 to 8 and 13 to 16 (Appendix 2 and 3) serve to show the growth of Saccharomyces cerevisiae with the addition of the various homoeopathic medicines.

The figures 6 to 10 below graphically illustrate these results. Microbiologically, due to the inherent inaccuracy of the plate count method there should be a difference of at least two or more logs for significance, thus these results indicate there is no significant difference between any of the variables.

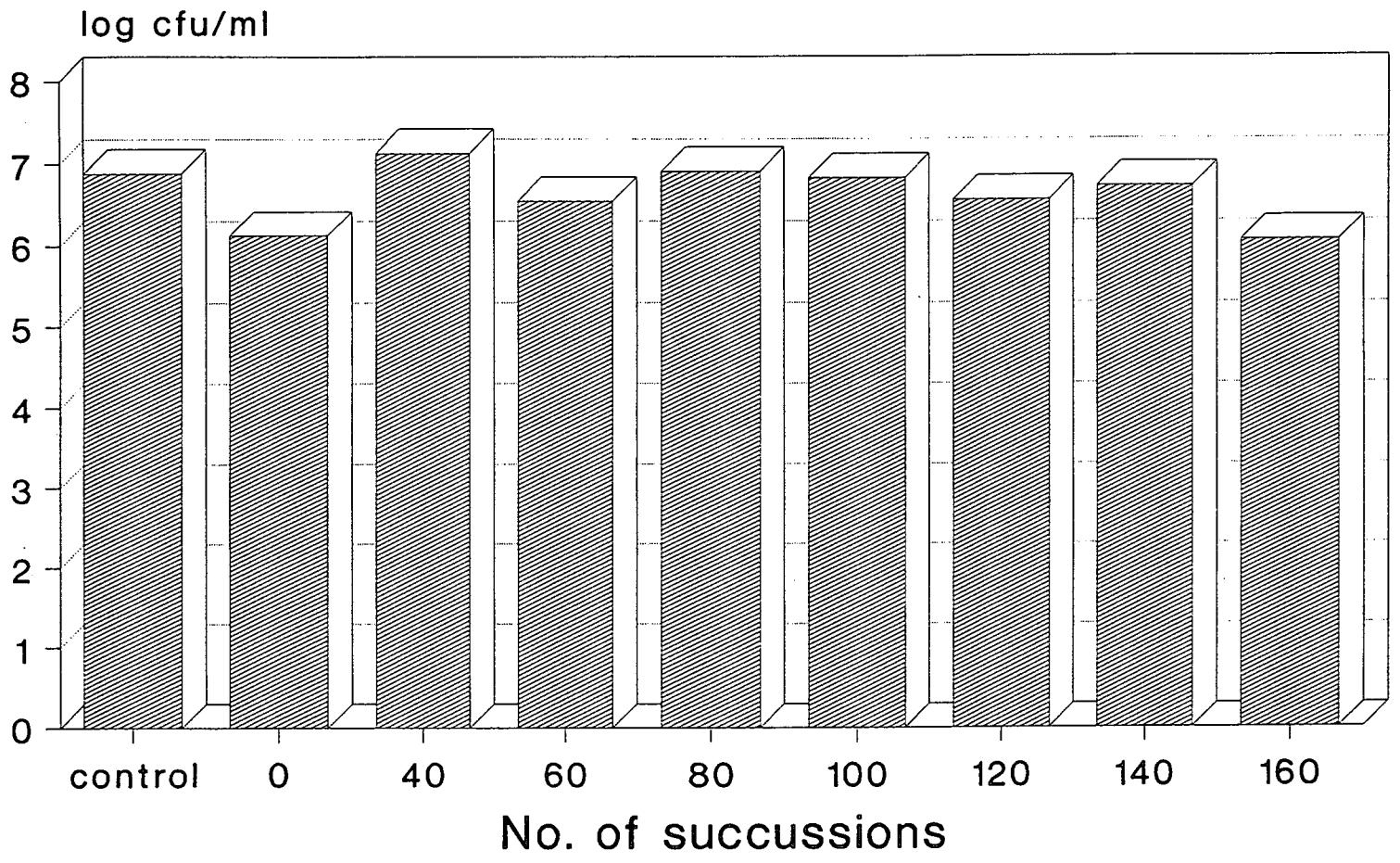

Figure 6: Effect of Pulsatilla 8CH mechanical succussion on the growth of Saccharomyces cerevisiae

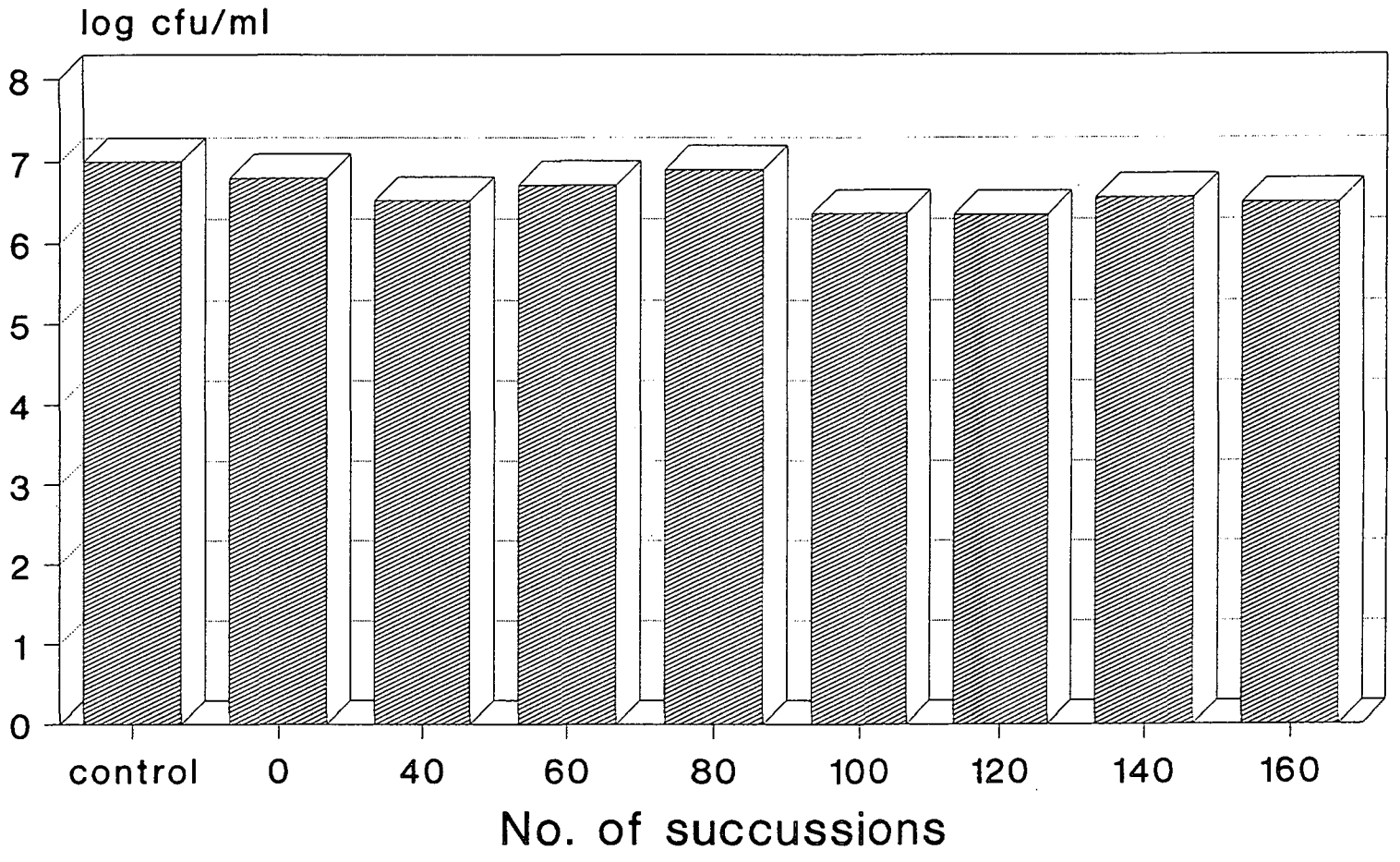

Figure 7: Effect of Kalium carbonicum mechanical succussion on the growth of Saccharomyces cerevisiae

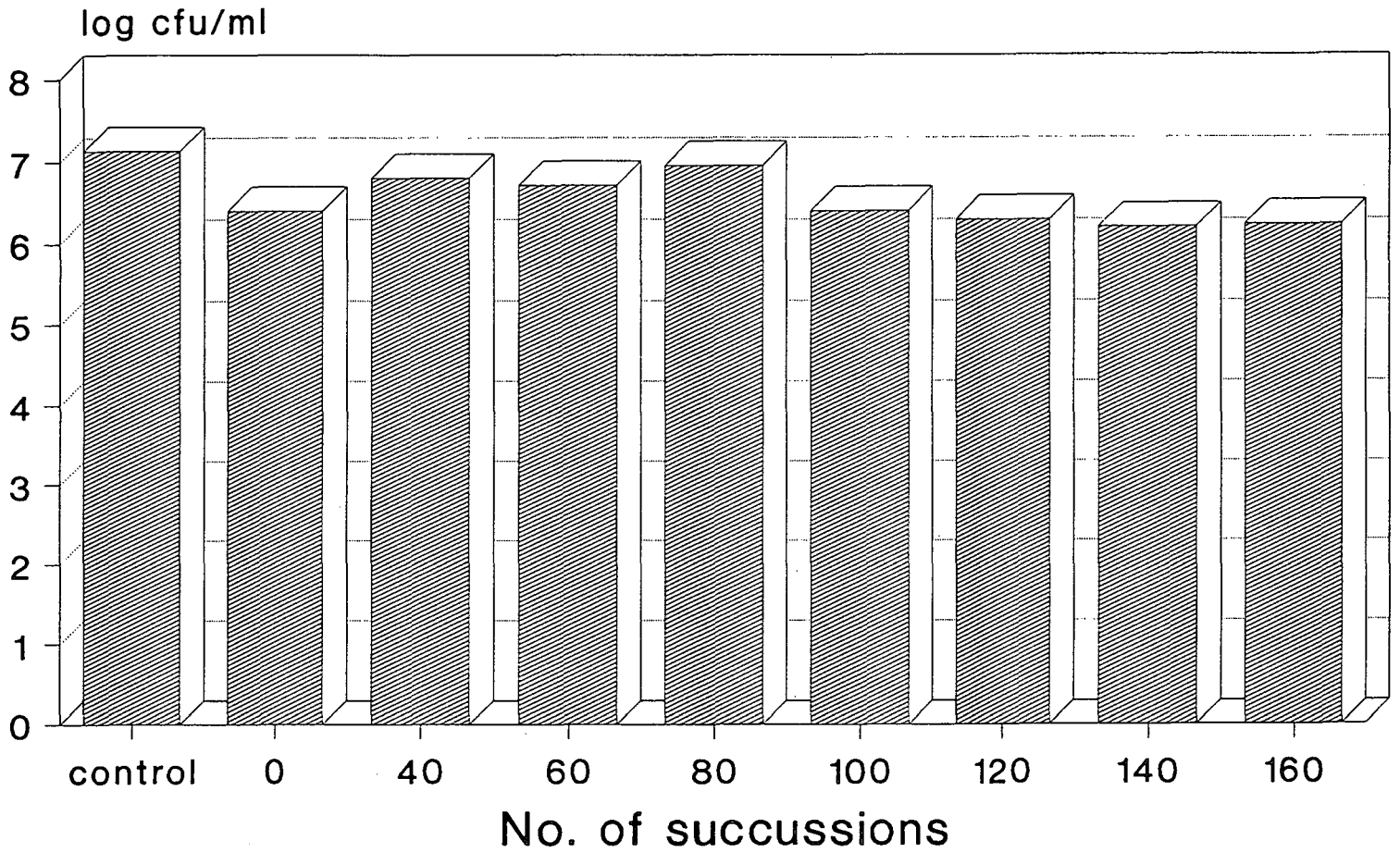

Figure 8: Effect of Natrum muriaticum mechanical succussion on the growth of Saccharomyces cerevisiae

