THE PROPHYLACTIC EFFECT OF *ACONITUM NAPELLUS* AND HOMŒOPATHIC PREPARATIONS OF POULTRY VACCINES IN CONDITIONS OF STRESS AND VACCINOSIS IN *GALLUS GALLUS DOMESTICUS*, ROSS HYBRID, IN BROILER FARMING

A dissertation submitted to the Faculty of Health Sciences, Technikon Witwatersrand, Johannesburg, in partial fulfilment of the requirements for the degree of Master of Technology: Homœopathy

by

Louis Mullinder
(Student Number: 9901696)

Specialist Supervisor:	Dr A Niven	4/2/04 Date
Supervisor:	Dr R K Razlog	04/02/04 Date
Co-Supervisor:	Dr J Roohani	4-2-04 Date

DECLARATION

I, Louis Mullinder, declare that this dissertation is original. It is being submitted to the Technikon Witwatersrand for the degree: Master of Technology: Homœopathy. It has not been submitted previously to this or any other institution for the purpose of obtaining a qualification.

Louis Mullinder

(Signature of Candidate)

14th day of November, 2003

DECLARATION

I, Louis Mullinder, declare that this dissertation is original. It is being submitted to the Technikon Witwatersrand for the degree: Master of Technology: Homœopathy. It has not been submitted previously to this or any other institution for the purpose of obtaining a qualification.

Louis Mullinder
(Signature of Candidate)

14th day of November, 2003

To homœopathy and those espousing healing

and

to those who seek to make animal husbandry more humane

ACKNOWLEDGEMENTS

Miss Elke Leistner
whose collaboration in this joint study has been invaluable

Drs Alex Niven, Radmila Razlog and Joanne Roohani
for guidance, expertise, advice and support in this research

Dr Radmila Razlog and Dr Joanne Roohani
for deepening interest in homœopathy through dedicated and devoted teaching

Natura Homœopathic Laboratories
for supporting this research by partially sponsoring the remedies

Prof Chris Smit, Mr Izak Smit and Miss Natalie Mullinder
for advice on, compilation and analysis of, the research statistics

Dr Otto Leistner and Mrs Jeanette McKenna
for advice, editing and unfailing patience in proofreading

Mr Conor Doak and Mr Gordon Blick
for advice and assistance regarding broiler farming

Mr Alois and Mrs Karla Ledwig of Technobase GmbH, Germany,
for all office technology support

Family and friends, whose support over the past five years
has made the study of homœopathy possible

but especially to

Mrs Thero Becker for making the broiler facility available for this research
and Mr Frikkie Pistorius for managing the research programme

ABSTRACT

Commercial broiler farming is a cost-effective farming method of raising large numbers of broilers in a short period of time to satisfy market needs. Broiler farmers are faced with numerous challenges given the high demand for the product. Many stressors affect production (Dohms and Metz, 1991), with stress (Klopp, 1999) and various diseases, such as Newcastle disease, infectious bursal disease and infectious bronchitis (Sainsbury, 2000) causing the most concern. Broiler chickens are routinely vaccinated against these three diseases (Travers, 2003).

The aim of this pilot research study was to determine the prophylactic effect of *Aconitum napellus* and homœopathic preparations of poultry vaccines in conditions of stress and vaccinosis in *Gallus gallus domesticus*, Ross hybrid, in broiler farming.

The study was conducted from 19 August to 24 September 2003 on a farm in Witpoort extensions 14 and 15, district Bronkhorstspruit. One hundred and fifty broiler chickens, *Gallus gallus domesticus*, Ross hybrid, were used as research subjects and divided at random into three groups of fifty each. **Group one** received treatment for vaccinosis at the beginning of the growth cycle (day one) and prior to each vaccination (days twelve, eighteen and twenty-two); **Group two** acted as control for the purposes of statistical analysis; **Group three** was treated once, on arrival, for stress using *Aconitum napellus* 200CH.

The treatment given during this research proved in no way detrimental to the research subjects since results were either positive or inconclusive:

- The mean live mass value of the control group (**Group two**) was statistically significantly less than the mean live mass values of the vaccinosis and stress groups (**Groups one** and **three**). The mean live mass values of the latter did not differ significantly from each other;

- No statistically significant differences were found between the carcass mass values of the three groups or between the mortality rates of the three groups;
- Feed conversion rates matched those in commercial broiler farming, but were improved in the treatment groups (**Groups one** and **three**) as compared with the control group (**Group two**);
- Performance efficiency factors were also found to be improved in the treatment groups (**Groups one** and **three**), as compared with the control group (**Group two**).

The homœopathic remedies utilised in this study are believed to have been effective in the prophylaxis of vaccinosis and stress as was evidenced by the statistically significant increase in live masses in the treatment groups (**Groups one** and **three**). Similarly, the homœopathic remedies are believed to have positively affected both feed conversion rates and performance efficiency factors.

Although the carcass mass values and mortality rates showed no statistically significant difference between the three groups, no conclusion should be drawn as to the effect of homœopathic remedies on these variables prior to future research in these fields, given the other positive outcomes of the study.

No change in colour, form, consistency or quality of the meat was observed during chilling or freezing of the carcasses. No adverse effects have been reported after consumption of prepared and cooked carcasses.

TABLE OF CONTENTS

		Page
DECLARATION		ii
DEDICATION		iii
ACKNOWLEDGEMENTS		iv
ABSTRACT		v
TABLE OF CONTENTS		vii
LIST OF APPENDICES		xii
LIST OF FIGURES		xiii
LIST OF TABLES		xiv
NOMENCLATURE		xv
CHAPTER 1		
INTRODUCTION		
1.1	HYPOTHESES	2
1.2	PURPOSE OF THE STUDY	2
1.3	IMPORTANCE OF THE PROBLEM	2
CHAPTER 2		
REVIEW OF RELATED LITERATURE		
2.1	HISTORY OF THE DOMESTIC FOWL	4
2.2	BROILER INDUSTRY IN SOUTH AFRICA	4
2.3	SUSCEPTIBILITY OF BROILERS TO DISEASE	4

2.3.1	Newcastle disease	5
2.3.2	Infectious bronchitis	7
2.3.3	Infectious bursal disease	8
2.4	STRESS FACTORS AFFECTING BROILER CHICKENS	9
2.4.1	Thermal extremes and humidity	10
2.4.2	Handling	11
2.4.3	Transport	11
2.4.4	Feeding regimen	12
2.4.5	Floor space availability	12
2.4.6	Broiler behaviour	12
2.4.7	Other stress factors	13
2.5	CONSEQUENCES OF STRESS	13
2.6	VACCINES AND VACCINOSIS	14
2.6.1	Vaccines	14
2.6.2	Vaccinosis	16
2.7	HOMŒOPATHY	18
2.7.1	Principles of homœopathy	18
2.7.2	Prophylaxis in homœopathy	20
2.7.3	Tautopathy	22
2.7.4	Homœopathic remedies for vaccinosis and stress	23
2.7.4.1	Homœopathic remedies for vaccinosis	23
2.7.4.2	Homœopathic remedies for stress	24
2.7.4.3	Potency selection	26

CHAPTER 3
MATERIALS AND METHODS

3.1	EQUIPMENT AND MATERIAL	27
3.2	METHODOLOGY	27
3.2.1	Duration and season of research	27
3.2.2	Research subjects and sample size	27
3.2.3	Place of research	28
3.2.4	Broiler house construction and layout	28
3.2.4.1	Broiler house cleaning and disinfecting	29
3.2.4.2	Floor space and divisions	29
3.2.5	Temperature control and lighting	30
3.2.6	Litter	30
3.2.7	Water and feed equipment	30
3.2.8	Weighing equipment	31
3.2.9	Water, feed and feeding regimen	31
3.2.10	Vaccination programmes, vaccines and vaccination procedure	32
3.2.10.1	Vaccination programme	32
3.2.10.2	Vaccines	33
3.2.10.3	Vaccination procedure	33
3.3	PREPARATION AND ADMINISTRATION OF HOMŒOPATHIC REMEDIES	34
3.3.1	Homœopathic preparations against vaccinosis and stress	34
3.3.2	Administration of homœopathic preparations	34
3.3.2.1	Administration of homœopathic remedies against vaccinosis	35
3.3.2.2	Administration of homœopathic remedy against stress	35

3.4	DATA COLLECTION AND ANALYSIS	36
3.4.1	Data collection	36
3.4.2	Data analysis	37

CHAPTER 4

RESULTS

4.1	INTRODUCTION	38
4.2	RESULTS	38
4.2.1	Live mass	38
4.2.2	Carcass mass values at slaughter	43
4.2.3	Mortality rate	43
4.2.4	Feed conversion rate	44
4.2.5	Performance efficiency factor	44
4.2.6	Weather data	45
4.3	ANALYTIC RESULTS	45
4.3.1	All groups: Live mass	45
4.3.2	All groups: Carcass mass	46
4.3.3	Mortality	46
4.3.4	Repeated Measures Analysis	46

CHAPTER 5

DISCUSSION OF RESEARCH RESULTS

5.1	SAMPLE SIZE	48
5.2	LIVE MASS	48
5.3	CARCASS MASS	49

5.4	MORTALITY	50
5.5	RANDOM SELECTION OF RESEARCH SUBJECTS	51
5.6	SEASON	51
5.7	VACCINOSIS AND STRESS TREATMENT GROUPS: LIVE MASS TREND	51
5.8	CARCASS PREPARATION	51
5.9	FEED CONVERSION RATE	52
5.10	PERFORMANCE EFFICIENCY FACTOR	52

CHAPTER 6

CONCLUSIONS AND RECOMMENDATIONS

6.1	INTRODUCTION	53
6.2	PROCEDURE	53
6.3	STATISTICAL FINDINGS	54
6.4	CONCLUSION	54
6.5	RECOMMENDATIONS	55

REFERENCES 57

LIST OF APPENDICES

	Page
APPENDIX A: List of materials and equipment	66
APPENDIX B: Weather data	67
APPENDIX C: Random live mass (kg): Vaccinosis treatment group	68
APPENDIX D: Random live mass (kg): Control group	69
APPENDIX E: Random live mass (kg): Stress treatment group	70
APPENDIX F: Vaccinosis treatment group: Non-paired random values - live mass and carcass mass in kilograms at slaughter	71
APPENDIX G: Control group: Non-paired random values - live mass and carcass mass in kilograms at slaughter	72
APPENDIX H: Stress treatment group: Non-paired random values - live mass and carcass mass in kilograms at slaughter	73

LIST OF FIGURES

	Page
Figure 4.1:	
Growth rate - all groups	**40**
Figure 4.2:	
Growth rate - vaccinosis treatment group versus control group	**41**
Figure 4.3:	
Growth rate - stress treatment group versus control group	**42**

LIST OF TABLES

	Page
Table 3.1: Vaccination programme	33
Table 3.2: Vaccine information	33
Table 4.1: Live mass mean (kg) over duration of study	39
Table 4.2: Live mass standard deviation over duration of study	39
Table 4.3: Live mass maximum value (kg) over duration of study	39
Table 4.4: Live mass minimum value (kg) over duration of study	39
Table 4.5: Carcass mass values at slaughter	43
Table 4.6: Mortality rate: All groups	43
Table 4.7: Feed conversion rate: All groups	44
Table 4.8: Performance efficiency factor: All groups	45

NOMENCLATURE

All-in, all-out system	One age of broilers for rearing purposes on a farm at any one time, followed by a rest period before a new rearing cycle to limit any disease spread from one age group to another (North and Bell, 1990).
Anthroposophy	Spiritual and mystical teachings of Rudolf Steiner (Treffry, 1999).
Broiler	Young tender chicken suitable for roasting (Treffry, 1999).
Debeaking	Act of removal by clipping or burning the first third of a beak of a chicken to prevent injury to other birds by aggressive behaviour (North and Bell, 1990).
Feed conversion rate	The total mass of feed consumed in kilograms over the total live mass at the broiler farm (University of Pretoria, 2002).
Harvesting	Gathering of chickens for slaughtering purposes.
Hatchery	Facility where chicken eggs are hatched under artificial conditions.
Litter	Bedding protection for animals.
Nosode	Homœopathic medicine derived from pathological material including micro-organisms, diseased tissue or the products of disease processes (Swayne, 2000).

Performance efficiency rate	A measure of performance using survivor-percentage, live mass, age, and feed conversion rate variables (University of Pretoria, 2002).
Piling	Act of jumping on other chickens to the extent where a pile or heap is formed with possible mortality or injury as a result (Klopp, 1999).
Prophylaxis	Prevention of disease or control of its possible spread.
Stocking density	Number of animals housed per square metre in animal husbandry (North and Bell, 1990).
Trampling	Act of walking over or stepping on other chickens with possible mortality or injury as a result (Klopp, 1999).
Vaccines	Suspension of dead, attenuated or otherwise modified micro-organisms for inoculation to produce immunity to a disease by stimulating the production of antibodies (Treffry, 1999).
Vent picking	Behaviour by birds where own or another bird's cloaca is repetitively pecked (Mississippi State University, 1997).
Waste	All chicken products other than carcass after slaughter.

CHAPTER ONE
INTRODUCTION

The Malthusian idea that burgeoning populations would eventually outstrip natural resources (Partington, 1992) has, in the intervening years, been proved incorrect. Broiler farming is an example of a multimillion dollar industry which requires sophisticated products to produce quality food for consumers at the lowest possible cost (Klopp, 1999); South Africa is no exception in this regard.

Broiler farmers are, however, faced with numerous challenges given the high demand for the product. According to Rosskopf and Woerpel (1996) improper management and stress are the primary contributing factors for most diseases of gallinaceous birds. In addition, immunosuppression due to stress is an extremely important factor which also increases the susceptibility of the broilers to infection and development of disease (Dohms, 1991; Cilliers, 1995).

Some of the most significant stressors that complicate broiler farming are extremes in temperature, overcrowding, loud sounds, infectious diseases, pollutants, sub-optimal nutrition, poor ventilation, drugs, including vaccinations, transport and predation. Although stress is a phenomenon which generally aids adaptation in nature, the severity encountered in broiler farming is such that it militates against returning the birds to homeostasis (Dohms and Metz, 1991).

Broiler chickens are vaccinated routinely during their life cycle (Travers, 2003). Most present-day vaccines have only a mild negative effect on healthy birds, but stress can exacerbate the effect leading to greater physiological change in the bird, possibly to great detriment (North and Bell, 1990). Vaccination against diseases should, however, not be seen as a solution to all infectious disease problems (Swayne, 1999) and vaccines also differ in their stressful effects during different life stages of the birds (North and Bell, 1990).

Controlling stressors has a positive impact in disease-preventing strategies (Swayne, 1999) and thus also in increasing broiler farming productivity.

1.1 HYPOTHESES

It is hypothesised that:

- The administration of a homœopathic preparation of *Aconitum napellus* 200CH will result in the alleviation of stress leading to a lowered mortality rate and increased mass gain in broiler chickens; and
- The homœopathic preparations of poultry vaccines 200CH will decrease the severity of, or eliminate, side effects of vaccines.

1.2 PURPOSE OF THE STUDY

The purpose of this study is to determine the effect that

- A homœopathic preparation of *Aconitum napellus* 200CH may have on the alleviation of stress in broiler chickens; and
- The homœopathic preparations of poultry vaccines 200CH may have on the alleviation of side effects of the vaccines;

as measured in live mass gain, carcass mass, mortality rate, feed conversion rate and performance efficiency factor.

1.3 IMPORTANCE OF THE PROBLEM

Broiler farming is more commercially viable, but more deleterious to the health of chickens than free-range farming (Niven, 2003), which would be the ideal. The

challenge faced by the industry is the enhancement of the quality of the lives of the broiler chickens by improving their health (Swayne, 1999).

A greater awareness of the conditions under which poultry husbandry is conducted has raised consumer concerns about consumer health, poultry welfare, poultry health and use of drugs (Van Niekerk, 2002). Since a negative economic impact of disease is enhanced in stressed poultry (Dohms and Metz, 1991), commercial advantages will be apparent if the quality of life in poultry husbandry is improved. Factors such as reduction of disease treatment costs, reducing the rate of mortality and better quality of market products evidenced in higher carcass mass of the broiler chickens should be considered (Dohms and Metz, 1991).

Enhancement of the quality of life of commercial poultry meets these concerns.

CHAPTER TWO
REVIEW OF RELATED LITERATURE

2.1 HISTORY OF THE DOMESTIC FOWL

The progenitor of the modern domestic fowl is believed to be the Red Jungle Fowl or *Gallus gallus*. It is thought that this species was first domesticated in South-East Asia and that domestication subsequently spread north and west through China and eventually to the rest of the world (Appleby *et al.*, 1992). In the earlier stages of domestication the fowl was valued mainly as a sacrificial or religious bird or for cock-fighting, according to the same authors. Plato recorded a deathbed wish by Socrates (Partington, 1992) which enjoined Chito to sacrifice a cock to Aesculapius, who was deified on account of his great knowledge of medicine. Appelby *et al.* (1992) state that the Romans were the first to develop the potential of the fowl in animal husbandry, creating specialised breeds, and that it was only in the nineteenth century that there was an explosion of poultry breeding.

2.2 BROILER INDUSTRY IN SOUTH AFRICA

Mitchell and Kettlewell (2000) reported that South Africa's production of chicken meat stood at four hundred and fifty-two thousand tons per annum in March 2000, the highest in Africa, representing sixteen percent of total African broiler output. South Africa is placed twenty-sixth in the world table of chicken slaughterers, with broiler meat constituting thirty-nine percent of total meat production in South Africa in the same year.

2.3 SUSCEPTIBILITY OF BROILERS TO DISEASE

Broilers are prone to infection by viruses, bacteria, fungi and parasites (Sainsbury, 2000). Bacterial diseases in poultry include colibacillosis, *Salmonella* sp.

infections, avian spirochaetosis, *Staphylococcus* sp. infections, infectious coryza, chronic respiratory disease, fowl cholera, tuberculosis (*Mycobacterium avium*). Fungal diseases include aspergillosis and candida (Janmaat, 1996).

According to Janmaat (1996) protozoan diseases include coccidiosis, blackhead and trichomoniasis; viral diseases include Marek's disease, lymphoid leucosis, fowl pox, infectious bronchitis, infectious laryngotracheitis, reticulo-endotheliosis, avian encephalomyelitis, Newcastle disease, avian influenza, and infectious bursal disease.

Ascites or pulmonary hypertension syndrome, is a condition encountered in broiler farming especially at high altitudes and in winter (Dutton, 2003). The Ross hybrid is considered most suitable for the broiler industry in the highveld in South Africa, given its relative resistance to the syndrome after careful genetic selection (Cilliers, 1995).

In discussion, Travers (2003) stated that in general it was established practice for broiler farms in South Africa vaccinate against Newcastle disease, infectious bronchitis and infectious bursal disease.

2.3.1 Newcastle disease

Newcastle disease is a highly contagious, increasingly virulent viral infection that affects chickens, as well as other gallinaceous birds (North and Bell, 1990). This disease causes great concern in the broiler industry (Cilliers, 1995). It presents predominantly with respiratory difficulties and nervous disorders, including paralysis (North and Bell, 1990; Mississippi State University, 1997). Although there is one serotype of the virus, there are four general forms classified according to their pathogenicity (North and Bell, 1990; Cilliers, 1995; Mississippi State University, 1997).

According to North and Bell (1990), Cilliers (1995) and Mississippi State University (1997) the four general forms are:

- Neurotropic or velogenic – this form has a high pathogenicity and presents acutely with a sudden onset and is often fatal. Signs include nervousness evidenced by a twisted neck in the birds and respiratory difficulty, gasping and sneezing;
- Viscerotropic velogenic – this is the most severe strain which has an extremely high pathogenicity, is highly virulent and results in a high mortality. Respiratory and nervous signs are less evident, and young broiler chickens present with spasms and twisted necks only. This form is sometimes referred to as the Asiatic type;
- Mesogenic – this form has an intermediate pathogenicity and presents with respiratory and nervous symptoms in young broiler chickens, but not in older birds. This is the most common type in the United States of America; and
- Lentogenic – this form has a mild pathogenicity. All ages of birds may have unnoticed infections presenting only with mild respiratory difficulty.

North and Bell (1990) and Cilliers (1995) state that Newcastle disease virus particles are spread easily via the air, trucks, clothing and other equipment, via feed, wild birds, exotic birds and predators or, if there is no all-in, all-out management programme on the farm. According to Cilliers (1995), once the broiler chickens have been infected, culling is the only resolution to prevent infection to other broiler chickens. No treatment exists for Newcastle disease, but antibiotics can prevent secondary infections according to North and Bell (1990).

Vaccination against Newcastle disease is believed by Leeson and Summers (2000) to be an effective prophylaxis. Routine vaccination against this disease is found in the vaccination programme in the broiler industry in South Africa (Travers, 2003).

2.3.2 Infectious bronchitis

Infectious bronchitis is a viral infection that affects only chickens. It is considered the most contagious of poultry diseases and presents with coughing, sneezing, nasal discharge and rales (Mississippi State University, 1997).

Young broiler chickens present with noticeable sneezing and wheezing, particularly at night, possibly with nasal discharge, watery eyes, swollen sinuses and gasping for breath (North and Bell, 1990). The mortality rate may be as high as fifty percent, with morbidity affecting practically all the birds. The incubation period is from eighteen to thirty-six hours, and the disease will usually run its course in five to twenty days. The severity of the disease is, however, associated with the damage done by secondary diseases, particularly those produced by the coliform bacterial infections (North and Bell, 1990; Cilliers, 1995).

In adult birds, as in chicks, the disease starts quickly, without notice, and with rapid transmission. Few noticeable signs of the disease are to be found in the bird itself, and are best evidenced by a drop in egg production. The mortality rate may be as high as twenty-five percent in broilers and the disease lasts from four to ten days (Ignjatovic and Sapats, 2000). Whether broilers should be vaccinated against infectious bronchitis is an individual decision, but the industry in South Africa follows the practice of vaccinating the birds routinely in the hatchery on day one of the life cycle with a full vaccination dose (Doak, 2003).

Infectious bronchitis is not transmitted via the egg, but through the transfer of the virus by air, people, animals, equipment, feed or by carrier birds who have recovered from the disease (North and Bell, 1990).

Infectious bronchitis is difficult to differentiate from many other respiratory diseases and a definite diagnosis usually requires laboratory analysis (Mississippi State University, 1997). When the disease occurs all susceptible birds on the

premises become infected, and since there is no treatment for infectious bronchitis, vaccination is regarded as the only control (North and Bell, 1990).

2.3.3 Infectious bursal disease

Infectious bursal disease, or Gumboro, is a highly infectious viral disease, developing rapidly, but of short duration (North and Bell, 1990). According to Cilliers (1995) the virus is remarkably resilient and survives in the environment for a long time without a host. It can be transmitted by air into neighbouring farms or by contact with faeces, persons or equipment.

According to North and Bell (1990) and Cilliers (1995) the virus infects the bursa or gland of Fabricius, situated close to the cloaca or vent of the bird, and leads to bursal changes characterized by initial swelling, a change in shape, and colour. The bursa may turn pink, yellow, red or black (Mississippi State University, 1997), and may be surrounded by, or filled with, a yellow gelatinous substance (Cilliers, 1995). After the acute infection stage, the bursa shrinks to half its normal size or may become even smaller (Mississippi State University, 1997).

The disease presents with listlessness, nervousness, sleepiness, dehydration and a whitish diarrhoea (North and Bell, 1990). According to Mississippi State University (1997) birds may display ruffled feathers, a slight tremor at the onset of the disease, strained defecation and pecking at the cloaca, or vent picking, in an attempt to alleviate irritation.

Mortality is variable, but in the course of infection the tissues of the bursa may be partially or permanently destroyed (North and Bell, 1990). Since the bursa plays an important role in the formation of antibodies to many diseases, infectious bursal disease can lead to compromise of the immune system in a broiler chicken and result in increased susceptibility to other infectious agents, allowing secondary infections to take place (Cilliers, 1995).

An important commercial consideration is that the disease can lead to pinhead or larger areas of bleeding into muscular tissue, particularly into the thigh and breast muscles, compromising carcass quality (Cilliers, 1995).

Broiler chickens inherit immunity to infectious bursal diseases from mother hens, such immunity being of limited duration (Cilliers, 1995). Once this immunity has subsided, broiler chickens are vaccinated against the disease at days twelve and eighteen (Doak, 2003) to afford immunity until time of slaughter. Another extremely important consideration in prophylaxis is complete disinfecting of the broiler facility, since the virus is so resilient (Cilliers, 1995). The broiler industry in South Africa follows the practice of disinfecting and then leaving broiler facilities vacant for up to two weeks prior to a new broiler chicken rearing cycle to combat this virus (Doak, 2003).

2.4 STRESS FACTORS AFFECTING BROILER CHICKENS

Exposure to stress factors on a continual basis is one of the most important features of broiler farming that results in increased mortality and morbidity, susceptibility to disease and reduced body weight (North and Bell, 1990). Stress results in increased heart rate and blood pressure, decreased feed consumption, decreased sexual activity, production of fewer antibodies, reduction in growth rate, increased incidence in ulcerative enteritis, reduction in plasma glycogen and ascites (North and Bell, 1990). According to North and Bell (1990) stress leads to an increase in cortisol levels, which in turn increases the resistance to bacterial infections; resistance to viral disease, however, is decreased.

Other signs of stress are increased carcass fat, increased nervousness of the birds (Dohms and Metz, 1991) and cannibalism (Klopp, 1999). Differences in the weight of internal organs can also occur (Memon *et al.*, 2001; Terraes *et al.*, 2001).

Broiler farmers have control over possible stress factors such as air quality, adequate floor or cage space, lighting, proper and regular feed, water quality and availability, removal of dead birds and temperature (Klopp, 1999). Factors such as transportation, change in familiar environment, changes in daily routine, sudden changes in environmental temperature, seasonal changes such as winter, vaccination, disease and beak trimming, all exacerbate stress levels (Weideman and Tackett, 2000).

2.4.1 Thermal extremes and humidity

In research conducted by Sandercock *et al.* (2001) acute heat stress resulted in panting which led to acid-base disturbances resulting in generalised myopathy. The occurrence of myopathy was higher in older birds, with breast muscle pH lower, carcass dehydration and an increased incidence of breast muscle haemorrhage. These authors recommend that pre-slaughter exposure to heat stress should be avoided to improve product quality. Hartlova *et al.* (2002) confirm the acid-base disturbances due to heat stress.

Conversely, broiler chickens exposed to cold extremes presented with a dramatic decline in body temperature and a significant elevation in stress response as measured in plasma corticosterone concentrations (Shinder *et al.*, 2002).

Another significant factor is the question of humidity. In research conducted by Yahav (2000), the ideal humidity level for raising broiler chickens has been found to be between sixty to sixty-five percent. According to Cilliers (1995), cold dry air with relative lack of humidity is a contributing factor to the occurrence of ascites.

2.4.2 Handling

Any manual catching process results in stress leading to an increased risk of mortality and injury. These factors are important not only in the welfare of the animals but also in commercial considerations (Knierim and Gocke, 2003). These authors confirm the finding by Lacy and Czarick (1998), who recommend that mechanical harvesting be implemented generally in the industry, since lower rates of mortality and injury were observed during their research.

Stress can be induced by any adverse human interactions with the birds (Swayne, 1999) and includes procedures such as weighing of the broiler chickens, and vaccination procedures (North and Bell, 1990).

Elrom (2000, Part IV) states that handling, as in procedures of catching, depopulation or harvesting, causes severe stress to the birds, possibly the severest in their short life.

2.4.3 Transport

In general, day-old chickens are sent from a commercial hatchery to the broiler farm and whilst en route already suffer from elevated levels of stress. Factors contributing to elevated stress levels include thermal stress, vehicle vibration, lack of ventilation, noise, odours, change in social order, food and water deprivation, fear and pain. A similar set of circumstances applies when broilers are sent for slaughter to an abattoir (Elrom, 2000, Part I).

Research into vehicle vibration by Abeyesinghe *et al.* (2001) confirms the findings of Elrom (2000, Part I) that chickens are averse to vibration.

Mitchell and Kettlewell (1998) report Warriss *et al.* (1990) as stating that the longer the journey, the higher the heat stress and mortality rate, which leads to

decreased productivity and meat quality and reduced welfare status. This is recognised by the industry as the most frequently occurring problem during commercial broiler transportation (Mitchell and Kettlewell, 1998).

Human interaction with the birds, both on loading and unloading, also leads to elevated stress levels (Swayne, 1999).