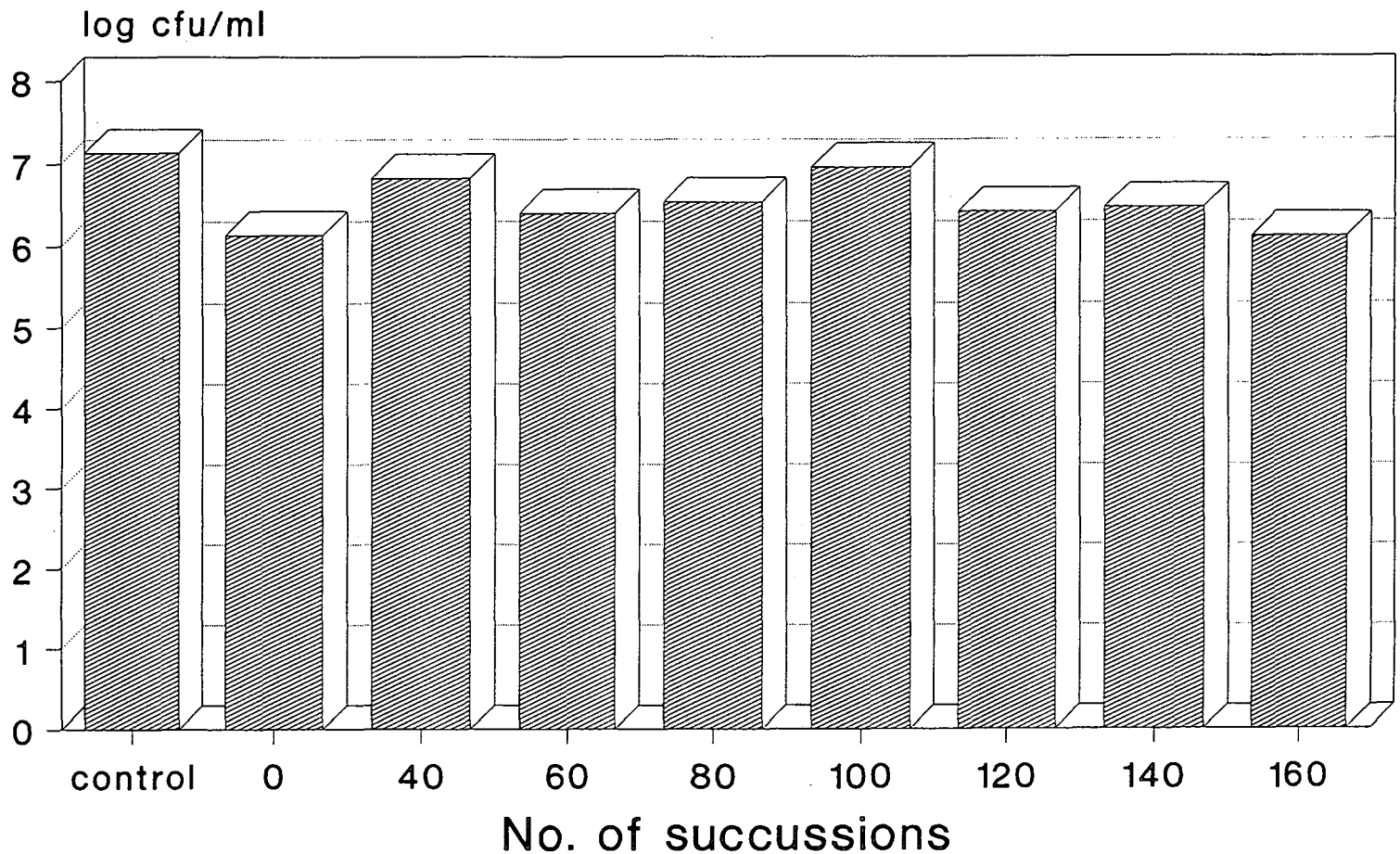

Figure 9: Effect of Psorinum 8CH mechanical succussion on the growth of <u>Saccharomyces cerevisiae</u>

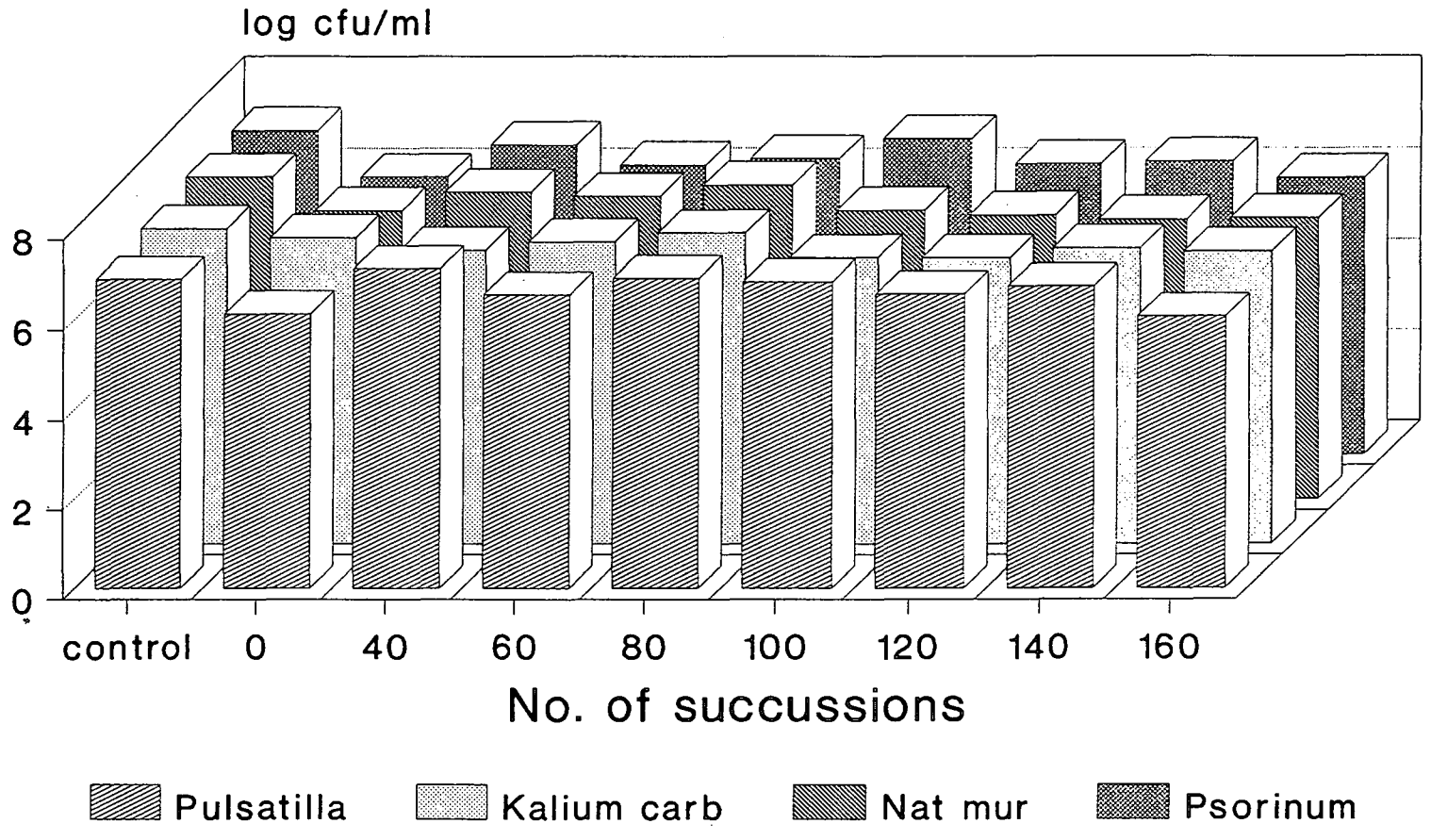

Figure 10: **E**ffect of different medicines and mechanical succussions on the growth of <u>Saccharomyces cerevisiae</u>

4.1 SUBPROBLEM THREE

This subproblem proposed to integrate the findings of hand and mechanical succussion, that is subproblems one and two in order to evaluate the relevance of succussion in the preparation of homoeopathic medicine.

The graphs below serve to illustrate the integration the results of the hand and mechanical succussion.

As a difference of two or more logs is necessary for a significance, these results indicate that there is no significant difference between any of the variables.