2.4.4 Feeding regimen

Food and water deprivation are stressors, as is any change in the diet formulation (Elrom, 2000, Part I). Higher plasma corticosterone is found in broiler chickens whose feed has been restricted (De Jong *et al.*, 2002). Cilliers (1995) states that where feed is restricted for any purpose, such as to retard growth during periods of ascites prevalence, the reintroduction of feed may lead to trampling or myocardial infarctions.

2.4.5 Floor space availability

Overpopulation is a potent stressor (Elrom, 2000, Part III) as was confirmed in a study by Heckert *et al.* (2002). McLean *et al.* (2002) state that the higher the number of broiler chickens, the less broilers feed, leading to a higher mortality rate. Mississippi State University (1997), confirms this finding with additional factors of increased aggression and a reduced growth rate being mentioned.

2.4.6 Broiler behaviour

Piling, feather picking, toe picking, head, tail and vent pecking and cannibalism are all behavioural manifestations of birds being stressed and crowded (Klopp, 1999; Mississippi State University, 1997). Debeaking to prevent this behaviour is another

factor which will lead to elevated levels of stress (Mississippi State University, 1997) and should be carried out at the earliest age to minimise the pain (Klopp, 1999). Reduction of light intensity is believed to be an effective method of controlling these aggressive actions by broiler chickens (Klopp, 1999).

2.4.7 Other stress factors

Elrom (2000, Part III) states that stressors may also include increased ambient ammonia, electric shocks, noise such as sonic booms or thunder, as well as lightning, any change in clothing by handlers, or lack of light and ventilation which may elicit fear and panic in broiler chickens.

Ammonia fumes, according to Cilliers (1995), paralyse ciliae in the respiratory system, resulting in an inability to eliminate dust with an increased susceptibility to lung diseases.

Esmail (1997) states that chickens exposed to noise higher than eighty-three decibels had a lower feed intake than those exposed to sixty-four decibel noise, leading to lower weight gain and lower feed conversion efficiency.

2.5 CONSEQUENCES OF STRESS

Any stress response is generally beneficial in that it assists broiler chickens in adapting to potentially harmful changes in their environment. Chronic or long-term stress, not normally be encountered in nature, has a detrimental effect on the immune and reproductive systems, as well as a negative impact on metabolism and energy balance (Elrom, 2000, Part II).

Elrom (2000, Part II) states that chronic or long-term stress leads to elevated levels of corticosteroids in the blood, with a significant sequela being increased

uric acid excretion. This leads to increased water loss, and thus dehydration, leading the broiler chickens to increase their water consumption to the detriment of feeding. Dramatic initial weight loss follows, with subsequent recovery in weight but not to the same extent as in a non-stressed bird. There is an increased deposition of fat at the expense of protein (Elrom, 2000, Part II).

Any flock exposed to chronic stress may thus not reach its optimal weight at the end of the rearing cycle. This increases the susceptibility of the broilers to infection and development of disease (Dohms, 1991; Cilliers, 1995). The mortality rate may also increase due to stress. A broiler-rearing programme should thus be maintained as stress-free as possible (Elrom, 2000, Part III).

Elrom (2000, Part III) further states that birds are very sensitive to threatening behaviour. If, for instance, the bird gives up trying to find an alternative and suitable coping strategy, or if it learns that none is available, it could enter the dangerous state of hopelessness, learned helplessness and behavioural depression. Such failure to cope could eventually lead to death through the breakdown of internal homeostatic mechanisms.

2.6 VACCINES AND VACCINOSIS

2.6.1 Vaccines

According to Travers (2003) the broiler industry routinely employs vaccination, with live vaccines, as a means to prevent disease in broiler chickens. North and Bell (1990) believe that although most present-day vaccines have only a mild negative effect on healthy birds, physiological change can be initiated by vaccines in birds suffering from stress. Vaccines also differ in their stressful effects during different life stages of the birds.

Current commercially-available vaccines do not always provide protection against new disease strains, and vaccination programmes are constantly adjusted in an attempt to improve protection against disease (Villegas, 1998). According to Ignjatovic and Sapats (2000), continual use of live vaccines complicates diagnosis since no simple diagnostic tool can differentiate a field strain from a vaccine strain. Serology is also complicated by the continual use of live vaccines.

According to Cilliers (1995), the use of live vaccines in the prevention of infectious bursal disease always causes a measure of damage to the cells of the bursa of Fabricius, which can compromise antibody formation in many diseases. Cilliers (1995) states further that this damage varies from a minimal degree when the use of mild vaccines is employed, to a medium, but distinct, degree of damage when powerful vaccines are employed. The latter, however, offer better protection against the disease, whereas mild vaccines offer hardly any protection to young broiler chickens, especially when the mother hen has been successfully vaccinated (Cilliers, 1995).

Severe vaccination reactions, after vaccinations against Newcastle and infectious bronchitis diseases on day one of the life cycle of the broiler chicken, lead to gasping, which should not be confused with symptoms of aspergillosis (Cilliers, 1995). The same author states that a post mortem examination is essential in establishing the cause of death.

Polyvalent vaccines, or those containing more than one strain, are more likely to produce greater stress following vaccination than those that are monovalent (North and Bell, 1990). The same authors state that industry recommendations warn against vaccinating birds that have elevated stress levels.

A holistic approach to disease in the broiler industry is summed up by Swayne (1999) as follows:

Prevention of disease, not treatment of disease is the most appropriate approach to disease control ...

2.6.2 Vaccinosis

The concept of vaccinosis, or disease caused by vaccination, was first mooted by Burnett (1897), a prominent homœopath in his time, who associated smallpox vaccination with various conditions such as neuralgia, chronic headaches and eczema.

Contemporary homœopaths differ in opinion on the question of vaccination, ranging from the belief that it is safe and effective, to those who fundamentally disagree (Torline, 2001). Teixera (2002) proposes the possibility that vaccination causes an imbalance in immunological response, specifically among Th_1 and Th_2 lymphocyte subpopulations. Vitoulkas (1980) is of the opinion that the process of immunisation has:

a profoundly disturbing effect on the health of an individual, particularly in relation to chronic disease.

The debate about vaccinosis is also now current within allopathic medical circles, particularly after the concept of a Gulf War syndrome was suggested as a result of a polyvaccination programme for military personnel (Hotopf *et al.*, 2000). Health authorities are alarmed at current debate surrounding a possible link between autism and the measles, mumps and rubella vaccination, which has led to a decline in parents following the vaccination programme (Cohen and Shoenfeld 1996; Begg *et al.*, 1998; Nicoll *et al.*, 1998).

Among allopaths opinion is also divided, but various allopathic studies have, however, shown that:

- *Evidence* (has) *established causality between diphtheria and tetanus toxoids and anaphylaxis, between measles vaccine and death from measles vaccine-strain viral infection and poliomyelitis and death from polio vaccine-strain viral infection, and between hepatitis B vaccine and anaphylaxis* (Stratton *et al.*, 1994);
- *A chronic enterocolitis* (has been identified) *that may be related to neuropsychiatric dysfunction in children. In most cases onset of symptoms was after measles, mumps and rubella immunisations* (Wakefield *et al.*, 1998);
- *The French Ministry of Health announced that routine immunisation of adolescents against recombinant hepatitis B virus has been suspended because of concerns that the vaccine exacerbates demyelinating diseases* (Simini, 1998);
- *Although a coincidental association between vaccination and the onset of systemic lupus erythematosus cannot be excluded, the temporal relationship with the development of symptoms makes it immunologically plausible that vaccination triggered systemic autoimmunity in these rare cases* (Older *et al.*, 1999);
- *Hepatitis B vaccine might be followed by various rheumatic conditions and might trigger the onset of underlying inflammatory or autoimmune rheumatic diseases* (Maillefert *et al.*, 1999);
- *Some autoimmune phenomena are clearly related to immunisation* (Shoenfeld and Aron-Maor, 2000);
- *Among veterans of the Gulf War there is a specific relation between multiple vaccinations given during deployment and later ill health. Multiple vaccinations in themselves do not seem to be harmful, but combined with the 'stress' of deployment they may be associated with adverse health outcomes* (Hotopf *et al.*, 2000);
- *Administration of multiple vaccines* (to infants) *in a short space of time could increase the risk of autoimmune disease* (Jeffreys, 2001) *and trigger autoimmune responses* (Rovere *et al.*, 1998);

- *In a cross-sectional study in terms of history of atopic and infectious diseases, use of antibiotics and vaccinations, and social and environmental variables prevalence of atopy is lower in children from anthroposophic families than in children from other families* (Alm *et al.*, 1999);
- *A mass vaccination response would produce fewer casualties* (in a potential smallpox attack) *and contain the outbreak more quickly than a surveillance-and-containment approach* (Lawrence, 2002); and
- *A significant correlation* (was found) *between pertussis vaccination and asthma* (Odent and Culpin, 2003).

Evidence thus points to the fact that vaccinosis should be investigated further. It is apparent that since vaccines cause adverse reactions in animal husbandry, that the concept of vaccinosis should also be investigated in this industry (Niven, 2003).

2.7 HOMŒOPATHY

Homœopathy is a system of healing, founded by Dr Samuel Hahnemann (1755 – 1843). Its name is derived from the Greek words *homoios* meaning 'similar' and *pathos* meaning 'suffering' (Brewster O'Reilly, 1997).

2.7.1 Principles of homœopathy

The fundamental therapeutic principle of homœopathy, formulated by Hahnemann, is:

Similia similibus curentur

which, in translation, means 'let likes be cured by like' (Eizayaga, 1991), the dictum of the Law of Similars.

This law espouses the principle of similitude, and finds its origins as far back as the fifth century before Christ when it was applied by Empedocles of Agrigentum, and later also by Hippocrates in the fourth century before Christ (Eizayaga, 1991). The practical application of this fundamental principle is to be found in the theory that any substance which produces a totality of symptoms in a healthy person can cure that totality of symptoms in a sick person (Vitoulkas, 1980).

The Law of Similars was confirmed by Hahnemann in the testing, or proving, of medicinal substances which created a symptom picture in a healthy individual. These symptom pictures were then matched to actual disease symptoms in sick individuals, who were then treated with the medicinal substance. Hahnemann discovered that the closer the match of the medicinal substance symptom picture to the actual symptom picture of the sick person, the more effective the treatment (Eizayaga, 1991).

In the transliterated words of Hahnemann, in aphorism 26:

> *When two very similar dynamic affections meet in a living organism, the stronger extinguishes the weaker. This is the Law of Similars upon which every real cure is based* (Brewster O'Reilly, 1997).

Hahnemann believed that the application of a single medicinal substance, otherwise termed the homœopathic remedy, or remedy, was sufficient to overcome the symptom picture in a sick person; he further believed that a minimum dose of the appropriate remedy could initiate cure (Eizayaga, 1991). In the transliterated words of Hahnemann, in aphorisms 273 and 279:

> *Administer only one, simple medicine at a time* (Brewster O'Reilly, 1997).

> *As a rule, even the smallest homeopathic doses will be strong enough to begin a cure, ...*(Brewster O'Reilly, 1997).

Since medicinal substances can be toxic, Hahnemann sought to eliminate toxicity by diluting the substances. In order to increase efficacy of the substance, Hahnemann believed that the addition of kinetic energy would heighten its therapeutic action. This process is called 'potentization' or 'dynamization' (Vitoulkas, 1980).

In the transliterated words of Hahnemann, in a footnote to aphorism 269:

Potentized medicines are not mere dilutions. The dynamization process reveals a substance's hidden medicinal power. The substance's dilution in a non-medicinal medium is just one part of the process (Brewster O'Reilly, 1997).

2.7.2 Prophylaxis in homœopathy

Various prophylactic options are available in homœopathy, notably constitutional treatment, *genus epidemicus* treatment and the use of nosodes (Eizayaga, 1991).

Hahnemann found that the prophylactic use of *Atropa belladonna* during a scarlet fever epidemic in Königslutter, Prussia, in 1801, successfully prevented children from contracting the disease (Eizayaga, 1991).

In the transliterated words of Hahnemann, in a footnote to aphorism 33:

However, in the Königslutter epidemic which I experienced, all the children who took a very small dose of Belladonna early enough remained free of this highly contagious childhood disease. If medicines can protect us from the contagion of a raging disease, so must they possess a preponderant power to differently tune our life force (Brewster O'Reilly, 1997).

Other mention of prophylactic treatment in homœopathy using plant remedies and nosodes include:

- The Prussian government made the use of *Atropa belladonna* compulsory in 1838 as a prophylaxis against scarlet fever (Dunham, 1994) after Hufeland's (1826) positive review of the results of the use of the remedy in the treatment of the disease in 1801;
- Clemens von Boenninghausen used *Camphor, Cuprum metallicum* and *Veratrum album* during a cholera epidemic in Europe in 1849 (Shepherd, 1967);
- The treatment of yellow fever epidemics by Mejía, Conadi, Clausolles, Granados, Varela and Petit de Murat in 1870 in Buenos Aires (Eizayaga, 1991);
- The use of *Variolinum* in 1902 against smallpox in Iowa, United States, by Eaton (Hoover, 2001);
- The use of *Gelsemium sempervirens, Arsenicum album* and *Bryonia alba* in the 1918 influenza pandemic (Hoover, 2001);
- The use of *Diptherinum* against diptheria in 1932 (Chavanon, 1932), repeated by Patterson and Boyd (1941) and by Roux in 1946 (Eizayaga, 1985);
- The treatment of poliomyelitis by Salk in 1957, in Buenos Aires (Eizayaga, 1991);
- The use of *Meningococcinum* against meningitis in Brazil, in 1974 (Castro and Nogueira, 1975);
- The use of *Lathyrus sativa* by Grimmer as prophylaxis against poliomyelitis (Currim, 1996); and
- The use of *Pertussin* by Fox (1987) against whooping cough, in 1987.

Considering such data from epidemics as a whole, Hoover (2001) concludes that *genus epidemicus* prescribing clearly appears to be effective.

Homœoprophylaxis using plant remedies and nosodes in animal research include:

- The use of a tumour nosode, *Arsenicum album* and *Mercurius nitricus* homœopathic complex in the treatment of genetically-inherited tumours in *Drosophila melanogaster*, or fruitfly. The mortality rate was shown to be

reduced four-fold in the groups treated with homœopathic remedies, as opposed to the mortality rate in the control groups (Stearns and Stark, 1925);

- The use of a nosode taken from the blood of mice infected by trypanosomiasis, or Chags-Cruz disease, to treat mice prophylactically before exposure to trypanosomal infection. All mice treated prophylactically survived, compared with no survivors among the control group (Annals Hom Fr., 1982). The use of the same nosode was shown to be effective in three separate studies with raised antibodies to the disease (CLMHI, 1986); and
- The use of a nosode against kennel cough, with successful results (Day, 1987).