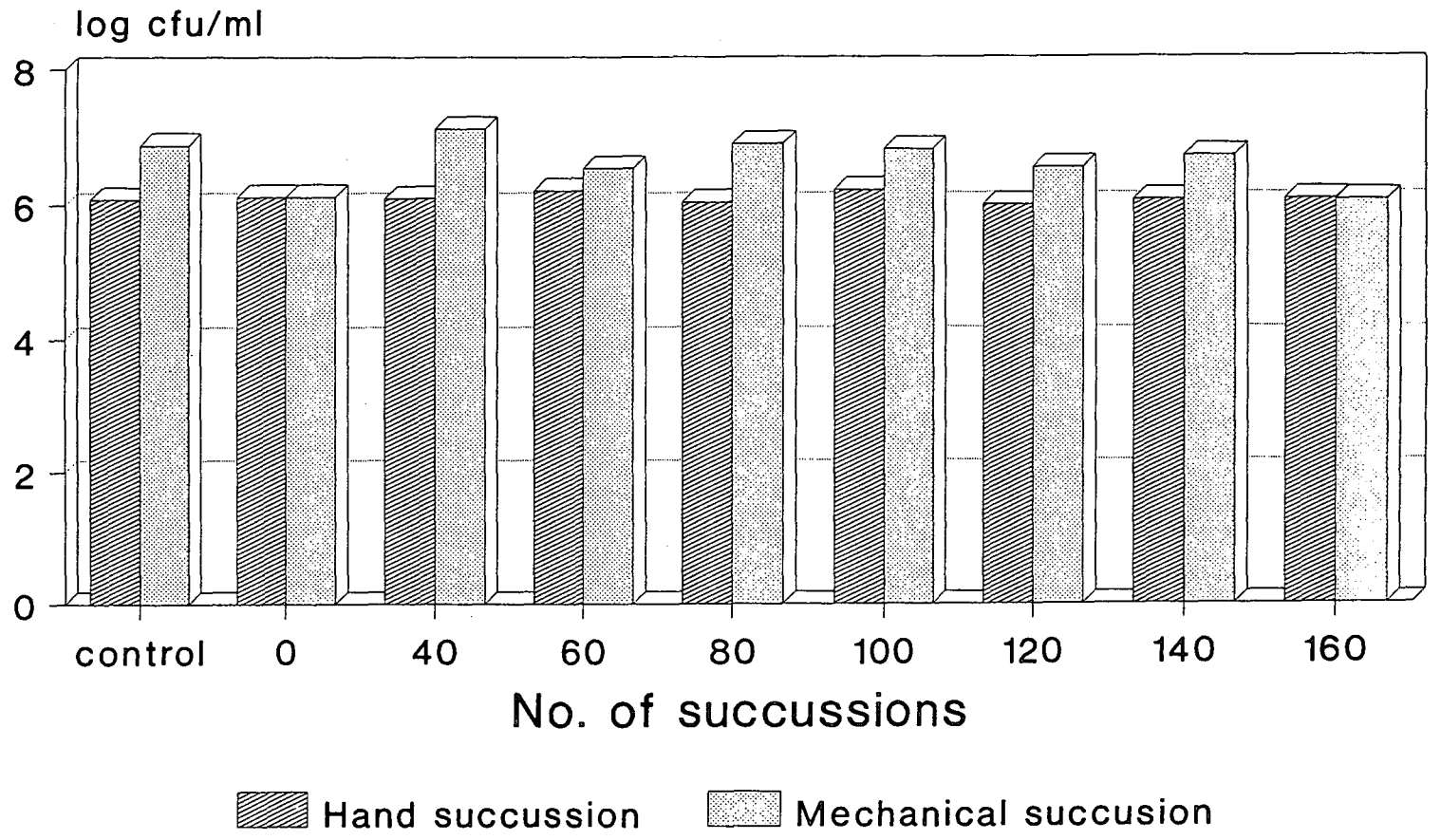

Figure 11: **E**ffect of Pulsatilla 8CH hand versus mechanical succussion on the growth of <u>Saccharomyces cerevisiae</u>

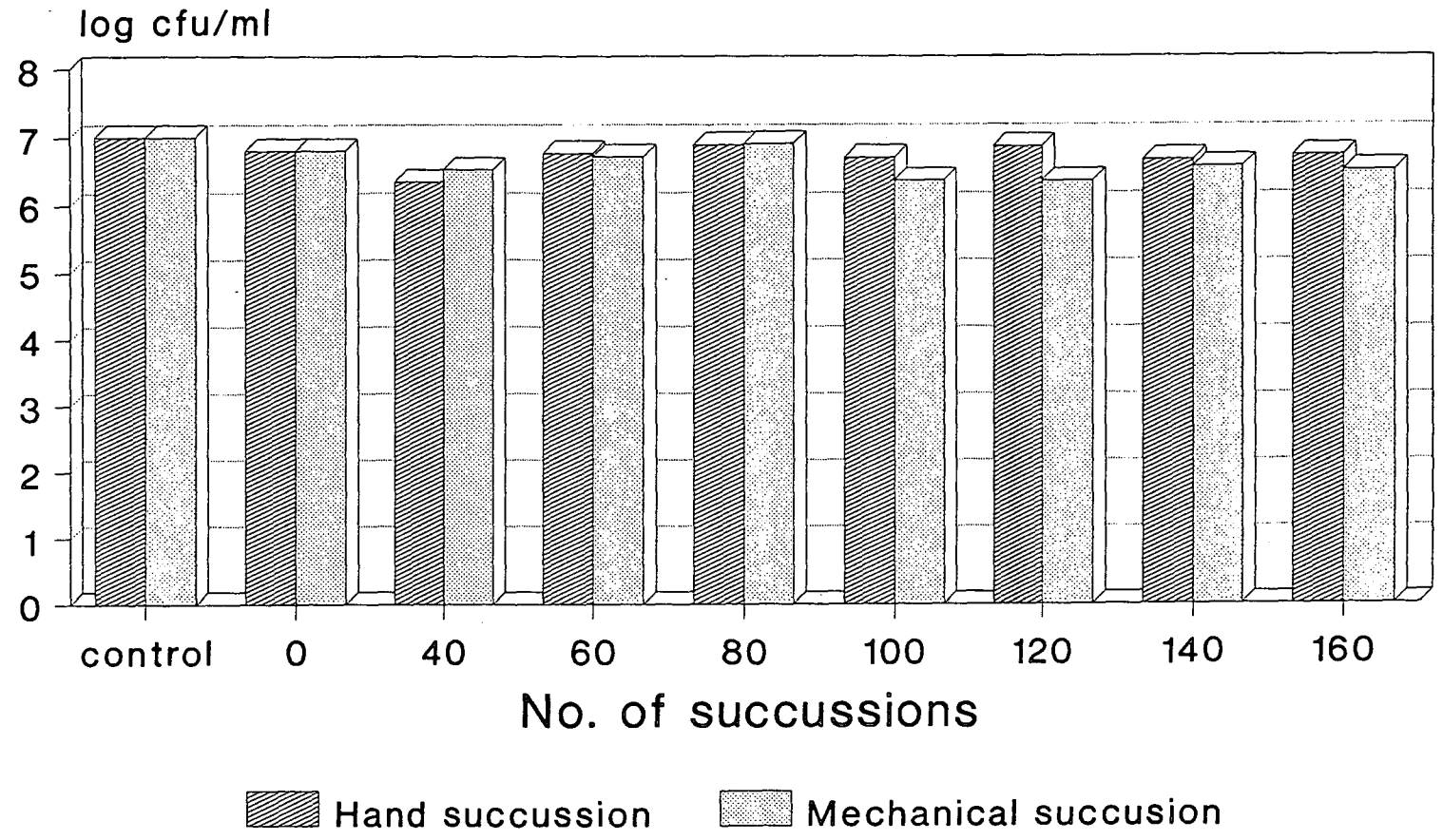

Figure 12: **E**ffect of Kalium carbonicum 8CH hand vs mechanical succussion on the growth of Saccharomyces cerevisiae

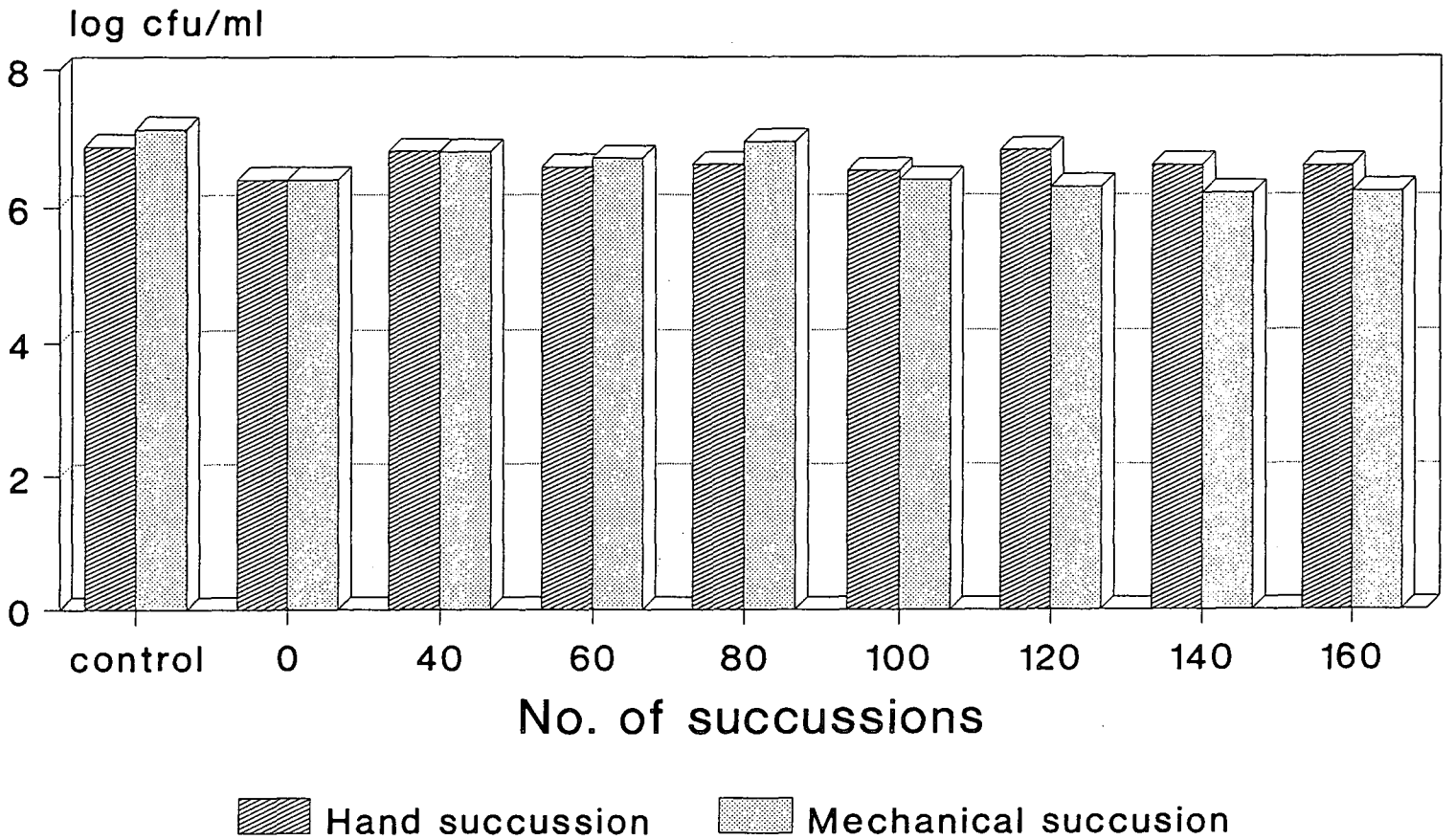

Figure 13: Effect of Natrum muriaticum 8CH hand vs mechanical succussion on the growth of Saccharomyces cerevisiae