Eizayaga (1991) also makes mention of homœoprophylaxis in animals citing the use of *Ledum palustre* and *Hypericum perforatum* against tetanus.

2.7.3 Tautopathy

In homœopathy various categories of medicines are used such as antidotes, contraries or antagonistics, complementaries or the unique remedy for the condition. The best antidote against a toxin is the same dynamized toxin and its use is the therapeutic method of tautopathy (Eizayaga, 1991).

Murphy (2003) sees tautopathy as the science of antidotes and toxicology, remarking that the first remedy ever prescribed in homœopathy was a tautopathic one since Hahnemann used *Cinchona officinalis* to treat poisoning by the same plant. The same author concludes that current drug usage in orthodox medicine, with concomitant toxicity, provides an entirely new repository of potential remedies for use in homœopathy. In his address to the Alliance of Registered Homœopaths in the United Kingdom in 2003, Murphy (2003) mentions nine methods of tautopathic prescribing, with the means to:

- Counteract the side effects of drugs;

- Eliminate drug residues stored by the body;
- Counteract drug withdrawal symptoms;
- Counterbalance drug addictions and cravings;
- Neutralize drug and chemical overdoses;
- Eliminate symptoms for which the drug is indicated;
- Act prophylactically;
- Induce detoxification as a means to induce proper functioning of the body; and
- Use homœopathic symptomatology as a guide to select an orthodox drug to treat the same symptoms.

Tautopathy as homœopathic prophylaxis is thus considered appropriate to redress potential harm caused by vaccination, or vaccinosis, using vaccines that are routinely used in the broiler industry, and preparing them by potentization and dynamization into a homœopathic vaccinosis remedy (Niven, 2003).

2.7.4 Homœopathic remedies for vaccinosis and stress

2.7.4.1 Homœopathic remedies for vaccinosis

Apart from tautopathic prophylaxis against vaccinosis, various remedies exist in homœopathy to treat vaccinosis. Burnett (1897) was of the opinion that certain persons dated their ill-health from an unsuccessful vaccination and suggested the use of *Thuja occidentalis* as a remedy for vaccinosis.

Under the rubric:

***VACCINATIONS**, ailments, after –*

Murphy (1996) includes *Thuja occidentalis*, but views the following remedies, among others, also as important in treating vaccinosis:

Malandrinum, Daphne mezereum, Smilax ornata, Silicea terra, Sulphur, and *Vaccininum* or a nosode from vaccine matter.

According to Vermeulen (2000):

- *Malandrinum* is regarded as a very effectual protection against smallpox, and is used for the ill-effects of vaccination. It may also be employed as a remedy for unhealthy, dry, rough skin which remains for years after vaccination;
- An indication for treatment with *Daphne mezereum* is against vaccination;
- *Smilax ornata* may be used for eruptions following vaccinations;
- *Silicea terra* may be used in treatment of abscesses and even convulsions after the ill-effects of vaccination;
- *Sulphur* may be used for pustular eruptions affecting the scalp, face, ears, groins and legs, as well as for otorrhoea after the bad effects of vaccination; and
- Vaccine toxicity may result in a morbid state of extreme chronicity and *Vaccininum* may be used as a prophylactic against, and to modify, the course of a smallpox infection.

According to Niven (2003) tautopathy is believed to enhance the action of vaccines and decrease the severity of, or eliminate, their side effects. A tautopathic prophylactic approach to counteract any possible toxicity, using homœopathic remedies made from poultry vaccines, is thus considered apposite for use in broiler farming to counteract vaccinosis.

2.7.4.2 Homœopathic remedies for stress

The language of the repertory does not encompass the modern concept of stress. The closest approximation to signs and symptoms experienced by broiler chickens under conditions of stress may be found under the following rubrics, among others (Murphy, 1996):

Mind, ANXIETY, *general –*
Mind, ANXIETY, *general, attacks of –*
Mind, ANXIETY, *general, breathing, difficult from –*
Mind, ANXIETY, *general, ailments from anxiety –*
Mind, ANXIETY, *general, chill, during –*
Mind, ANXIETY, *general, crowd, in a –*
Mind, ANXIETY, *general, fear, with –*
Mind, ANXIETY, *general, fright, after –*
Mind, ANXIETY, *general, others, from –*
Mind, ANXIETY, *general, sudden –*
Mind, FEAR*, general –*
Mind, FEAR*, phobias, claustrophobia, closed places –*
Mind, FEAR*, phobias, crowd, in a –*
Mind, FEAR*, phobias, death of –*
Mind, FEAR*, phobias, noise from –*
Mind, FEAR*, phobias, people of –*
Mind, FEAR*, phobias, riding in a carriage –*
Mind, FEAR*, phobias, suffocation of –*

The leading remedy found in these rubrics is *Aconitum napellus.* Other remedies to consider in treating stress in broiler chickens might be (Murphy, 1996):

Argentum nitricum, Atropa belladonna, Arsenicum album, Aurum metallicum, Borax, Calcarea carbonica, Calcarea phosphorica, Carcinosin, Cicuta virosa, Datura stramonium, Digitalis purpurea, Graphites, Ignatia amara, Kalium arsenicum, Lycopodium clavatum, Lyssinum, Natrum carbonicum, Papaver somniferum, Phosphorus, Platinum metallicum, Psorinum, Sepia succus, and *Zincum phosphoricum.*

These remedies also feature prominently, but not to the same extent as *Aconitum napellus,* in the same rubrics.

Clarke (1991), however, cites Hughes as remarking that the condition to which *Aconitum napellus* is homœopathic, is 'tension'. According to Clarke (1991) the word 'tension' gives the best idea of the action and sphere of the remedy:

There is emotional and mental tension, as shown in fright and fear and its consequences, anxiety, and fear of death; tension in the systemic vessels, as in the effects of a chill ... ; muscular tension, as in tetanus; tension of involuntary muscles, as in heart spasms, and tension of the semi-involuntary muscular apparatus of respiration, as in asthma; and finally tension of the special senses in heightened sensation and heightened sensitiveness to pain ... Hence, Aconite in its therapeutic action corresponds to the effects of a number of conditions which excite a state of tension.

Vermeulen (2000) describes the keynote of *Aconitum napellus* as encompassing extreme anxiety and fear due to any cause, with physical and mental restlessness and aversion to handling. The same author concludes that fright is the most characteristic manifestation of this remedy.

Aconitum napellus is thus considered the appropriate remedy to treat stress in broiler chickens.

2.7.4.3 Potency selection

As recommended by the specialist supervisor, Dr A.G. Niven, the remedies used in this research study were administered in a 200CH potency to test the efficacy of this potency in prophylaxis (Niven, 2003).

CHAPTER THREE
MATERIALS AND METHODS

3.1 EQUIPMENT AND MATERIAL

See Appendix A.

3.2 METHODOLOGY

3.2.1 Duration and season of research

The research study took place over thirty-seven days, from 19 August to 24 September 2003, towards the end of the South African winter and beginning of spring.

The research was started on arrival of the day-old broiler chickens from the hatchery and conducted over thirty-seven days until the average live mass of treatment groups totalled 1.7 kilograms, which is a general mass guideline for the broiler industry in South Africa for slaughtering (Doak, 2003). Depending on the consumer demand or requirements the industry may only slaughter at day forty-two (Cilliers, 1995).

3.2.2 Research subjects and sample size

One hundred and fifty broiler chickens, *Gallus gallus domesticus*, Ross hybrid, were used in this research. As is practice in the broiler farming industry (Doak, 2003), all research subjects were female and of the same age. The requirement of homogeneity for statistical analysis was thus also met (Smit, 2003).

The Grade A broiler chickens were obtained from Earlybird Farm (Pty) Ltd, Kaalfontein, Mpumalanga, South Africa, an established hatchery which provides day-old broiler chickens to the industry. The broiler chickens were divided at random into three groups of fifty each by an employee of Earlybird Farm and were transported by road over a distance of approximately forty kilometres to the place of research.

One group of fifty broiler chickens was designated at random by the farm manager as the group to be treated prophylactically against vaccinosis, over and above normal farm-rearing procedures. For statistical purposes this group was labelled '**Group one**'.

Another group of fifty broiler chickens was designated at random by the farm manager as the control group. This group underwent normal farm-rearing procedures only. For statistical purposes this group was labelled '**Group two**'.

The remaining group was designated as the group to be treated for stress, over and above normal farm-rearing procedures. For statistical purposes this group was labelled '**Group three**'.

3.2.3 Place of research

The research was conducted on the farm Witpoort Extensions 14 and 15, in the Bronkhorstspruit District in Mpumalanga, South Africa.

3.2.4 Broiler house construction and layout

An existing brick and roofed structure, with a concrete floor, used previously for broiler chicken farming, was adapted for research purposes. The structure was considered suitable for this research since it required only minimal change as it

met the following basic requirements of a convection broiler house as set out by Cilliers (1995):

- The long axis of the structure was constructed on an east-west axis; and
- The space between the wall and roof allowed for adequate convection ventilation, thus obviating the necessity for artificial ventilation.

3.2.4.1 Broiler house cleaning and disinfecting

The structure was cleaned prior to the research. As recommended by the specialist supervisor, Dr A.G. Niven, and in contradistinction to industry practice, no disinfecting procedure was followed. This was done to provide a non-sterile environment to allow for the possible survival of any endogenous pathogen, such as infectious bursal disease, in order to test the parameters of the research study, namely prophylactic treatment against pathogens (Niven, 2003).

3.2.4.2 Floor space and divisions

The broiler house enclosed a floor space of forty-four square metres. Half of the broiler house was converted for research purposes.

Three individual divisions were constructed within the broiler house using hardboard, secured with vertical supports and wire to form individual divisions with a floor space of four square metres per division. The height of the divisions reached one metre to prevent fully-grown broilers from moving from one division to another.

Fifty broiler chickens were reared in each division. According to the University of Pretoria (2002) nine to twelve broiler chickens per square metre is the recommended maximum number per square metre. The floor space as used per fifty broiler chickens thus met industry standards.

To prevent instinctive huddling in corners that could result in mortality, broiler chickens were restricted within the individual divisions by a circular hardboard construction with an area of 1.8 square metres for the first fourteen days.

3.2.5 Temperature control and lighting

Hooded electric infra-red lighting, directing heat downward towards the broilers, was used over and above usual electrical lighting and ambient temperature to ensure suitable heat standards for the broilers. The accuracy of temperature control as maintained by the farm manager was evidenced by the absence of panting, huddling or heat-related mortality of the broilers. Lighting was maintained every day for a twenty-four hour period.

3.2.6 Litter

Untreated pine shavings, considered the ideal litter for broiler farming within the industry (North and Bell, 1990; Cilliers, 1995; Doak, 2003), were used as litter. The litter was spread within the individual divisions to a depth of eight centimetres, kept dry and loose, and was not changed for the duration of the research. This met the broiler industry requirements (Cilliers, 2002).

3.2.7 Water and feed equipment

All equipment was labelled with laminated labels bearing the division numbers of the divisions in which the equipment was used and was not ever used in any other division.

One flat feeding tray per fifty broiler chickens, as specified by the feed supplier, Meadow Feeds, a division of Astral Operations Ltd, was placed in each division for the research period.

One automatic feeder per fifty broiler chickens, as specified by the feed supplier, Meadow Feeds, was placed in each division from day five until conclusion of the research period.

One fountain drinker per fifty broiler chickens, as specified by the feed supplier, Meadow Feeds, was placed in each division from day one to day ten.

One bell drinker per fifty broiler chickens, as specified by the feed supplier, Meadow Feeds, was placed in each division from day five until conclusion of the research period.

3.2.8 Weighing equipment

A digital scale recording a maximum of two kilograms up to three decimal places was used to record the live mass of the broiler chickens every six days on the farm.

Another digital scale recording a maximum of one hundred and fifty kilograms up to two decimal places, rounding the mass off to the nearest five grams, was used to record the live and carcass mass of the broiler chickens at the slaughter house.

3.2.9 Water, feed and feeding regimen

The farm utilised in this research had its own source of water supply. Water was drawn from a borehole for all farming and domestic requirements.

Water in the fountain drinkers was replaced with fresh water on a regular basis, as and when required by the broiler chickens. Bell drinkers were linked to a continuous supply of fresh water and provided water automatically as broiler chickens drank water.

A biphasal feed regimen, suitable for small-scale farmers (Cilliers, 1995) was followed. Commercial feed, which commonly contains medication (Cilliers, 1995), was purchased from Meadow Feeds, a division of Astral Operations Ltd.

The following feed was used in the research study:

- Starter feed, in the form of crumble, contained the medication Maxiban500/ Olaquindox200 and was used from day one until broiler chickens had consumed an average of one kilogram per broiler chicken on day sixteen, or one hundred and fifty kilograms in total for all three groups; and
- Grower feed, in the form of pellets, contained the medication Salinocox500/ Flavomycin 375 and was then used until the date of slaughter on day thirty-seven, a further three hundred and seventy five kilograms of feed for all three groups.

A total of five hundred and twenty five kilograms of feed was thus used for the research period.

Overlap periods with regard to both feed type, as well as feed and water equipment, were maintained in order to minimise any stress which might have been caused by sudden change in feed type or equipment usage.

3.2.10 Vaccination programme, vaccines and vaccination procedure

3.2.10.1 Vaccination programme

Vaccinations on day one were carried out at the hatchery on instruction of the researcher to meet industry practices (Travers, 2003). General immunisation programmes on broiler farms in South Africa, according to Travers (2003), are as follows:

Table 3.1: Vaccination programme

Day one	**Infectious bronchitis, Newcastle disease**
Day twelve	**Infectious bursal disease**
Day eighteen	**Infectious bursal disease**
Day twenty-two	**Newcastle disease**

3.2.10.2 Vaccines

Live vaccines against infectious bronchitis, infectious bursal disease and Newcastle disease were purchased from Immuno-Vet Services CC, Midrand, Gauteng, South Africa.

Relevant details are as follows:

Table 3.2: Vaccine information

Disease	Label	Lot number	Expiry date	Quantity
Infectious bronchitis	**TAD IB vac I**	**2046722**	**10.2004**	**One**
Infectious bursal disease	**TAD Gumboro vac**	**2047211**	**09.2004**	**Three**
Newcastle disease	**TAD ND vac La Sota**	**2019962**	**06.2004**	**Two**

3.2.10.3 Vaccination procedure

Vaccines were administered according to the vaccination programme (Travers, 2003) and prepared according to the Immuno-Vet Services specifications.

Vaccines for infectious bronchitis and Newcastle disease were administered at the hatchery on day one at the instruction of the researcher to meet industry practices. The other vaccines in the vaccination programme were prepared and placed into

the drinking water of the broiler chickens in the fountain drinkers on the study days as illustrated in **Table 3.1**.

All fountain drinkers were labelled with laminated labels bearing the division numbers of the divisions in which they were used and were not ever used in any other division.

3.3 PREPARATION AND ADMINISTRATION OF HOMŒOPATHIC REMEDIES

3.3.1 Homœopathic preparations against vaccinosis and stress

Natura Homoeopathic Laboratories, Pretoria, prepared the homœopathic remedy for stress, *Aconitum napellus*, in a 200CH potency, from the mother tincture according to the French pharmacopoeia method in August 2003.

The researcher provided Natura Homoeopathic Laboratories, Pretoria, with freeze-dried live poultry vaccines obtained from Immuno-Vet Services to prepare the homœopathic remedies for infectious bronchitis, infectious bursal disease and Newcastle disease. The individual homœopathic remedies were prepared by potentising the live poultry vaccines to a 4X potency according to the German pharmacopoeia, and thereafter to a 200CH potency according to the French pharmacopoeia method in August 2003.

3.3.2 Administration of homœopathic preparations

All remedies were administered in liquid preparation according to the guidelines for administering homœopathic remedies to flocks of birds, by using the formula of mixing five millilitres of the remedy into one hundred litres of fresh drinking water (Niven, 2003), as follows:

- *Aconitum napellus* 200CH on arrival of the broiler chicks from the hatchery;
- The remedies against vaccinosis on day one of the life cycle after vaccination at the hatchery, and subsequently prior to each vaccination at the broiler house on the study days as illustrated in **Table 3.1**.

All equipment was labelled with laminated labels bearing the division numbers of the divisions in which they were used and were not ever used in any other division.

3.3.2.1 Administration of homœopathic remedies against vaccinosis

Since broiler chickens were vaccinated against Newcastle disease and infectious bronchitis at the hatchery, the vaccinosis remedies for these diseases were administered individually on arrival of the broiler chickens at the place of research. The other vaccinosis remedies were administered individually and prophylactically on the same day as which the individual vaccination took place, as illustrated in **Table 3.1**.

Vaccines were administered by placing the prepared vaccines into the drinking water of the broiler chickens using fountain drinkers. All remedies, in 200CH potencies, were administered directly into the drinking water of the bell drinkers, but in advance of the actual vaccine administration, with exception of those administered on day one, allowing all broiler chickens to drink from the water and consume remedies.

3.3.2.2 Administration of homœopathic remedy against stress

The remedy, *Aconitum napellus* 200CH, was administered directly into the drinking water once only, on the day of arrival of the broiler chickens from the hatchery. Broiler chickens were allowed to drink all the medicated water, where after the fountain drinker was discarded and not used again during the research period.

3.4 DATA COLLECTION AND ANALYSIS

3.4.1 Data collection

Data of all groups in the research study were kept and maintained separately.

Dead broiler chickens were removed from the houses on a daily basis and the numbers recorded. Ten broiler chickens, chosen at random from each group by the farm manager, were weighed every six days and the mass was recorded. A digital scale was used in the weighing process.

At day thirty-six weighing indicated that the broiler chickens were ready for slaughter as they had reached an average mass of more than 1.7 kilograms in the treatment groups, which is used by the industry as a mass standard for slaughtering (Doak, 2003).

At slaughter (day thirty-seven) ten broiler chickens from each group were chosen at random by the farm manager. Live mass was recorded individually at the abattoir for each group. After slaughter the mass of the individual carcasses of each group was recorded. Non-paired averages for live mass and carcass mass for each group were calculated and recorded separately.

A record of rainfall, minimum, maximum and average temperatures, as well as wind speed was obtained from the South African Weather Service for the period of research. Since the Service does not have a station on the farm, records from the closest weather station were used, namely Witbank, Mpumalanga. Refer to Appendix B for detailed data.

3.4.2 Data analysis

The results were analysed and compared for the three respective groups using various statistical tests:

- SAS (Version 8) (SAS Institute Inc.) was used for calculating descriptive statistics and testing hypotheses;
- The Shapiro-Wilk Test was used to establish normality for live and carcass mass;
- Differences between the mean live mass for all three groups, as well as differences in carcass mass for all three groups, were tested using Analysis of Variance (ANOVA);
- Duncan's Multiple Range Test ($\alpha = 0.05$) was then used to test for statistical significance in the differences between live mass in the three groups, as well as between carcass mass in the three groups;
- Fisher's Exact Test was used to test whether the treatment and control mortality rates differed significantly;
- A Bonferonni significance level correction was also employed in the analysis of mortality rate; and
- A Repeated Measure Analysis was used to test whether the treatments behaved differently over time.

All graphs were drawn using Microsoft Excel.

CHAPTER FOUR
RESULTS

4.1 INTRODUCTION

One hundred and fifty broiler chickens were divided at random into three groups of fifty research subjects each:

- **Group one** was treated for vaccinosis by using the respective homœopathic preparations of poultry vaccines 200CH against the specific disease on arrival and prior to every vaccination procedure (see **Table 3.1**). The broiler chickens were allowed to drink from the water and consume remedies prior to the vaccination procedure;
- **Group two** was used as a control group and received no homœopathic treatment; and
- **Group three** was treated for stress once only on arrival by using the homœopathic remedy *Aconitum napellus* 200CH.

The research study took place over thirty-seven days, from 19 August 2003 to 24 September 2003.

4.2 RESULTS

4.2.1 Live mass

Detailed live mass data for all three groups are contained in Appendices C, D and E. Live mass mean values for all three groups follows as **Table 4.1**, live mass standard deviation values for all three groups follows as **Table 4.2**, live mass maximum values for all three groups follows as **Table 4.3**, and live mass minimum values for all three groups follows as **Table 4.4**:

Table 4.1: Live mass mean (kg) over duration of study

Group	Day of study							
	Day 1	Day 6	Day 12	Day 18	Day 24	Day 30	Day 36	Day 37
1	0.0400	0.1168	0.2616	0.4910	0.8385	01.2341	1.7254	1.8000
2	0.0400	0.1028	0.2359	0.4448	0.7919	1.1251	1.5678	1.6450
3	0.0400	0.1127	0.2547	0.4755	0.8324	1.2190	1.7597	1.8500

Table 4.2: Live mass standard deviation over duration of study

Group	Day of study							
	Day 1	Day 6	Day 12	Day 18	Day 24	Day 30	Day 36	Day 37
1	0.0000	0.0141	0.0342	0.0803	0.1422	0.0813	0.1403	0.0943
2	0.0000	0.0154	0.0427	0.0584	0.0883	0.1697	0.1026	0.1657
3	0.0000	0.0137	0.0237	0.0588	0.0640	0.1418	0.1264	0.1826

Table 4.3: Live mass maximum value (kg) over duration of study

Group	Day of study							
	Day 1	Day 6	Day 12	Day 18	Day 24	Day 30	Day 36	Day 37
1	0.0400	0.1320	0.3100	0.6600	1.2000	1.3650	2.0000	2.0000
2	0.0400	0.1230	0.1279	0.4990	0.8890	1.5330	1.6790	1.8500
3	0.0400	0.1310	0.2850	0.5490	0.9200	1.4600	1.9900	2.2000

Table 4.4: Live mass minimum value (kg) over duration of study

Group	Day of study							
	Day 1	Day 6	Day 12	Day 18	Day 24	Day 30	Day 36	Day 37
1	0.0400	0.0880	0.2180	0.3880	0.7090	1.1110	1.5550	1.7000
2	0.0400	0.0670	0.1470	0.3090	0.6400	0.8510	1.4090	1.4000
3	0.0400	0.0860	0.2110	0.3690	0.7280	1.0210	1.6300	1.6500

Growth rate graphs follow as **Figures 4.1**, **4.2** and **4.3**. **Figure 4.1** shows mass gains for all three groups separately over the thirty-seven day study period. Mass gain for the stress treatment group (**Group three**) overtakes that of the vaccinosis treatment group (**Group one**) between day thirty and day thirty-seven.

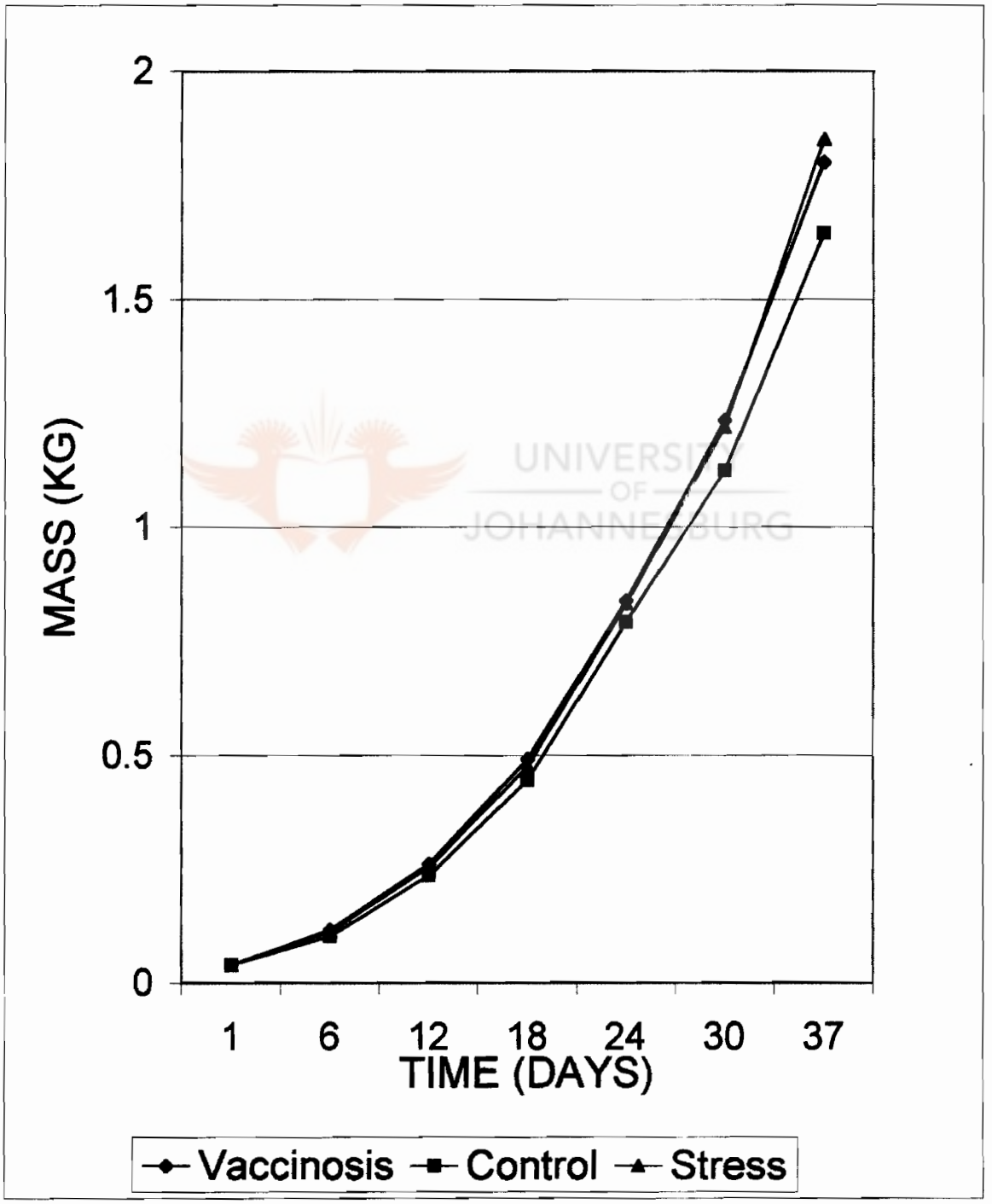

Figure 4.1: Growth rate - all groups

Figure 4.2 shows that the vaccinosis treatment group (**Group one**) demonstrates a consistent mass gain over and above that of the control group (**Group two**), with a final mass gain of 0.155 kilogram increase over the control group (**Group two**).