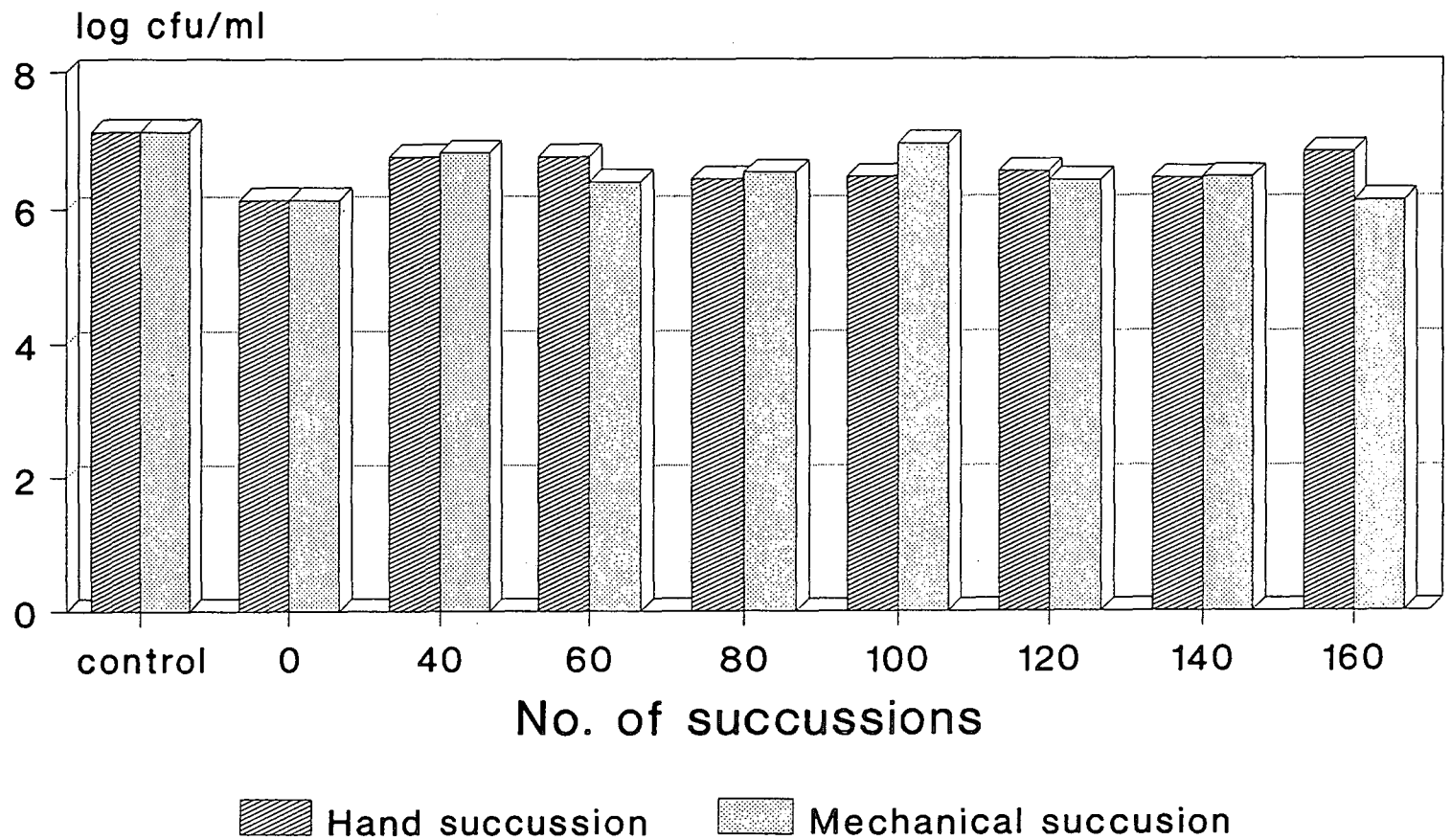

Figure 14: Effect of Psorinum 8CH hand vs mechanical succussion on the growth of Saccharomyces cerevisiae

CHAPTER FIVE

5.0 DISCUSSION

This chapter serves to discuss the results displayed in the previous chapter and compare them to other investigations involving Saccharomyces cerevisiae and homoeopathic medicines.

In the statistical analysis of the results using Tukey's multiple comparison test Psorinum, Kali carbonicum and Natrum muriaticum have all shown a significant difference to the control in both preparations involving hand and mechanical succussion (Appendix 4). These results thus show that the homoeopathic medicines above do affect the yeast growth.

5.1 SUBPROBLEM ONE

It is interesting to note from the current study that Pulsatilla, which Jones and Jenkins (1983) have based all their previous studies on, has shown to have the least significant effect on the Sacchromyces cerevisiae growth. This is in concurrence with Steffan (1985) in his critical analysis of Jones and Jenkins (1983) study, where he concluded that the yeast showed no sensitivity whatsoever toward Pulsatilla.

Psorinum 8CH prepared using hand succussion showed the optimal number of succussions to be 40 (Figure 4),(Appendix 2,3,4).
In the preparation of Kali carbonicum 8CH using hand succussion the medicine showed a significant difference to the control where

no medicine had been added, but did not show any significant difference to each other in the various different numbers of succussion (Figure 2), (Appendix 4).

Although Natrum muriaticum 8CH hand succussion showed that there was significant difference to the control on the whole, none of the preparations individually showed a significant difference (Figure 3), (Appendix 4).

These results do vary from the results of Jones et. al.(1983) where it was stated that the optimal number of hand succussions was 60. Jones et. al., (1983), had only used Pulsatilla in their study thus further causing a questioning of the validity of their results.

5.2 SUBPROBLEM TWO

Pulsatilla 8CH prepared with mechanical succussion showed no significant difference in growth to the controls (Figure 6), (Appendix 4).

Psorinum 8CH prepared with mechanical succussion showed the optimal number of succussions to be 40 (Figure 9), (Appendix 2,3,4).

Kalium carbonicum 8CH prepared with mechanical succussion showed the optimal number of succussions to be 80 (Figure 7), (Appendix 2,3,4).

Likewise the mechanical preparation of Natrum muriaticum 8CH showed the optimal number of succussions to be 80 (Figure 8), (Appendix 2,3,4).

In previous research as undertaken by Jones et. al.,(1983) the optimal number of mechanical succussions was found to be 140, this result varies substantially from the results of the present study.

The optimal number of succussions for Psorinum, irrespective of the preparation method, appears to be 40. The optimal number of mechanical succussions for Kali carbonicum and Natrum muriaticum appears to be 80. While their optimal number of hand succusions remains unclear.

6.3 SUBPROBLEM THREE

The integration of the results of subproblems one and two shows statistically, on a numerical basis that succussion plays an observably significant role in the preparation of the homoeopathic medicines (Appendix 4). However the graphically illustrated results (Figures 11 to 14), did not show a significant difference. According to the method and model used, findings show that succussion plays no role and thus the relevance of succussion in the preparation of homoeopathic medicines is questionable.

CHAPTER SIX

RECOMMENDATIONS AND CONCLUSIONS

6.1 RECOMMENDATIONS

It is recommended that research should be continued in this field, with emphasis being based on the development of a reliable and sensitive microbial or cell culture system for in vitro testing of homoeopathic medicines. The model as suggested by Jones and Jenkins (1983) appears to have certain weaknesses; especially the lack of sensitivity to Pulsatilla the singular medicine on which all of their studies have been based.

It is suggested that a larger number of yet untested Homoeopathic medicines be included in further studies so as to further validate the results. In further studies, a larger number of trials should be utilized than in the present study and perhaps an automated method of cell counting such as a Coulter counter should be used.

6.2 CONCLUSIONS

In this study, the researcher attempted to determine the effect of succussion in the preparation of homoeopathic medicine in terms of the methods of succussion and cell culture growth, in order to determine the relevance of succussion in the preparation of homoeopathic medicine.

The graphically illustrated results did not not show a significant difference, that is, a log of two or more neccesary for significance was not observed. However statistically, on a numerical basis, it appears that succussion plays an observably significant role in the preparation of homoeopathic medicine. Although from the current research it is not possible to conclude a definite optimal number of succussions for preparing all homoeopathic medicines. It is also not possible to determine whether hand or mechanical preparations are more successful in the preparation of all of the homoeopathic medicines.

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APPENDICES

APPENDIX 1:

Add 0.1ml of mother tincture to 9,9ml distilled water in a potency - bank phial, cap and hand succuss = 1CH.

Add 0.1ml of 1CH to 9.9ml distilled water in a potency - bank phial, cap and hand succuss = 2CH.

Add 0.1ml of 2CH to 9.9ml distilled water in a potency - bank phial, cap and hand succuss = 3CH.

Add 0.1ml of 3CH to 9.9ml distilled water in a potency - bank phial, cap and hand succuss = 4CH.

Add 0.1ml of 4CH to 9.9ml distilled water in a potency - bank phial, cap and hand succuss = 5CH.

Add 0.1ml of 5CH to 9.9ml distilled water in a potency - bank phial, cap and hand succuss = 6CH.

Add 0.1ml of 6CH to 9.9ml distilled water in a potency - bank phial, cap and hand succuss = 7CH.

Add 0.1ml of 7CH to 9.9ml distilled water in a potency - bank phial, cap and hand succuss = 8CH.

APPENDIX 2:

APPENDIX 2.1:

TABLE 1: PULSATILLA 8CH - hand

TABLE 1: Growth of Saccharomyces cerevisiae, with the addition of Pulsatilla 8CH, prepared by hand succussion.

MEDIAN VALUES

NO. SUCCUSSIONS	GROWTH NO: 1	GROWTH NO:2
CONTROL	136000	106000
0	96000	72000
40	108000	101000
60	180000	142000
80	139000	79000
100	180000	150000
120	111000	90000
140	110000	124000
160	145000	94000

APPENDIX 2.2:

TABLE 2: KALI CARBONICUM 8CH - hand

TABLE 2: Growth of Saccharomyces cerevisiae with the addition of Kali carbonicum 8CH, prepared by hand succussion.

MEDIAN VALUES

NO. SUCCUSSIONS	GROWTH NO: 1	GROWTH NO: 2
CONTROL	960000	1050000
0	620000	640000
40	400000	480000
60	540000	610000
80	940000	630000
100	420000	580000
120	750000	690000
140	400000	520000
160	550000	490000

APPENDIX 2.3:

TABLE 3: NATRUM MURIATICUM 8CH - hand

TABLE 3: Growth of Saccharomyces cerevisiae with the addition of Natrum muriaticum 8CH, prepared by hand succussion.

MEDIAN VALUES

NO. SUCCUSSIONS	GROWTH NO: 1	GROWTH NO: 2
CONTROL	680000	850000
0	138000	370000
40	540000	750000
60	210000	550000
80	480000	360000
100	360000	320000
120	690000	650000
140	300000	510000
160	370000	430000

APPENDIX 2.4:

TABLE 4: PSORINUM 8CH - hand

TABLE 4:Growth of Saccharomyces cerevisiae with the addition of Psorinum 8CH, prepared by hand succussion.

MEDIAN VALUES

NO. SUCCUSSIONS	GROWTH NO: 1	GROWTH NO: 2
CONTROL	1300000	1400000
0	132000	160000
40	600000	540000
60	540000	620000
80	330000	210000
100	340000	260000
120	36000	34000
140	31000	24000
160	70000	64000

APPENDIX 2.5:

TABLE 5: PULSATILLA 8CH - mechanical

TABLE 5: Growth of Saccharomyces cerevisiae with the addition of Pulsatilla 8CH, prepared by mechanical succussion.

MEDIAN VALUES

NO. OF SUCCUSSIONS	GROWTH NO: 1	GROWTH NO: 2
CONTROL	680000	850000
0	96000	72000
40	222000	241000
60	290000	410000
80	740000	850000
100	590000	730000
120	570000	590000
140	230000	820000
160	320000	257000

APPENDIX 2.6:

TABLE 6: KALI CARBONICUM 8CH - mechanical

TABLE 6: Growth of Saccromyces cerevisiae with the addition of Kali carbonicum 8CH, prepared by mechanical succussion.