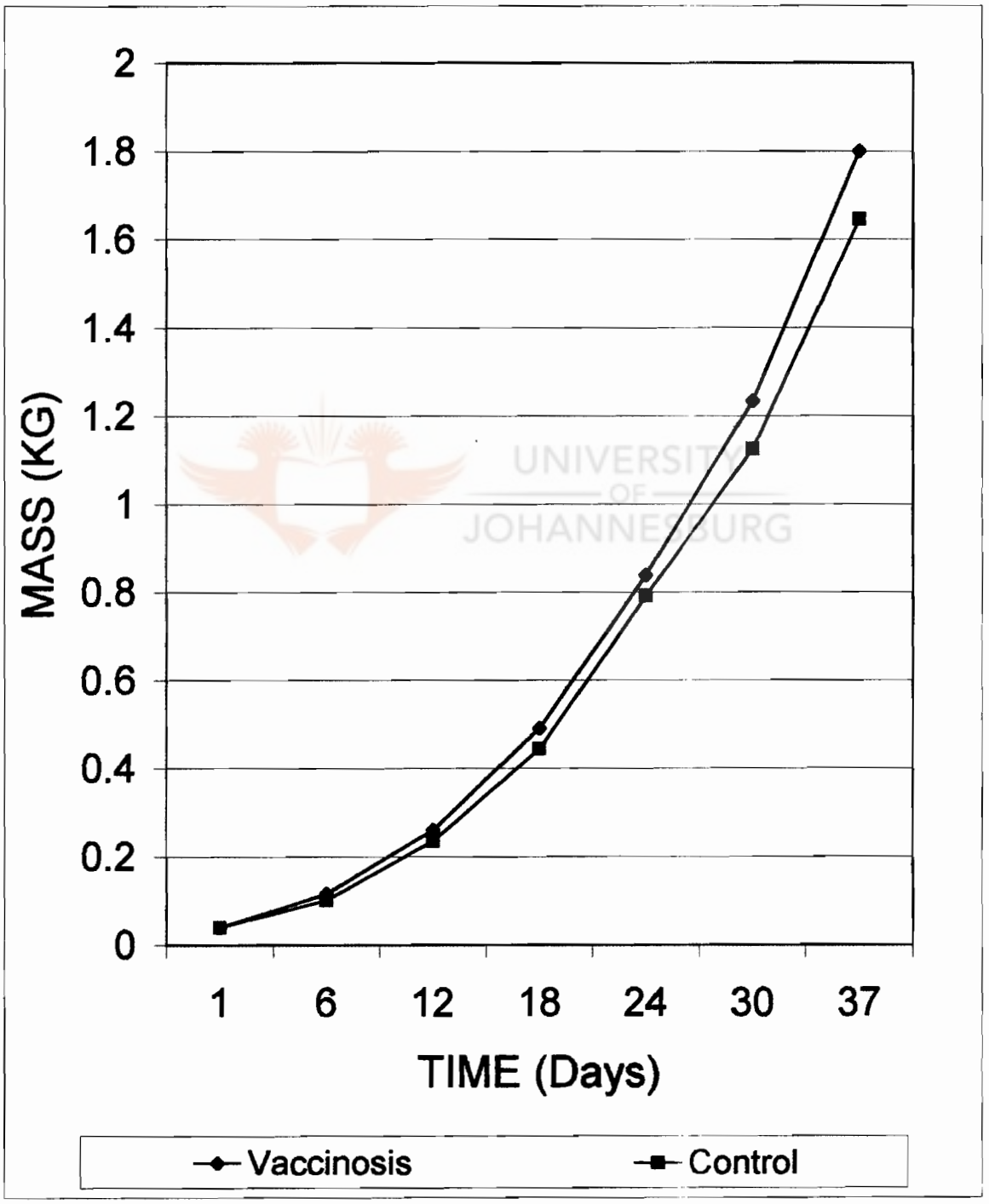

Figure 4.2: Growth rate - vaccinosis treatment group versus control group

Figure 4.3 shows that the stress treatment group (**Group three**) demonstrates a consistent mass gain over and above that of the control group (**Group two**), with a final mass gain of 0.205 kilogram increase over the control group (**Group two**).

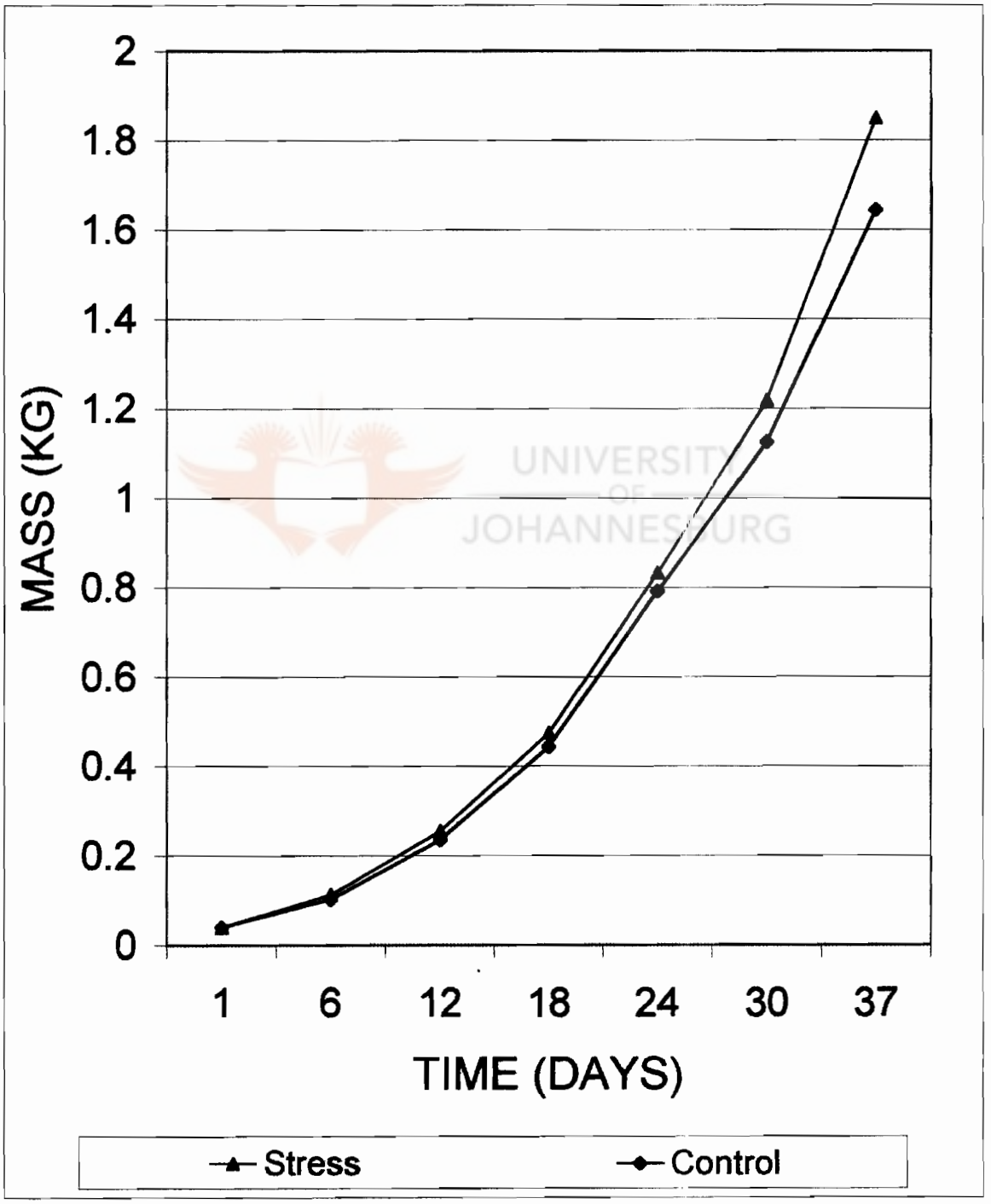

Figure 4.3: Growth rate - stress treatment group versus control group

4.2.2 Carcass mass values at slaughter

Detailed data for all three groups are to be found in Appendices F, G and H. The stress treatment group (**Group three**) had the highest carcass mass at 1.300 kilograms, followed by the vaccinosis treatment group (**Group one**) at 1.275 kilograms, with the control group (**Group two**) weighing the least at 1.200 kilograms. Mean, standard deviation, minimum and maximum results of the carcass mass for all three groups follow as **Table 4.5**:

Table 4.5: Carcass mass values at slaughter

Group	Day 37			
	Mean (kg)	Standard deviation	Maximum value (kg)	Minimum value (kg)
1	1.275	0.0540	1.35	1.20
2	1.200	0.1546	1.45	1.00
3	1.300	0.1225	1.50	1.15

4.2.3 Mortality rate

Data, in number and in percentage, for all three groups follow as **Table 4.6**. The vaccinosis treatment group (**Group one**) showed a mortality rate of four percent, the control group (**Group two**) four percent and the stress treatment group (**Group three**) had no deaths.

Table 4.6: Mortality rate: All groups

Date	Day of study	Group 1	Group 2	Group 3
22 Aug.	4	0	1	0
1 Sept.	14	0	1	0
3 Sept.	16	1	0	0
10 Sept.	23	1	0	0
TOTAL		2	2	0
PERCENTAGE		4	4	0

4.2.4 Feed conversion rate

A feed conversion rate (FCR) (University of Pretoria, 2002) was calculated for each group according to the formula:

$$FCR = \frac{\text{Total kilograms feed consumed}}{\text{Total live mass at farm}}$$

The stress treatment group (**Group three**) converted feed most efficiently at a value of 1.8918, followed by the vaccinosis treatment group (**Group one**) at a value of 2.0254, with the control group (**Group two**) converting feed least efficiently at a value of 2.2163. Data for all three groups follow as **Table 4.7**:

Table 4.7: Feed conversion rate: All groups

Group one	**2.0254**
Group two	**2.2163**
Group three	**1.8918**

4.2.5 Performance efficiency factor

A performance efficiency factor (PEF) (University of Pretoria, 2002) was calculated for each group using the following formula:

$$PEF = \frac{\text{\% survivors x live mass}}{\text{age x FCR x 100}}$$

The stress treatment group (**Group three**) performed most efficiently at a value of 0.0264, followed by the vaccinosis treatment group (**Group one**) at a value of 0.0234, with the control group (**Group two**) performing least efficiently at a value of 0.0192. Data for all three groups follow as **Table 4.8**:

Table 4.8: Performance efficiency factor: All groups

Group one	**0.0230**
Group two	**0.0192**
Group three	**0.0264**

4.2.6 Weather data

A record of rainfall, minimum, maximum and average temperatures, as well as wind speed was obtained from the South African Weather Service for the period of research. For detailed data see Appendix B.

4.3 ANALYTIC RESULTS

4.3.1 All groups: Live mass

Appendices C, D and E contain detailed live mass data for all three groups.

Validity in any ANOVA test requires that the residuals be approximately normally distributed. The Shapiro-Wilk test was used and it was concluded that normality could be assumed for the live mass and carcass mass.

ANOVA was then used to test whether there were any statistically significant differences between the mean live mass of the three groups.

ANOVA showed that the mean live mass of at least one of the three groups was not equal to the mean live mass of the other groups. The p-value was found to be 0.0151. Subsequently Duncan's Multiple Range Test was applied and it was found that the mean live mass of the control group (**Group two**) was statistically significantly less than the mean live mass of both the stress group (**Group three**) and the vaccinosis group (**Group one**).

Although the mean live mass of the control group (**Group two**) differed significantly from the mean live mass of the two treatment groups (**Groups one** and **three**), the mean live mass of the latter did not differ significantly from each other.

4.3.2 All groups: Carcass mass

ANOVA showed that there were no statistically significant differences between the carcass mass of the three groups. The p-value was found to be 0.1627.

4.3.3 Mortality

Fisher's Exact Test was used to test whether the mortality rate differed significantly between the control group (**Group two**) and treatment groups (**Groups one** and **three**)(see **Table 4.6** above for data). A Bonferonni level of significance correction was employed.

There were no statistically significant differences between the mortality rate of the control group (**Group two**) and stress treatment group (**Group t**wo) (p-value = 0.2475) or between the control group (**Group two**) and vaccinosis treatment group (**Group one**) (p-value = 0.6913).

4.3.4 Repeated Measures Analysis

Repeated Measures Analysis is a statistical procedure to test whether the treatments behaved differently over time, with testing for time and group as main effects and with time and group interaction effect.

One of the assumptions underlying this statistical procedure is that the same research subjects are measured over time, otherwise termed the Existence of Data Dependence.

In the present study, however, the assumption of dependence between the different time periods could not be made since the exact same chickens were not used for data capturing at every time period.

Repeated Measures Analysis could thus not be employed.

CHAPTER FIVE
DISCUSSION OF RESEARCH RESULTS

5.1 SAMPLE SIZE

As this study consisted of only a relatively small number of research subjects the difference between treatment groups (**Groups one** and **three**) and the control group (**Group two**) needs to be comparatively large in order to achieve a statistically significant difference. Had the number of research subjects been larger, such as on a commercial broiler farm which houses approximately thirty-thousand broiler chickens, only a small, but consistent difference between treatment and control groups would be needed to achieve a statistically significant difference.

Sample size is thus seen as a factor which may have influenced statistically non-significant results, such as carcass mass and mortality rate results.

5.2 LIVE MASS

Despite the relatively small sample size a significant statistical difference regarding live mass was found between the treatment groups (**Groups one** and **three**) and the control group (**Group two**). Using ANOVA a p-value of 0.0151 was found.

Due to the impracticality of weighing the same broiler chickens at every weighing session, a Repeated Measures Analysis was not possible. This was further confirmed by the fact that the results from Repeated Measures Analysis differed considerably when mass values of day thirty-six were substituted in the analysis by mass values taken on day thirty-seven.

Notwithstanding, if the mean mass versus time graphs for the three groups are considered and ANOVA is conducted at the different time periods, the data would

appear to indicate that the difference between the control group (**Group two**) and the treatment groups (**Groups one** and **three**) was observed only towards the end of the thirty-seven day time period.

This difference between groups over time could therefore not be tested statistically in this study, but can be described qualitatively and presented graphically. The fact that a Repeated Measures Analysis was not possible is, however, not of serious consequence, since it has been shown that the final live mass of the two treatment groups differed significantly from the control group.

Day-old broiler chicks were not weighed individually and the researcher relied on an average mass as supplied by the hatchery.

5.3 CARCASS MASS

Although the study showed no statistical significance between the carcass mass of the three groups, the graphical trend of the divergence of live mass between the treatment groups (**Groups one** and **three**) and control group (**Group two**) might have led to a finding of statistical significance in the carcass mass had the broiler chickens been slaughtered at day forty-two, as is sometimes the case in the industry.

The fact that no statistical significance was found may, however, be ascribed to chance in this particular study (Smit, 2003). Sample size may have been another factor.

The result does not exclude practical significance to the farmer, however, where the increased mean carcass mass of the treatment groups might translate into a higher profit for these carcasses.

The abattoir was unable to meet the requirements of the researcher in that the carcass mass could not be paired with its corresponding live mass. If this had been possible, ANOVA would have been used to establish whether there might have been any statistical significance between the waste mass of individual chickens in the three groups.

5.4 MORTALITY

No statistical difference was found in the mortality rate of the three groups. The p-value was 0.2475 between the control group (**Group two**) and stress treatment group (Group three). The p-value was 0.6913 between the control group (**Group two**) and vaccinosis treatment group (**Group one**). Sample size may have played a role.

Although this study aimed at reproducing industry conditions as far as possible, a comparison between the mortality rate in this study and mortality rate in the industry should not be made due to differing conditions and sample size. The commercial broiler farming mortality rate is reckoned at six percent up to day forty-two (University of Pretoria, 2002).

Notwithstanding, the mortality rate in this study showed no deaths in the vaccinosis treatment group (**Group one**), but two deaths (four percent) in each of the stress treatment group (**Group three**) and control group (**Group two**). The rate of four percent is thus lower than the industry.

Lack of expertise on the part of the researcher in the field of poultry pathology, as well as the impracticality of travelling to the farm on days of mortality, resulted in no investigation as to the cause of death. Establishment of exact causes of death would have led to more specific conclusions as to the mortality rate.

5.5 RANDOM SELECTION OF RESEARCH SUBJECTS

All research subjects, whether for group selection, weighing or slaughtering purposes, were selected at random by someone independent of the study, and not by the researcher, in an attempt to eliminate any subject bias.

5.6 SEASON

The study was conducted towards the end of the South African winter and beginning of spring (August and September) particularly since winter is a potent stressor for broiler chickens, and leads to increased incidences of lung disease (Niven, 2003). No influence from winter conditions was directly evident on the results as far as could be established.

5.7 VACCINOSIS AND STRESS TREATMENT GROUPS: LIVE MASS TREND

For most of the study period the vaccinosis treatment group (**Group one**) showed a higher live mass gain over the other groups (**Groups two** and **three**). **Figure 4.1**, however, shows that the live mass value for the stress treatment group (**Group three**) increases above the value for that of the vaccinosis treatment group (**Group one**) between days thirty and thirty-seven of the study. No direct reason for this occurrence could be established.

5.8 CARCASS PREPARATION

No change in colour, form, consistency or quality of the meat was observed during chilling or freezing of the carcasses. No adverse effects have been reported after consumption of prepared and cooked carcasses.

5.9 FEED CONVERSION RATE

The feed conversion rate for all three groups approximates that of the industry, which is approximately two (Doak, 2003). The treatment groups (**Groups one** and **three**), however, showed that food was utilised more efficiently by them than by the control group (**Group two**).

5.10 PERFORMANCE EFFICIENCY FACTOR

The performance efficiency factor for all three groups showed that performance of the treatment groups (**Groups one** and **three**) was better than that of the control group (**Group two**).

CHAPTER SIX
CONCLUSION AND RECOMMENDATIONS

6.1 INTRODUCTION

The purpose of this study was to determine the effect that prophylactically administered homœopathic remedies against conditions of vaccinosis and stress had on broiler chickens.

6.2 PROCEDURE

Homœopathic preparations of poultry vaccines 200CH were administered to a sample size of fifty broiler chickens (**Group one**) on day one of their life cycle after vaccination at the hatchery, and subsequently prior to each vaccination at the broiler house.

A homœopathic preparation of *Aconitum napellus* 200CH was administered to a sample size of fifty broiler chickens (**Group three**) once only, on day one of the life cycle, to assess the possible alleviation of stress in broiler chickens.

A control group of fifty broiler chickens (**Group two**) was not given any homœopathic remedies but otherwise received the same treatment as the treatment groups.

The efficacy of the treatment was evaluated using the following variables:

- Live mass gain;
- Carcass mass;
- Mortality;
- Feed conversion rate; and
- Performance efficiency factor.

6.3 STATISTICAL FINDINGS

It was found that the mean live mass of the control group (**Group two**) was statistically significantly less than the mean live mass of both the vaccinosis and stress groups (**Groups one** and **three**). Although the mean live mass of the control group (**Group two**) differed significantly from the mean live mass of the two treatment groups, the mean live mass of the latter (**Groups one** and **three**) did not differ significantly from each other.

Although the study showed no statistical significance between the carcass mass of the three groups, the graphical trend of the divergence of live mass between the treatment groups (**Groups one** and **three**) and control group (**Group two**) might have led to a finding of statistical significance in the carcass mass had the broiler chickens been slaughtered at day forty-two, as is sometimes the case in the industry. Paired values might also have shown significant differences between the carcass mass of the three groups.

No statistical difference was found in the mortality rate of the three groups.

The feed conversion rate for all three groups approximates that of the industry. The treatment groups (**Groups one** and **three**), however, utilised food more efficiently than the control group (**Group two**).

The performance efficiency factor for all three groups shows that performance of the treatment groups (**Groups one** and **three**) was better than that of the control group (**Group two**).

6.4 CONCLUSION

The treatment given during this research proved in no way detrimental to the research subjects: results were either positive or inconclusive.

The conclusion to be drawn is that the homœopathic remedies were effective in treating stress and vaccinosis prophylactically as was evidenced in the live mass gain which was statistically significantly greater in the treatment groups (**Groups one** and **three**) than in the control group (**Group two**)

A further conclusion is that the feed conversion rate was affected positively by the homœopathic remedies as was evidenced in the better utilisation of food to achieve higher live mass in the stress treatment group (**Group three**) and vaccinosis treatment group (**Group one**).

Similarly, the performance efficiency factors were affected positively by the homœopathic remedies as was evidenced in the formula calculation.

Although carcass mass and mortality rates showed no statistical significant difference between the three groups, no conclusion should be drawn as to the effect of homœopathic remedies on these variables prior to future research in these fields, given the other positive outcomes of the study.

6.5 RECOMMENDATIONS

It is recommended that any researcher consider the following recommendations in future similar research studies:

- Repeat the study on a larger scale to verify the results of this study;
- Repeat the study using data of the exact same research subjects for all variable values throughout the study so that Repeated Measures Analysis for data dependence can be performed;
- Repeat the study with other groups such as broiler breeders, commercial layers, free-range breeders and layers using homœopathic remedies;

- Treat prophylactically using homœopathic remedies for any other condition or disease affecting the health or commercial viability of broiler chickens, such as fowl pox, avian influenza, or ascites;
- Treat diseased broiler chickens using homœopathic remedies;
- Treat broiler breeders over successive generations to improve possible genetic resistance to disease;
- Use different remedies to treat stress or vaccinosis, as mentioned under **2.7.4.1 Homœopathic remedies for vaccinosis** and **2.7.4.2 Homœopathic remedies for stress** above;
- Weigh broiler chicks on day one to establish an accurate baseline reading for mean live mass values;
- Change the frequency of the dose or the amount of the dose of the homœopathic remedies in a separate, but similar study, to establish any difference in results;
- Use a different grade of broiler chicken to compare results with the results of this study;
- Lengthen the duration of the study to at least day forty-two to establish whether the change in duration might result in statistical significance of the carcass mass values;
- Use an abattoir able to meet researcher requirements with regard to pairing for statistical purposes or separating various organs for comparison or pathology purposes;
- Use organic feed, rather than commercial feed, to establish any difference in results;
- Use other commercial poultry groups, such as turkeys or ducks, or animal groups, such as cattle, to establish the effect of homœopathic remedies on the health and performance of these groups; and
- Validate seasonal variations by conducting studies in other seasons
- Conduct post mortem examinations on all dead broiler chickens and record the results.

REFERENCES

Abeyesinghe, S.M., Wathes, C.M., Nicol, C.J., Randall, J.M. (2001) The aversion of broiler chickens to concurrent vibrational and thermal stressors. *Applied Animal Behaviour Science*, **73(3)**: 199-215.

Alm, J.S., Swartz, J., Lilja, G., Scheynius, A., Pershagen, G. (1999) Atopy in children of families with an anthroposophic lifestyle. *Lancet*, **353(9163)**: 1485.

Annals Hom, Fr. (1982) **24(3)**:
pp. Thrush P. http://www.holisticbird.org/pages/homBasics.htm.

Appleby, M.C., Hughes, B.O., Elson, H.A. (1992) Poultry Production Systems: Behaviour, Management and Welfare. C.A.B. International, Wallingford, United Kingdom.

Begg, M., Ramsay, M., White, J., Bozoky, Z. (1998) Media dents confidence in MMR vaccine. *British Medical Journal*, **316**: 561.

Brewster O'Reilly, W. (ed). (1997) Organon of the Medical Art by Dr Samuel Hahnemann. Birdcage Books, Washington, United States of America.

Burnett, J.C. (1897) Vaccinosis and its Cure by Thuja; With remarks on Homœoprophylaxis. Second edition. Health Science Press, Grayshot, United Kingdom.

Castro, D. and Nogueira, G.G. (1975) Use of the nosode Meningococcinum as a preventative against meningitis. *Journal American Institute of Homeopathy*, **74**: 211-219.

Chavanon, P. (1932) La Dipterie. Fourth edition, Niort Imprimerie, St Denis, France.

Cilliers, J.A. (1995) Die Suider-Afrikaanse Braaikuikenhandleiding. Promedia, Pretoria, South Africa.

Clarke, J.H. (1991) A dictionary of Practical Materia Medica. Volume 1: A-H. Homœopathic Book Service, Sittingbourne, United Kingdom.

CLMHI: Congress Liga Medicorum Homœopathica Internationalis. 1986 Transactions, Rio de Janeiro: no pages.

Cohen, A.D. and Shoenfeld, Y. (1996) Vaccine-immune autoimmunity. *Journal of Autoimmunity,* **9(6)**: 699-703.

Currim, A. N., (ed). (1996) The Collected Works of Arthur Hill Grimmer, M.D. Hahnemann International Institute, Greifenberg, Germany.

Day, C. (1987) Isopathic prevention of kennel cough – is vaccination justified? *International Journal of Veterinary Homeopathy*, **2(2)**: 57.

De Jong, I.C., Van Voorst, S., Ehlhardt, D.A., Blokhuis, H.J. (2002) Effects of restricted feeding on physiological stress parameters in growing broiler breeders. *British Poultry Science*, **43(2)**: 157-168.

Doak, C. (2003) Vaccination and life-cycle of broiler chickens. Personal discussion, 31 May 2003, Johannesburg. (Early Bird subcontractor, Diepsloot, Tel. (011) 464 1840).

Dohms, J.E. (1991) Mechanisms of immunosuppression. *Veterinary Immunological Immunopathology*, **30**: 19-30.

Dohms, J.E. and Metz, A. (1991) Stress – mechanisms of immunosuppression. *Veterinary Immunological Immunopathology*, **30**: 89-109.

Dunham, C. (1994) Lectures on Materia Medica. B. Jain Publishers, New Delhi, India.

Dutton, M. (2003) Personal discussion, 29 May 2003, Johannesburg. (Chairman: Faculty Research Committee, Technikon Witwatersrand, Tel. (011) 406 2466).

Eizayaga, F.X. (1985) Tratamiento Homeopatico de las Enfermedades Agudàs y Su Prevension. *Homeopatia*, **51(342)**: 352-362.

Eizayaga, F.X. (1991) Treatise on Homoeopathic Medicine. Ediciones Marecel, Buenos Aires.

Elrom, K. (2000) Review article:
Part I: Handling and transportation of broilers' welfare, stress, fear and meat quality: *Israel Journal of Veterinary Medicine*, **55(1)**: 1-3.
Part II: Stress. *Israel Journal of Veterinary Medicine*, **55(2)**: 39-45.
Part III: Fear: Definitions, its relation to stress, causes of fear, responses of fear and measurement of fear. *Israel Journal of Veterinary Medicine*, **55(3)**: 79-82.
Part IV: Handling of broilers. *Israel Journal of Veterinary Medicine*, **55(4)**: 121-125.

Esmail, S.H. (1997) Noise effects on feed intake, digestibility, and performance of broiler chickens. *Agricultural Sciences*, **24(1)**: 1-9.

Fox, A.D. (1987) Whooping cough prophylaxis with Pertussin 30. *British Homeopathic Journal*, **76**: 69-70.

Hartlova, H., Blaha, J., Koubkova, M., Draslarova, J., Fucikova, A. (2002) Influence of heat stress on the metabolic response in broiler chickens. *Scientia Agriculturae Bohemica*, **33(4)**: 145-149.

Heckert, R.A., Estevez, I., Russek-Cohen, E., Pettit-Riley, R. (2002) Effects of density and perch availability on the immune status of broilers. *Poultry Science*, **81(4)**: 451-457.

Hoover, T.A. (2001) Homeopathic Prophylaxis: Fact or Fiction. *Journal American Institute of Homeopathy*, **3**: 168-175.

Hotopf, M., David, A., Hull, L., Ismail, K., Unwin, C., Wessely, S. (2000) Role of vaccinations as risk factors for ill health in veterans of the Gulf War: cross sectional study. *British Medical Journal*, **320 (7246)**: 1363.

Hufeland, C. (1826) Prophylactic power of Belladonna in scarlet fever. *Hufeland's Journal*.

Ignjatovic, J. and Sapats, S. (2000) Avian infectious bronchitis virus. *Review of Scientific Technology*, **19(2)**: 493-508.

Janmaat, A. (1996) Infectious Diseases of Poultry, Darwin. *Agnote* **668 (K1)**: 1-5.

Jeffreys, R. (2001) T-cells and vaccination. *Lancet*, **357(9266)**: 1451.

Klopp, S. (1999) Care and management of poultry in the laboratory. *Poultry and Avian Biology Reviews,* **10**: 97-99.

Knierim, U. and Gocke, A. (2003) Effect of catching broilers by hand or machine on rates of injuries and dead-on-arrivals. *Animal Welfare*, **12(1)**: 63-73.

Lacy, M.P. and Czarick, M. (1998) Mechanical harvesting of broilers. *Poultry Science*, **77(12)**: 1794-1797.

Lawrence, D. (2002) Mass vaccination after a smallpox attack might be best researchers suggest. *Lancet*, **360(9327)**: 148.

Leeson, S. and Summers, J.D. (2000) Broiler Breeder Production, University Books, Canada.

Maillefert, J.F., Sibilia, J., Toussirot, E., Vignon, E., Eschard, J.P., Lorcerie, B., Juvin, R., Perchin-Geneste, N., Piroth, C., Wendling, D., Kuntz, J.L., Tavernier, C. and Gaudin, P. (1999) Rheumatic disorders developed after hepatitis B vaccination. *Rheumatology,* **38(10)**: 978-983.

McLean, J.A., Savory, C.J., Sparks, N.H.C. (2002) Welfare of male and female broiler chickens in relation to stocking density, as indicated by performance, health and behaviour. *Animal Welfare*, **11(1)**: 55-73.

Memon, A., Qureshi, N.A., Rind, M.I., Solangi, A.A., Memon, G. (2001) Effect of two commercial anti-stress drugs on the growth of artificially induced stressed broilers. *Pakistani Veterinary Journal*, **21(1)**: 36-38.

Mississippi State University, Cooperative Extension Service. (1997) Viral Diseases; Bacterial Diseases; Miscellaneous Management Related Diseases: http://www.mssate.edu/dept/poultry/disviral.htm;http://www.mssate.edu/dept/poultry/disbact.htm;http://www.mssate.edu/dept/poultry/dismisc.htm.

Mitchell, M.A. and Kettlewell, P.J. (2000) The problems of broiler transport – the scientific basis of practical solutions. *Poultry Bulletin*, March: 129-134.