MEDIAN VALUES

NO. OF SUCCUSSIONS	GROWTH NO: 1	GROWTH NO: 2
CONTROL	960000	1050000
0	620000	640000
40	298000	370000
60	550000	480000
80	720000	860000
100	231000	228000
120	222000	234000
140	420000	310000
160	370000	259000

APPENDIX 2.7:

TABLE 7: NATRUM MURIATICUM 8CH - mechanical

TABLE 7:Growth of Saccharomyces cerevisiae with the addition of Natrum muriaticum 8CH, prepared by mechanical succussion.

MEDIAN VALUES

NO. OF SUCCUSSIONS	GROWTH NO: 1	GROWTH NO: 2
CONTROL	1300000	1400000
0	138000	370000
40	600000	660000
60	540000	480000
80	800000	1000000
100	260000	240000
120	180000	210000
140	140000	180000
160	180000	161000

APPENDIX 2.8:

TABLE 8: PSORINUM 8CH - mechanical

TABLE 8: Growth of Saccharomyces cerevisiae with the addition of Psorinum 8CH, prepared by mechanical succussion.

MEDIAN VALUES

NO. OF SUCCUSSIONS	GROWTH NO: 1	GROWTH NO: 2
CONTROL	130000	140000
0	132000	160000
40	700000	630000
60	193000	300000
80	390000	280000
100	94000	86000
120	241000	270000
140	290000	289000
160	92000	168000

APPENDIX 3:

APPENDIX 3.1:

TABLE 9:

Growth of Saccharomyces cerevisiae in the presence of Pulsatilla 8CH prepared by hand succussion and varying number of succussions.

NO. OF SUCCUSSIONS	NO. OF CFU/ML MEAN ± STANDARD DEVIATION
CONTROL	121000 ± 21213
0	84000 ± 16971
40	104500 ± 4950
60	161000 ± 26870
80	109000 ± 42426
100	165000 ± 21213
120	100500 ± 14849
140	117000 ± 9899.49
160	119500 ± 36062.45

APPENDIX 3.2:

TABLE 10:

Growth of Saccharomyces cerevisiae in the presence of Kalium carbonicum 8CH prepared by hand succussion and varying numbers of succussion.

NO. OF SUCCUSSIONS	NO. OF CFU/ML MEAN ± STANDARD DEVIATION
CONTROL	1005000 ± 63640
0	630000 ± 14142
40	440000 ± 56569
60	575000 ± 49497
80	785000 ± 219203
100	500000 ± 113137
120	720000 ± 42426
140	460000 ± 84853
160	520000 ± 42426

APPENDIX 3.3:

TABLE 11:

Growth of Saccharomyces cerevisiae in the presence of Natrum muriaticum 8CH prepared by hand succussion and varying number of succussions.

NO. OF SUCCUSSIONS	NO. OF CFU/ML MEAN ± STANDARD DEVIATION
CONTROL	765000 ± 120208
0	254000 ± 164049
40	645000 ± 148492
60	380000 ± 240416
80	420000 ± 84853
100	340000 ± 28284
120	670000 ± 28284
140	405000 ± 148492
160	400000 ± 42426

APPENDIX 3.4:

TABLE 12:

Growth of Saccharomyces cerevisiae in the presence of Psorinum 8CH prepared by hand succussion and varying numbers of succussion.

NO. OF SUCCUSSIONS	NO OF CFU/ML MEAN ± STANDARD DEVIATION
CONTROL	1350000 ± 70711
0	146000 ± 19799
40	570000 ± 42426
60	580000 ± 56569
80	270000 ± 84853
100	300000 ± 56569
120	35000 ± 1414
140	27500 ± 4950
160	67000 ± 4243

APPENDIX 3.5:

TABLE 13:

Growth of Saccharomyces cerevisiae in the presnce of Pulsatilla 8CH prepared by mechanical succussion and varying numbers of succussion.

NO. OF SUCCUSSIONS	NO. OF CFU/ML MEAN ± STANDARD DEVIATION
CONTROL	765000 ± 120208
0	84000 ± 16971
40	231500 ± 13435
60	350000 ± 84853
80	795000 ± 77782
100	660000 ± 98995
120	580000 ± 14142
140	525000 ± 417193
160	288500 ± 445448

APPENDIX 3.6:

TABLE 14:

Growth of Saccharomyces cerevisiae in the presence of Kalium carbonicum 8CH prepared by mechanical succussion and varying numbers of succussion.

NO. OF SUCCUSSIONS	NO. OF CFU/ML MEAN ± STANDARD DEVIATION
CONTROL	1005000 ± 63640
0	630000 ± 14142
40	334000 ± 50912
60	515000 ± 49497
80	790000 ± 98995
100	229500 ± 2121
120	228000 ± 8485
140	365000 ± 77782
160	314500 ± 78489

APPENDIX 3.7:

TABLE 15:

Growth of Saccharomyces cerevisiae in the presence of Natrum muriaticum 8CH prepared by mechanical succussion and varying numbers of succussion.

NO. OF SUCCUSSIONS	NO. OF CFU/ML MEAN ± STANDARD DEVIATION
CONTROL	1350000 ± 70711
0	254000 ± 164049
40	630000 ± 42426
60	510000 ± 42426
80	9000000 ± 141421
100	250000 ± 14142
120	195000 ± 21213
140	2160000 ± 28284
160	1705000 ± 13435

APPENDIX 3.8:

TABLE 16:

Growth of Saccharomyces cerevisiae in the presence of Psorinum 8CH prepared br mechanical succussion and varying number of succussions.

NO. OF SUCCUSSIONS	NO. OF CFU/ML MEAN ± STANDARD DEVIATION
CONTROL	1350000 ± 70711
0	146000 ± 19799
40	665000 ± 49497
60	2465000 ± 75660
80	335000 ± 77782
100	90000 ± 5657
120	255500 ± 20506
140	289500 ± 707
160	130000 ± 53740

APPENDIX 4:

APPENDIX 4.1

This is a LOTUS file
The PULS.WKS file contains
18 cases, each consisting of
5 variables (including system variables)

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INDEPENDENT SAMPLES T-TEST: PULSHAND by SHAKING2

	Number of Cases	Mean	Standard Deviation	Standard Error
SHAKING2 = 1	2	121000.000	21213.203	15000.000
SHAKING2 = 2	16	120062.500	33074.600	8268.650

Mean difference = 937.500

Test for equality of variance SD < 0.05

F = 2.431 P = .280

Test for equality of means

Assumption	t value	df	1-tail prob.
Equal variance	.04	16	.485
Unequal variance	.05	1.69	.481

Effect size statistics

Assumption	Statistics	80.0% Confidence Interval
Equal variance	r = .0096	[-.3107 To .3280]
	D = .0193	[-.6537 To .6943]
Unequal variance	r = .0421	[-.2810 To .3566]
	D = .0842	[-.5857 To .7634]

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INDEPENDENT SAMPLES T-TEST: PULSMECH by SHAKING2

	Number of Cases	Mean	Standard Deviation	Standard Error
SHAKING2 = 1	2	765000.000	120208.153	85000.000
SHAKING2 = 2	16	439250.000	258813.318	64703.329

Mean difference = 325750.000

Test for equality of variance

F = 4.636 P = .096

Test for equality of means

Assumption	t value	df	1-tail prob.
Equal variance	1.72	16	.052
Unequal variance	3.05	2.44	.036

Effect size statistics

Assumption	Statistics	80.0% Confidence Interval
Equal variance	r = .3952	[.0868 To .6345]
	D = .8604	[.1743 To 1.6417]
Unequal variance	r = .8900	[.7973 To .9417]
	D = 3.9043	[2.6418 To 5.5982]

APPENDIX 4.2

This is a LOTUS file
The PULS.WKS file contains
18 cases, each consisting of
5 variables (including system variables)

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ONEWAY: PULSHAND by SHAKING3

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	8	11507000000.00	1438375000.00	2.4181	.1051
Within Groups	9	5353500000.00	594833333.33		
Total	17	16860500000.00			

SD < 0.05

Proportion of Variance Explained (R-Square) = .6825

Group	Count	Mean	Std Dev	Std Err	90 Pct C.I. for Mean
SHAKING3 = 0	2	84000.00	16970.56	12000.00	8233.87 To 159766.13
SHAKING3 = 1	2	121000.00	21213.20	15000.00	26292.34 To 215707.66
SHAKING3 = 40	2	104500.00	4949.75	3500.00	82401.55 To 126598.45
SHAKING3 = 60	2	161000.00	26870.06	19000.00	41036.96 To 280963.04
SHAKING3 = 80	2	109000.00	42426.41	30000.00	-80415.33 To 298415.33
SHAKING3 = 100	2	165000.00	21213.20	15000.00	70292.34 To 259707.66
SHAKING3 = 120	2	100500.00	14849.24	10500.00	34204.64 To 166795.36
SHAKING3 = 140	2	117000.00	9899.49	7000.00	72803.09 To 161196.91
SHAKING3 = 160	2	119500.00	36062.45	25500.00	-41503.03 To 280503.03
Total	18	120166.67	31492.76	7422.92	107253.69 To 133079.65

Tukey's HSD Multiple Comparisons

SHAKING3		Difference	90% Pct conf interval		Sig.
0	120	16500.0000	-67552.5244 To	100552.52	.9980
0	40	20500.0000	-63552.5244 To	104552.52	.9916
0	80	25000.0000	-59052.5244 To	109052.52	.9727
0	140	33000.0000	-51052.5244 To	117052.52	.8904
0	160	35500.0000	-48552.5244 To	119552.52	.8507
0	1	37000.0000	-47052.5244 To	121052.52	.8241
0	60	77000.0000	-7052.5244 To	161052.52	.1474
0	100	81000.0000	-3052.5244 To	165052.52	.1184

120	40	4000.0000	-80052.5244 To 88052.524	1.0000
120	80	8500.0000	-75552.5244 To 92552.524	1.0000
120	140	16500.0000	-67552.5244 To 100552.52	.9980
120	160	19000.0000	-65052.5244 To 103052.52	.9948
120	1	20500.0000	-63552.5244 To 104552.52	.9916
120	60	60500.0000	-23552.5244 To 144552.52	.3467
120	100	64500.0000	-19552.5244 To 148552.52	.2849
40	80	4500.0000	-79552.5244 To 88552.524	1.0000
40	140	12500.0000	-71552.5244 To 96552.524	.9997
40	160	15000.0000	-69052.5244 To 99052.524	.9989
40	1	16500.0000	-67552.5244 To 100552.52	.9980
40	60	56500.0000	-27552.5244 To 140552.52	.4178
40	100	60500.0000	-23552.5244 To 144552.52	.3467
80	140	8000.0000	-76052.5244 To 92052.524	1.0000
80	160	10500.0000	-73552.5244 To 94552.524	.9999
80	1	12000.0000	-72052.5244 To 96052.524	.9998
80	60	52000.0000	-32052.5244 To 136052.52	.5073
80	100	56000.0000	-28052.5244 To 140052.52	.4273
140	160	2500.0000	-81552.5244 To 86552.524	1.0000
140	1	4000.0000	-80052.5244 To 88052.524	1.0000
140	60	44000.0000	-40052.5244 To 128052.52	.6810
140	100	48000.0000	-36052.5244 To 132052.52	.5933
160	1	1500.0000	-82552.5244 To 85552.524	1.0000
160	60	41500.0000	-42552.5244 To 125552.52	.7347
160	100	45500.0000	-38552.5244 To 129552.52	.6482
1	60	40000.0000	-44052.5244 To 124052.52	.7658
1	100	44000.0000	-40052.5244 To 128052.52	.6810
60	100	4000.0000	-80052.5244 To 88052.524	1.0000

ONEWAY: PULSMECH by SHAKING3

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	8	993657444444.44	124207180555.5	5.2187	.0117
Within Groups	9	214203000000.00	23800333333.33		
Total	17	1207860444444.4			

Proportion of Variance Explained (R-Square) = .8227

Group	Count	Mean	Std Dev	Std Err	90 Pct C.I. for Mean
SHAKING3 = 0	2	84000.00	16970.56	12000.00	8233.87 To 159766.13

SHAKING3 = 40	2	231500.00	13435.03	9500.00	171518.48 To 291481.52
SHAKING3 = 160	2	288500.00	44547.73	31500.00	89613.91 To 487386.09
SHAKING3 = 60	2	350000.00	84852.81	60000.00	-28830.66 To 728830.66
SHAKING3 = 140	2	525000.00	417193.00	295000.00	-1337584 To 2387584.0
SHAKING3 = 120	2	580000.00	14142.14	10000.00	516861.56 To 643138.44
SHAKING3 = 100	2	660000.00	98994.95	70000.00	218030.90 To 1101969.1
SHAKING3 = 1	2	765000.00	120208.15	85000.00	228323.24 To 1301676.7
SHAKING3 = 80	2	795000.00	77781.75	55000.00	447738.57 To 1142261.4
Total	18	475444.44	266553.21	62827.19	366149.62 To 584739.27

Tukey's HSD Multiple Comparisons

SHAKING3		Difference	90% Pct conf interval	Sig.
0	40	147500.0000	-384173.0320 To 679173.03	.9816
0	160	204500.0000	-327173.0320 To 736173.03	.9000
0	60	266000.0000	-265673.0320 To 797673.03	.7230
0	140	441000.0000	-90673.0320 To 972673.03	.2178
0	120	496000.0000	-35673.0320 To 1027673.0	.1364
0	100	576000.0000	44326.9680 To 1107673.0	.0677
0	1	681000.0000	149326.9680 To 1212673.0	.0271
0	80	711000.0000	179326.9680 To 1242673.0	.0210
40	160	57000.0000	-474673.0320 To 588673.03	1.0000
40	60	118500.0000	-413173.0320 To 650173.03	.9952
40	140	293500.0000	-238173.0320 To 825173.03	.6284
40	120	348500.0000	-183173.0320 To 880173.03	.4448
40	100	428500.0000	-103173.0320 To 960173.03	.2414
40	1	533500.0000	1826.9680 To 1065173.0	.0984
40	80	563500.0000	31826.9680 To 1095173.0	.0756
160	60	61500.0000	-470173.0320 To 593173.03	1.0000
160	140	236500.0000	-295173.0320 To 768173.03	.8169
160	120	291500.0000	-240173.0320 To 823173.03	.6353
160	100	371500.0000	-160173.0320 To 903173.03	.3770
160	1	476500.0000	-55173.0320 To 1008173.0	.1614
160	80	506500.0000	-25173.0320 To 1038173.0	.1245
60	140	175000.0000	-356673.0320 To 706673.03	.9530
60	120	230000.0000	-301673.0320 To 761673.03	.8357
60	100	310000.0000	-221673.0320 To 841673.03	.5713
60	1	415000.0000	-116673.0320 To 946673.03	.2694
60	80	445000.0000	-86673.0320 To 976673.03	.2106
140	120	55000.0000	-476673.0320 To 586673.03	1.0000
140	100	135000.0000	-396673.0320 To 666673.03	.9892
140	1	240000.0000	-291673.0320 To 771673.03	.8065
140	80	270000.0000	-261673.0320 To 801673.03	.7095
120	100	80000.0000	-451673.0320 To 611673.03	.9997
120	1	185000.0000	-346673.0320 To 716673.03	.9377
120	80	215000.0000	-316673.0320 To 746673.03	.8755

100	1	105000.0000	-426673.0320 To 636673.03	.9979
100	80	135000.0000	-396673.0320 To 666673.03	.9892
1	80	30000.0000	-501673.0320 To 561673.03	1.0000

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This is a SPSS/PC+ system file
The KALI.SIM file contains
18 cases, each consisting of
5 variables (including system variables)

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INDEPENDENT SAMPLES T-TEST: KALIHAND by SHAKING2

	Number of Cases	Mean	Standard Deviation	Standard Error
SHAKING2 = 1	2	1005000.000	63639.610	45000.000
SHAKING2 = 2	16	578750.000	139946.418	34986.605

Mean difference = 426250.000

Test for equality of variance SD < 0.05

F = 4.836 P = .088

Test for equality of means

Assumption	t value	df	1-tail prob.
Equal variance	4.17	16	.000
Unequal variance	7.48	2.51	.004

Effect size statistics

Assumption	Statistics	80.0% Confidence Interval
Equal variance	r = .7213	[.5223 To .8458]
	D = 2.0828	[1.2249 To 3.1709]
Unequal variance	r = .9783	[.9583 To .9887]
	D = 9.4343	[6.7058 To 13.205]

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INDEPENDENT SAMPLES T-TEST: KALIMECH by SHAKING2

	Number of Cases	Mean	Standard Deviation	Standard Error

SHAKING2 = 1	2	1005000.000	63639.610	45000.000
SHAKING2 = 2	16	425750.000	199375.859	49843.965

Mean difference = 579250.000

Test for equality of variance

F = 9.815 P = .014

Test for equality of means

Assumption	t value	df	1-tail prob.
Equal variance	3.99	16	.000
Unequal variance	8.63	4.51	.000

Effect size statistics

Assumption	Statistics	80.0% Confidence Interval
Equal variance	r = .7060	[.4992 To .8367]
	D = 1.9936	[1.1522 To 3.0554]
Unequal variance	r = .9710	[.9446 To .9849]
	D = 8.1265	[5.7554 To 11.395]

APPENDIX 4.4

This is a LOTUS file
The KALI.WKS file contains
18 cases, each consisting of
5 variables (including system variables)

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ONEWAY: KALIHAND by SHAKING3

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	8	539277777777.78	67409722222.22	7.4395	.0034
Within Groups	9	81550000000.00	9061111111.11		
Total	17	620827777777.78			

SD < 0.05

Proportion of Variance Explained (R-Square) = .8686

Group	Count	Mean	Std Dev	Std Err	90 Pct C.I. for Mean
SHAKING3 = 0	2	630000.00	14142.14	10000.00	566861.56 To 693138.44
SHAKING3 = 1	2	1005000.0	63639.61	45000.00	720877.01 To 1289122.9
SHAKING3 = 40	2	440000.00	56568.54	40000.00	187446.23 To 692553.77
SHAKING3 = 60	2	575000.00	49497.47	35000.00	354015.45 To 795984.55
SHAKING3 = 80	2	785000.00	219203.10	155000.00	-193645.8 To 1763645.8
SHAKING3 = 100	2	500000.00	113137.08	80000.00	-5107.54 To 1005107.5
SHAKING3 = 120	2	720000.00	42426.41	30000.00	530584.67 To 909415.33
SHAKING3 = 140	2	460000.00	84852.81	60000.00	81169.34 To 838830.66
SHAKING3 = 160	2	520000.00	42426.41	30000.00	330584.67 To 709415.33
Total	18	626111.11	191100.19	45042.75	547754.29 To 704467.93

Tukey's HSD Multiple Comparisons

SHAKING3		Difference	90% Pct conf interval		Sig.
40	140	20000.0000	-308052.8691	To 348052.86	1.0000
40	100	60000.0000	-268052.8691	To 388052.86	.9987
40	160	80000.0000	-248052.8691	To 408052.86	.9916
40	60	135000.0000	-193052.8691	To 463052.86	.8659
40	0	190000.0000	-138052.8691	To 518052.86	.5784

40	120	280000.0000	-48052.8691 To 608052.86	.1957
40	80	345000.0000	16947.1309 To 673052.86	.0785
40	1	565000.0000	236947.1309 To 893052.86	.0041
140	100	40000.0000	-288052.8691 To 368052.86	.9999
140	160	60000.0000	-268052.8691 To 388052.86	.9987
140	60	115000.0000	-213052.8691 To 443052.86	.9354
140	0	170000.0000	-158052.8691 To 498052.86	.6907
140	120	260000.0000	-68052.8691 To 588052.86	.2559
140	80	325000.0000	-3052.8691 To 653052.86	.1044
140	1	545000.0000	216947.1309 To 873052.86	.0052
100	160	20000.0000	-308052.8691 To 348052.86	1.0000
100	60	75000.0000	-253052.8691 To 403052.86	.9944
100	0	130000.0000	-198052.8691 To 458052.86	.8859
100	120	220000.0000	-108052.8691 To 548052.86	.4203
100	80	285000.0000	-43052.8691 To 613052.86	.1828
100	1	505000.0000	176947.1309 To 833052.86	.0086
160	60	55000.0000	-273052.8691 To 383052.86	.9993
160	0	110000.0000	-218052.8691 To 438052.86	.9483
160	120	200000.0000	-128052.8691 To 528052.86	.5232
160	80	265000.0000	-63052.8691 To 593052.86	.2395
160	1	485000.0000	156947.1309 To 813052.86	.0112
60	0	55000.0000	-273052.8691 To 383052.86	.9993
60	120	145000.0000	-183052.8691 To 473052.86	.8213
60	80	210000.0000	-118052.8691 To 538052.86	.4703
60	1	430000.0000	101947.1309 To 758052.86	.0236
0	120	90000.0000	-238052.8691 To 418052.86	.9828
0	80	155000.0000	-173052.8691 To 483052.86	.7717
0	1	375000.0000	46947.1309 To 703052.86	.0512
120	80	65000.0000	-263052.8691 To 393052.86	.9978
120	1	285000.0000	-43052.8691 To 613052.86	.1828
80	1	220000.0000	-108052.8691 To 548052.86	.4203

ONEWAY: KALIMECH by SHAKING3

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	8	1165430777777.7	145678847222.2	41.7830	.0000
Within Groups	9	31379000000.00	3486555555.56		
Total	17	1196809777777.7			

Proportion of Variance Explained (R-Square) = .9738

Group	Count	Mean	Std Dev	Std Err	90 Pct C.I. for Mean
SHAKING3 = 120	2	228000.00	8485.28	6000.00	190116.93 To 265883.07
SHAKING3 = 100	2	229500.00	2121.32	1500.00	220029.23 To 238970.77
SHAKING3 = 160	2	314500.00	78488.85	55500.00	-35918.36 To 664918.36
SHAKING3 = 40	2	334000.00	50911.69	36000.00	106701.61 To 561298.39
SHAKING3 = 140	2	365000.00	77781.75	55000.00	17738.57 To 712261.43
SHAKING3 = 60	2	515000.00	49497.47	35000.00	294015.45 To 735984.55
SHAKING3 = 0	2	630000.00	14142.14	10000.00	566861.56 To 693138.44
SHAKING3 = 80	2	790000.00	98994.95	70000.00	348030.90 To 1231969.1
SHAKING3 = 1	2	1005000.0	63639.61	45000.00	720877.01 To 1289122.9
Total	18	490111.11	265331.07	62539.13	381317.40 To 598904.82

Tukey's HSD Multiple Comparisons

SHAKING3		Difference	90% Pct conf interval	Sig.
120	100	1500.0000	-201993.9057 To 204993.90	1.0000
120	160	86500.0000	-116993.9057 To 289993.90	.8468
120	40	106000.0000	-97493.9057 To 309493.90	.6857
120	140	137000.0000	-66493.9057 To 340493.90	.4162
120	60	287000.0000	83506.0943 To 490493.90	.0151
120	0	402000.0000	198506.0943 To 605493.90	.0016
120	80	562000.0000	358506.0943 To 765493.90	.0003
120	1	777000.0000	573506.0943 To 980493.90	.0002
100	160	85000.0000	-118493.9057 To 288493.90	.8573
100	40	104500.0000	-98993.9057 To 307993.90	.6992
100	140	135500.0000	-67993.9057 To 338993.90	.4279
100	60	285500.0000	82006.0943 To 488993.90	.0156
100	0	400500.0000	197006.0943 To 603993.90	.0016
100	80	560500.0000	357006.0943 To 763993.90	.0003
100	1	775500.0000	572006.0943 To 978993.90	.0002
160	40	19500.0000	-183993.9057 To 222993.90	1.0000
160	140	50500.0000	-152993.9057 To 253993.90	.9906
160	60	200500.0000	-2993.9057 To 403993.90	.1071
160	0	315500.0000	112006.0943 To 518993.90	.0082
160	80	475500.0000	272006.0943 To 678993.90	.0006
160	1	690500.0000	487006.0943 To 893993.90	.0002
40	140	31000.0000	-172493.9057 To 234493.90	.9997
40	60	181000.0000	-22493.9057 To 384493.90	.1664
40	0	296000.0000	92506.0943 To 499493.90	.0124
40	80	456000.0000	252506.0943 To 659493.90	.0007
40	1	671000.0000	467506.0943 To 874493.90	.0002
140	60	150000.0000	-53493.9057 To 353493.90	.3231
140	0	265000.0000	61506.0943 To 468493.90	.0246
140	80	425000.0000	221506.0943 To 628493.90	.0011
140	1	640000.0000	436506.0943 To 843493.90	.0002

60	0	115000.0000	-88493.9057 To 318493.90	.6042
60	80	275000.0000	71506.0943 To 478493.90	.0197
60	1	490000.0000	286506.0943 To 693493.90	.0005
0	80	160000.0000	-43493.9057 To 363493.90	.2629
0	1	375000.0000	171506.0943 To 578493.90	.0026
80	1	215000.0000	11506.0943 To 418493.90	.0767

APPENDIX 4.5

This is a LOTUS file
The NAT.WKS file contains
18 cases, each consisting of
5 variables (including system variables)

INDEPENDENT SAMPLES T-TEST: NATHAND by SHAKING2

	Number of Cases	Mean	Standard Deviation	Standard Error
SHAKING2 = 1	2	765000.000	120208.153	85000.000
SHAKING2 = 2	16	439250.000	169724.286	42431.072

Mean difference = 325750.000

Test for equality of variance SD < 0.05

F = 1.994 P = .357

Test for equality of means

Assumption	t value	df	1-tail prob.
Equal variance	2.60	16	.009
Unequal variance	3.43	1.55	.053

Effect size statistics

Assumption	Statistics	80.0% Confidence Interval
Equal variance	r = .5450	[.2732 To .7362]
	D = 1.2999	[.5680 To 2.1756]
Unequal variance	r = .9398	[.8865 To .9685]
	D = 5.5011	[3.8326 To 7.7775]

INDEPENDENT SAMPLES T-TEST: NATMECH by SHAKING2

	Number of Cases	Mean	Standard Deviation	Standard Error
SHAKING2 = 1	2	1350000.000	70710.678	50000.000
SHAKING2 = 2	16	383687.500	267096.417	66774.104

Mean difference = 966312.500

Test for equality of variance

F = 14.268 P = .004

Test for equality of means

Assumption	t value	df	1-tail prob.
Equal variance	4.97	16	.000
Unequal variance	11.58	6.39	.000

Effect size statistics

Assumption	Statistics	80.0% Confidence Interval
Equal variance	r = .7791	[.6120 To .8796]
	D = 2.4852	[1.5475 To 3.6975]
Unequal variance	r = .9770	[.9559 To .9881]
	D = 9.1633	[6.5090 To 12.830]

This is a LOTUS file
The NAT.WKS file contains
18 cases, each consisting of
5 variables (including system variables)

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ONEWAY: NATHAND by SHAKING3

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	8	481328444444.44	60166055555.56	3.5194	.0393
Within Groups	9	153862000000.00	17095777777.78		
Total	17	635190444444.44			

SD < 0.05

Proportion of Variance Explained (R-Square) = .7578

Group	Count	Mean	Std Dev	Std Err	90 Pct C.I. for Mean
SHAKING3 = 0	2	254000.00	164048.77	116000.00	-478405.9 To 986405.93
SHAKING3 = 1	2	765000.00	120208.15	85000.00	228323.24 To 1301676.7
SHAKING3 = 40	2	645000.00	148492.42	105000.00	-17953.65 To 1307953.6
SHAKING3 = 60	2	380000.00	240416.31	170000.00	-693353.5 To 1453353.5
SHAKING3 = 80	2	420000.00	84852.81	60000.00	41169.34 To 798830.66
SHAKING3 = 100	2	340000.00	28284.27	20000.00	213723.11 To 466276.89
SHAKING3 = 120	2	670000.00	28284.27	20000.00	543723.11 To 796276.89
SHAKING3 = 140	2	405000.00	148492.42	105000.00	-257953.6 To 1067953.6
SHAKING3 = 160	2	400000.00	42426.41	30000.00	210584.67 To 589415.33
Total	18	475444.44	193298.07	45560.79	396186.43 To 554702.46

Tukey's HSD Multiple Comparisons

SHAKING3		Difference	90% Pct conf interval	Sig.
0	100	86000.0000	-364606.5957 To 536606.59	.9983
0	60	126000.0000	-324606.5957 To 576606.59	.9808
0	160	146000.0000	-304606.5957 To 596606.59	.9567
0	140	151000.0000	-299606.5957 To 601606.59	.9484
0	80	166000.0000	-284606.5957 To 616606.59	.9180
0	40	391000.0000	-59606.5957 To 841606.59	.1836
0	120	416000.0000	-34606.5957 To 866606.59	.1427
0	1	511000.0000	60393.4043 To 961606.59	.0534

100	60	40000.0000	-410606.5957 To 490606.59	1.0000
100	160	60000.0000	-390606.5957 To 510606.59	.9999
100	140	65000.0000	-385606.5957 To 515606.59	.9998
100	80	80000.0000	-370606.5957 To 530606.59	.9990
100	40	305000.0000	-145606.5957 To 755606.59	.4105
100	120	330000.0000	-120606.5957 To 780606.59	.3295
100	1	425000.0000	-25606.5957 To 875606.59	.1301
60	160	20000.0000	-430606.5957 To 470606.59	1.0000
60	140	25000.0000	-425606.5957 To 475606.59	1.0000
60	80	40000.0000	-410606.5957 To 490606.59	1.0000
60	40	265000.0000	-185606.5957 To 715606.59	.5622
60	120	290000.0000	-160606.5957 To 740606.59	.4645
60	1	385000.0000	-65606.5957 To 835606.59	.1949
160	140	5000.0000	-445606.5957 To 455606.59	1.0000
160	80	20000.0000	-430606.5957 To 470606.59	1.0000
160	40	245000.0000	-205606.5957 To 695606.59	.6438
160	120	270000.0000	-180606.5957 To 720606.59	.5421
160	1	365000.0000	-85606.5957 To 815606.59	.2371
140	80	15000.0000	-435606.5957 To 465606.59	1.0000
140	40	240000.0000	-210606.5957 To 690606.59	.6642
140	120	265000.0000	-185606.5957 To 715606.59	.5622
140	1	360000.0000	-90606.5957 To 810606.59	.2489
80	40	225000.0000	-225606.5957 To 675606.59	.7248
80	120	250000.0000	-200606.5957 To 700606.59	.6232
80	1	345000.0000	-105606.5957 To 795606.59	.2870
40	120	25000.0000	-425606.5957 To 475606.59	1.0000
40	1	120000.0000	-330606.5957 To 570606.59	.9856
120	1	95000.0000	-355606.5957 To 545606.59	.9967

ONEWAY: NATMECH by SHAKING3

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	8	2677982444444.4	334747805555.5	52.7231	.0000
Within Groups	9	57142500000.00	6349166666.67		
Total	17	2735124944444.4			

Proportion of Variance Explained (R-Square) = .9791

Group	Count	Mean	Std Dev	Std Err	90 Pct C.I. for Mean
SHAKING3 = 140	2	160000.00	28284.27	20000.00	33723.11 To 286276.89

SHAKING3 = 160	2	170500.00	13435.03	9500.00	110518.48 To 230481.52
SHAKING3 = 120	2	195000.00	21213.20	15000.00	100292.34 To 289707.66
SHAKING3 = 100	2	250000.00	14142.14	10000.00	186861.56 To 313138.44
SHAKING3 = 0	2	254000.00	164048.77	116000.00	-478405.9 To 986405.93
SHAKING3 = 60	2	510000.00	42426.41	30000.00	320584.67 To 699415.33
SHAKING3 = 40	2	630000.00	42426.41	30000.00	440584.67 To 819415.33
SHAKING3 = 80	2	900000.00	141421.36	100000.00	268615.57 To 1531384.4
SHAKING3 = 1	2	1350000.0	70710.68	50000.00	1034307.7 To 1665692.2
Total	18	491055.56	401110.59	94542.67	326588.17 To 655522.95

Tukey's HSD Multiple Comparisons

SHAKING3		Difference	90% Pct conf interval	Sig.
140	160	10500.0000	-264106.9194 To 285106.91	1.0000
140	120	35000.0000	-239606.9194 To 309606.91	.9999
140	100	90000.0000	-184606.9194 To 364606.91	.9540
140	0	94000.0000	-180606.9194 To 368606.91	.9426
140	60	350000.0000	75393.0806 To 624606.91	.0279
140	40	470000.0000	195393.0806 To 744606.91	.0043
140	80	740000.0000	465393.0806 To 1014606.9	.0003
140	1	1190000.0000	915393.0806 To 1464606.9	.0002
160	120	24500.0000	-250106.9194 To 299106.91	1.0000
160	100	79500.0000	-195106.9194 To 354106.91	.9766
160	0	83500.0000	-191106.9194 To 358106.91	.9692
160	60	339500.0000	64893.0806 To 614106.91	.0332
160	40	459500.0000	184893.0806 To 734106.91	.0050
160	80	729500.0000	454893.0806 To 1004106.9	.0003
160	1	1179500.0000	904893.0806 To 1454106.9	.0002
120	100	55000.0000	-219606.9194 To 329606.91	.9977
120	0	59000.0000	-215606.9194 To 333606.91	.9963
120	60	315000.0000	40393.0806 To 589606.91	.0503
120	40	435000.0000	160393.0806 To 709606.91	.0072
120	80	705000.0000	430393.0806 To 979606.91	.0004
120	1	1155000.0000	880393.0806 To 1429606.9	.0002
100	0	4000.0000	-270606.9194 To 278606.91	1.0000
100	60	260000.0000	-14606.9194 To 534606.91	.1280
100	40	380000.0000	105393.0806 To 654606.91	.0170
100	80	650000.0000	375393.0806 To 924606.91	.0005
100	1	1100000.0000	825393.0806 To 1374606.9	.0002
0	60	256000.0000	-18606.9194 To 530606.91	.1368
0	40	376000.0000	101393.0806 To 650606.91	.0182
0	80	646000.0000	371393.0806 To 920606.91	.0005
0	1	1096000.0000	821393.0806 To 1370606.9	.0002
60	40	120000.0000	-154606.9194 To 394606.91	.8291
60	80	390000.0000	115393.0806 To 664606.91	.0145
60	1	840000.0000	565393.0806 To 1114606.9	.0002

40	80	270000.0000	-4606.9194 To 544606.91	.1081
40	1	720000.0000	445393.0806 To 994606.91	.0003
80	1	450000.0000	175393.0806 To 724606.91	.0057

APPENDIX 4.7

This is a LOTUS file
The PSOR.WKS file contains
18 cases, each consisting of
5 variables (including system variables)

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INDEPENDENT SAMPLES T-TEST: PSORHAND by SHAKING2

	Number of Cases	Mean	Standard Deviation	Standard Error
SHAKING2 = 1	2	1350000.000	70710.678	50000.000
SHAKING2 = 2	16	249437.500	219742.871	54935.718

Mean difference = 1100562.50

Test for equality of variance SD < 0.05

F = 9.657 P = .014

Test for equality of means

Assumption	t value	df	1-tail prob.
Equal variance	6.87	16	.000
Unequal variance	14.82	4.44	.000

Effect size statistics

Assumption	Statistics	80.0% Confidence Interval
Equal variance	r = .8643	[.7527 To .9276]
	D = 3.4366	[2.2866 To 4.9664]
Unequal variance	r = .9900	[.9808 To .9948]
	D = 14.062	[10.052 To 19.625]

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INDEPENDENT SAMPLES T-TEST: PSORMECH by SHAKING2

	Number of Cases	Mean	Standard Deviation	Standard Error
SHAKING2 = 1	2	1350000.000	70710.678	50000.000
SHAKING2 = 2	16	269687.500	178043.710	44510.927

Mean difference = 1080312.50

Test for equality of variance

F = 6.340 P = .047

Test for equality of means

Assumption	t value	df	1-tail prob.
Equal variance	8.31	16	.000
Unequal variance	16.14	3.08	.000

Effect size statistics

Assumption	Statistics	80.0% Confidence Interval
Equal variance	r = .9011	[.8168 To .9477]
	D = 4.1560	[2.8314 To 5.9398]
Unequal variance	r = .9941	[.9887 To .9970]
	D = 18.379	[13.164 To 25.624]

APPENDIX 4.8

This is a LOTUS file
The PSOR.WKS file contains
18 cases, each consisting of
5 variables (including system variables)

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ONEWAY: PSORHAND by SHAKING3

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	8	2861779111111.1	357722388888.8	154.5126	.0000
Within Groups	9	20836500000.00	2315166666.67		
Total	17	2882615611111.1			

SD < 0.05

Proportion of Variance Explained (R-Square) = .9928

Group	Count	Mean	Std Dev	Std Err	90 Pct C.I. for Mean
SHAKING3 = 0	2	146000.00	19798.99	14000.00	57606.18 To 234393.82
SHAKING3 = 1	2	1350000.0	70710.68	50000.00	1034307.7 To 1665692.2
SHAKING3 = 40	2	570000.00	42426.41	30000.00	380584.67 To 759415.33
SHAKING3 = 60	2	580000.00	56568.54	40000.00	327446.23 To 832553.77
SHAKING3 = 80	2	270000.00	84852.81	60000.00	-108830.6 To 648830.66
SHAKING3 = 100	2	300000.00	56568.54	40000.00	47446.23 To 552553.77
SHAKING3 = 120	2	35000.00	1414.21	1000.00	28686.16 To 41313.84
SHAKING3 = 140	2	27500.00	4949.75	3500.00	5401.55 To 49598.45
SHAKING3 = 160	2	67000.00	4242.64	3000.00	48058.47 To 85941.53
Total	18	371722.22	411783.47	97058.29	202878.63 To 540565.81

Tukey's HSD Multiple Comparisons

SHAKING3		Difference	90% Pct conf interval	Sig.
140	120	7500.0000	-158322.7995 To 173322.79	1.0000
140	160	39500.0000	-126322.7995 To 205322.79	.9927
140	0	118500.0000	-47322.7995 To 284322.79	.3540
140	80	242500.0000	76677.2005 To 408322.79	.0120
140	100	272500.0000	106677.2005 To 438322.79	.0056
140	40	542500.0000	376677.2005 To 708322.79	.0002
140	60	552500.0000	386677.2005 To 718322.79	.0002
140	1	1322500.0000	1156677.2005 To 1488322.7	.0002

120	160	32000.0000	-133822.7995 To 197822.79	.9982
120	0	111000.0000	-54822.7995 To 276822.79	.4223
120	80	235000.0000	69177.2005 To 400822.79	.0147
120	100	265000.0000	99177.2005 To 430822.79	.0068
120	40	535000.0000	369177.2005 To 700822.79	.0002
120	60	545000.0000	379177.2005 To 710822.79	.0002
120	1	1315000.0000	1149177.2005 To 1480822.7	.0002
160	0	79000.0000	-86822.7995 To 244822.79	.7650
160	80	203000.0000	37177.2005 To 368822.79	.0351
160	100	233000.0000	67177.2005 To 398822.79	.0155
160	40	503000.0000	337177.2005 To 668822.79	.0002
160	60	513000.0000	347177.2005 To 678822.79	.0002
160	1	1283000.0000	1117177.2005 To 1448822.7	.0002
0	80	124000.0000	-41822.7995 To 289822.79	.3092
0	100	154000.0000	-11822.7995 To 319822.79	.1391
0	40	424000.0000	258177.2005 To 589822.79	.0004
0	60	434000.0000	268177.2005 To 599822.79	.0003
0	1	1204000.0000	1038177.2005 To 1369822.7	.0002
80	100	30000.0000	-135822.7995 To 195822.79	.9988
80	40	300000.0000	134177.2005 To 465822.79	.0029
80	60	310000.0000	144177.2005 To 475822.79	.0023
80	1	1080000.0000	914177.2005 To 1245822.7	.0002
100	40	270000.0000	104177.2005 To 435822.79	.0060
100	60	280000.0000	114177.2005 To 445822.79	.0047
100	1	1050000.0000	884177.2005 To 1215822.7	.0002
40	60	10000.0000	-155822.7995 To 175822.79	1.0000
40	1	780000.0000	614177.2005 To 945822.79	.0002
60	1	770000.0000	604177.2005 To 935822.79	.0002

ONEWAY: PSORMECH by SHAKING3

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	8	2532336111111.1	316542013888.8	124.0936	.0000
Within Groups	9	22957500000.00	2550833333.33		
Total	17	2555293611111.1			

Proportion of Variance Explained (R-Square) = .9910

Group	Count	Mean	Std Dev	Std Err	90 Pct C.I. for Mean
SHAKING3 = 100	2	90000.00	5656.85	4000.00	64744.62 To 115255.38

SHAKING3 = 160	2	130000.00	53740.12	38000.00	-109926.0 To 369926.08
SHAKING3 = 0	2	146000.00	19798.99	14000.00	57606.18 To 234393.82
SHAKING3 = 60	2	246500.00	75660.43	53500.00	-91290.67 To 584290.67
SHAKING3 = 120	2	255500.00	20506.10	14500.00	163949.26 To 347050.74
SHAKING3 = 140	2	289500.00	707.11	500.00	286343.08 To 292656.92
SHAKING3 = 80	2	335000.00	77781.75	55000.00	-12261.43 To 682261.43
SHAKING3 = 40	2	665000.00	49497.47	35000.00	444015.45 To 885984.55
SHAKING3 = 1	2	1350000.0	70710.68	50000.00	1034307.7 To 1665692.2
Total	18	389722.22	387700.13	91381.80	230753.52 To 548690.92

Tukey's HSD Multiple Comparisons

SHAKING3		Difference	90% Pct conf interval	Sig.
100	160	40000.0000	-134058.0662 To 214058.06	.9942
100	0	56000.0000	-118058.0662 To 230058.06	.9583
100	60	156500.0000	-17558.0662 To 330558.06	.1593
100	120	165500.0000	-8558.0662 To 339558.06	.1256
100	140	199500.0000	25441.9338 To 373558.06	.0505
100	80	245000.0000	70941.9338 To 419058.06	.0153
100	40	575000.0000	400941.9338 To 749058.06	.0002
100	1	1260000.0000	1085941.9338 To 1434058.0	.0002
160	0	16000.0000	-158058.0662 To 190058.06	1.0000
160	60	116500.0000	-57558.0662 To 290558.06	.4224
160	120	125500.0000	-48558.0662 To 299558.06	.3450
160	140	159500.0000	-14558.0662 To 333558.06	.1472
160	80	205000.0000	30941.9338 To 379058.06	.0436
160	40	535000.0000	360941.9338 To 709058.06	.0002
160	1	1220000.0000	1045941.9338 To 1394058.0	.0002
0	60	100500.0000	-73558.0662 To 274558.06	.5817
0	120	109500.0000	-64558.0662 To 283558.06	.4892
0	140	143500.0000	-30558.0662 To 317558.06	.2226
0	80	189000.0000	14941.9338 To 363058.06	.0669
0	40	519000.0000	344941.9338 To 693058.06	.0003
0	1	1204000.0000	1029941.9338 To 1378058.0	.0002
60	120	9000.0000	-165058.0662 To 183058.06	1.0000
60	140	43000.0000	-131058.0662 To 217058.06	.9909
60	80	88500.0000	-85558.0662 To 262558.06	.7084
60	40	418500.0000	244441.9338 To 592558.06	.0005
60	1	1103500.0000	929441.9338 To 1277558.0	.0002
120	140	34000.0000	-140058.0662 To 208058.06	.9980
120	80	79500.0000	-94558.0662 To 253558.06	.7979
120	40	409500.0000	235441.9338 To 583558.06	.0005
120	1	1094500.0000	920441.9338 To 1268558.0	.0002
140	80	45500.0000	-128558.0662 To 219558.06	.9871
140	40	375500.0000	201441.9338 To 549558.06	.0009
140	1	1060500.0000	886441.9338 To 1234558.0	.0002

80	40	330000.0000	155941.9338 To	504058.06	.0021
80	1	1015000.0000	840941.9338 To	1189058.0	.0002
40	1	685000.0000	510941.9338 To	859058.06	.0002