Murphy, R. (1996) Homeopathic Medical Repertory – A Modern Alphabetical Repertory. Second edition. Hahnemann Academy of North America, Colorado, United States of America.

Murphy, R. (2003) Homeopathic Toxicology: Address to Alliance of Registered Homeopaths Annual Conference, United Kingdom. http://www.alchemilla.com/hana/articles/Toxicologyed1.html.

Nicoll, A., Elliman, D., Ross, E. (1998) MMR vaccination and autism 1998. *British Medical Journal*, **316 (7133)**: 715.

Niven, A. (2003) Infectious diseases encountered in broiler farming and vaccinations. Personal discussion, 23 May 2003, Johannesburg. (Homœopathic Veterinarian, Tel. (011) 705 3113).

North, M.O. and Bell, D.D. (1990) Commercial Chicken Production Manual. Fourth edition. Van Nostrand Reinhold, New York.

Odent, M. and Culpin, E. (2003) Effect of immunisation status on asthma prevalence. *Lancet*, **361(9355)**: 434.

Older, S.A., Battafarano D.F., Enzenauer, R.J. and Krieg, A.M. (1999) Can immunization precipitate connective tissue disease? Report of five cases of systemic lupus erythematosus and review of the literature. *Semin Arthritis Rheum,* **29(3):** 131-139.

Partington, A. (ed). (1992) The Oxford Dictionary of Quotations. Fourth edition. Oxford University Press, Oxford, United Kingdom.

Patterson, J. and Boyd, W.E. (1941) Potency action: A preliminary study of the alteration of the Schick test by a homeopathic potency. *British Homeopathic Journal*, **31**: 301-309.

Rosskopf Jr., W.J. and Woerpel, R.W. (1996) Diseases of Cage and Aviary Birds. Third edition, Williams and Wilkins, Baltimore, United States of America.

Rovere, P., Vallinoto, C, Bondanza, A. (1998) cutting edge: bystander apoptosis triggers dendritic cell maturation and antigen-presenting function. *Journal of Immunology*, **161**: 4467-4471.

Sainsbury, D. (2000) Poultry Health and Management. Fourth edition. Gray Publishing, United Kingdom.

Sandercock, D.A., Hunter, R.R., Nute, G.R., Mitchell, M.A., Hocking, P.M. (2001) Acute heat stress – induced alterations in blood acid-base status and skeletal muscle membrane integrity in broiler chickens at two ages: implications for meat quality. *Poultry Science*, **80(4)**: 418-425.

Shepherd, D. (1967) Homeopathy in Epidemic Diseases. The CW Daniel Company, Ltd., Essex, United Kingdom.

Shinder, D., Luger, D., Rusal, M., Rzepakovsky, V., Bresler, V., Yahav, S. (2002) Early age cold conditioning in broiler chickens (*Gallus domesticus*): thermo-tolerance and growth responses. *Journal of Thermal Biology*, **27(6)**: 517-523.

Shoenfeld, Y. and Aron-Maor, A. (2000) Vaccination and autoimmunity – "vaccinosis": a dangerous liaison? *Journal of Autoimmunity*, **14**: 1-10.

Simini, B. (1998) Relaxation of penalty for non-immunised Italians. *Lancet*, **352(9135)**: 1204.

Smit, C.F. (2003) Statistical testing of results of broiler farming research. Personal discussion, 30 May 2003, Pretoria. (Professor of Statistics, University of Pretoria, Tel. (012) 420 25 23).

Stearns, G. and Stark, M. (1925) Experiments with homeopathic potentised substances given to *Drosophila melanogaster* with hereditary tumours. *The Homeopathic Recorder*, **40**: 130.

Stratton, K.R., Howe, C.J. and Johnston R.B. Jr. (1994) Adverse events associated with childhood vaccines other than pertussis and rubella. Summary of a report from the Institute of Medicine. *Journal American Medical Association,* **271(20)**: 1602-1605.

Swayne, D.E. (1999) Disease diagnosis and control in the laboratory. *Poultry and Avian Biology Reviews,* **10**: 65-77.

Swayne, J. (ed). (2000) International Dictionary of Homeopathy, Churchill Livingstone, United Kingdom.

Teixeira, M.Z. (2002) Is there scientific evidence that suppression of acute diseases in childhood induces chronic diseases in the future? *Homeopathy,* **91(4)**: 207-216.

Terraes, J.C., Sandoval, G.L., Fernandez, R.J., Revidatti, F.A. (2001) Response to stress induced by a manoeuvre and treatment with a hepatic protective product in broiler chickens. *Veterinaria Mexico*, **32(3)**: 195-200.

Torline, J.R. (2001) The effect of *Aconitum napellus* 30C on the occurrence and severity of adverse reactions following Diptheria-Tetanus-Pertussis and *Haemophilus influenzae* type b immunisation. Dissertation submitted to the Technikon Witwatersrand, M-Tech Homœopathy.

Travers, A.F. (2003) General immunisation programme on broiler farms in South Africa. Personal discussion, 26 May 2003, Pretoria. (Director: Avimune (Pty) Ltd, Tel: (012) 664 57 30).

Treffry, D. (ed). (1999) Collins English Dictionary, Millennium edition, Harper Collins Publishers, United Kingdom.

University of Pretoria, Faculty of Veterinary Sciences, Department of Production Animal and Community Health, Section: Poultry Health. (2002) Lecture Theme Notes: Basic Poultry Production and Management, Poultry Diseases.

Van Niekerk, S. (2002) The effect prohylactic *Escherichia coli* nosodes may have on alleviating enteric disease in pre-weaned piglets. Dissertation submitted to the Technikon Witwatersrand, M-Tech Homœopathy.

Vermeulen, F. (2000) Concordant Materia Medica. Millennium edition. Emryss bv Publishers, Haarlem, The Netherlands.

Villegas, P. (1998) Viral diseases of the respiratory system. *Poultry Science*, **77(8)**: 1143-1145.

Vitoulkas, G. (1980) The Science of Homoeopathy. First Grove Press edition, New York.

Wakefield, A.J., Murch S.H., Anthony, A., Linnell, J., Casson, D.M., Malik, M., Berelowitz, M., Dhillon, A.P., Thomson, M.A., Harvey, P., Valentine, A., Davies, S.E., Walker-Smith, J.A. (1998) Ileal-lymphoid-nodular hyperplasia, non-specific colitis, and pervasive developmental disorder in children. *Lancet*, **351(9103)**: 637-641.

Warriss, P.D., Bevis, E.A., Brown, S.N. (1990) Time spent by broiler chickens in transit to processing plants. *Veterinary Record*, **127**: 617-619.

Weideman Jr., R.F. and Tackett, C.D. (2000) Cardio-pulmonary function in broilers reared at warm or cool temperatures; effect of acute inhalation of 100% oxygen. *Poultry Science*, **79(2)**: 257-264.

Yahav, S. (2000) Domestic fowl – strategies to confront environmental conditions. *Poultry and Avian Biology Reviews*, **11(2)**: 81-95.

APPENDIX A

List of materials and equipment

- Four fountain drinkers
- Three feeding trays
- Three bell drinkers
- Three automatic feeders
- Three infra-red lamps
- Three hoods for infra-red lamps
- Six light bulbs with electrical cabling and connections
- Hosepipe with fittings for continuous water supply
- Two cubic meters pine shavings for use as litter
- Fork to loosen litter
- Digital scales for weighing purposes
    - Micro PS 1
    - Tchibo TCM 207761
- Three transport crates for transport from hatchery
- Three transport crates for transport to slaughter
- Hardboard, wooden support posts, nails and wire for division construction
- Three disposable syringes, with needles, for vaccine preparation
- Disposable latex gloves for use during vaccine preparation
- Two hardboard clipboards with pens and paper for data documentation

APPENDIX B

Weather data

Witbank weather data obtained from the South African Weather Service, for the period 19 August to 24 September 2003:

MONTH	DATE	DAY OF STUDY	RAIN-FALL (mm)	TEMP. MIN. (°C)	TEMP. MAX. (°C)	TEMP. AVE. (°C)	WIND SPEED (m/s)
AUGUST	19	1	0	11.40	24.10	17.80	15.20
	20	2	0	2.10	11.30	6.70	14.30
	21	3	0	-4.30	14.10	4.80	9.20
	22	4	0	-0.70	15.60	7.50	9.80
	23	5	0	3.40	22.20	12.80	7.50
	24	6	0	7.20	13.30	15.30	13.50
	25	7	0	1.90	21.90	11.90	13.50
	26	8	0	4.80	15.10	9.90	15.10
	27	9	0	1.90	22.20	12.10	10.40
	28	10	0	6.20	24.00	15.10	7.90
	29	11	0	9.50	26.10	17.80	8.10
	30	12	0	7.70	23.50	15.60	7.60
	31	13	0	8.00	25.70	16.90	8.30
SEPT.	1	14	0	9.90	27.30	18.60	8.10
	2	15	0	9.20	27.80	18.50	7.60
	3	16	0	9.80	26.10	17.90	9.10
	4	17	0	8.60	24.90	16.80	10.90
	5	18	0	11.00	24.20	17.60	13.40
	6	19	0	7.70	19.70	13.70	14.80
	7	20	0	4.30	20.30	12.30	8.80
	8	21	0	7.30	24.70	15.90	11.90
	9	22	0	10.20	27.90	19.10	12.50
	10	23	0	8.80	24.30	16.60	11.50
	11	24	0	7.50	24.30	15.90	10.30
	12	25	0	10.90	27.40	19.10	16.60
	13	26	9.00	12.40	24.60	18.50	14.30
	14	27	0	8.80	16.30	12.60	13.60
	15	28	0	5.80	18.40	12.10	10.70
	16	29	0	5.50	20.80	13.20	9.00
	17	30	0	7.90	23.40	15.70	7.60
	18	31	0	9.80	23.50	16.60	10.60
	19	32	0	10.80	28.60	19.70	11.40
	20	33	0	14.50	28.90	21.70	13.50
	21	34	0	14.50	26.30	20.40	11.30
	22	35	0	10.00	21.00	15.50	14.10
	23	36	0	9.00	20.70	14.90	9.70
	24	37	0	9.70	25.40	17.60	9.50

APPENDIX C

Random live mass (kg): Vaccinosis treatment group

Date (2003)	Study day	Research subjects										Aver-age
		1	2	3	4	5	6	7	8	9	10	
19/8	1	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.400	0.4000
24/8	6	0.101	0.132	0.120	0.112	0.130	0.129	0.126	0.110	0.088	0.120	0.1168
30/8	12	0.222	0.253	0.226	0.301	0.252	0.253	0.218	0.310	0.293	0.288	0.2616
5/9	18	0.509	0.438	0.660	0.488	0.508	0.479	0.430	0.388	0.580	0.430	0.4910
11/9	24	0.889	0.861	0.740	0.738	0.799	0.709	0.889	1.200	0.760	0.800	0.8385
17/9	30	1.325	1.111	1.160	1.365	1.208	1.232	1.155	1.246	1.313	1.226	1.2341
23/9	36	1.574	1.835	1.862	2.000	1.607	1.745	1.555	1.666	1.720	1.690	1.7254
24/9	37	1.70	1.80	2.00	1.80	1.70	1.70	1.80	1.80	1.90	1.80	1.8000

APPENDIX D

Random live mass (kg): Control group

Date (2003)	Study day	Research subjects										Aver-age
		1	2	3	4	5	6	7	8	9	10	
19/8	1	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.400	0.4000
24/8	6	0.089	0.098	0.113	0.106	0.123	0.106	0.067	0.107	0.107	0.112	0.1028
30/8	12	0.275	0.245	0.228	0.193	0.278	0.208	0.253	0.279	0.147	0.253	0.2359
5/9	18	0.309	0.489	0.450	0.428	0.488	0.389	0.448	0.499	0.448	0.460	0.4448
11/9	24	0.88	0.749	0.789	0.847	0.889	0.640	0.882	0.689	0.818	0.728	0.7919
17/9	30	1.100	1.001	0.851	1.128	1.533	1.129	1.142	1.112	1.152	1.03	1.1251
23/9	36	1.641	1.679	1.604	1.578	1.502	1.480	1.409	1.668	1.677	1.440	1.5678
24/9	37	1.75	1.45	1.70	1.40	1.80	1.70	1.80	1.50	1.50	1.85	1.6450

APPENDIX E

Random live mass (kg): Stress treatment group

Date (2003)	Study day	Research subjects										Aver-age
		1	2	3	4	5	6	7	8	9	10	
19/8	1	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.400	0.4000
24/8	6	0.117	0.131	0.108	0.123	0.112	0.110	0.098	0.086	0.113	0.129	0.1127
30/8	12	0.267	0.269	0.265	0.230	0.269	0.285	0.227	0.269	0.255	0.211	0.2547
5/9	18	0.488	0.380	0.549	0.498	0.454	0.490	0.369	0.499	0.529	0.499	0.4755
11/9	24	0.830	0.879	0.769	0.788	0.728	0.880	0.990	0.778	0.920	0.852	0.8324
17/9	30	1.160	1.025	1.212	1.350	1.212	1.460	1.290	1.021	1.130	1.330	1.2190
23/9	36	1.750	1.672	1.640	1.955	1.830	1.990	1.739	1.630	1.690	1.701	1.7597
24/9	37	1.65	1.95	2.20	1.65	2.00	1.65	1.80	1.75	1.90	1.95	1.8500

APPENDIX F

Vaccinosis treatment group: Non-paired random values - live mass and carcass mass in kilograms at slaughter

Date	Subject	Live mass	Carcass
24 Sept.	1	1.70	1.25
24 Sept.	2	1.80	1.35
24 Sept.	3	2.00	1.30
24 Sept.	4	1.80	1.30
24 Sept.	5	1.70	1.20
24 Sept.	6	1.70	1.25
24 Sept.	7	1.80	1.25
24 Sept.	8	1.80	1.30
24 Sept.	9	1.90	1.35
24 Sept.	10	1.80	1.20
AVERAGE	1	1.80	1.275

APPENDIX G

Control group: Non-paired random values - live mass and carcass mass in kilograms at slaughter

Date	Subject	Live mass	Carcass
24 Sept.	1	1.75	1.45
24 Sept.	2	1.45	1.00
24 Sept.	3	1.70	1.20
24 Sept.	4	1.40	1.15
24 Sept.	5	1.80	1.45
24 Sept.	6	1.70	1.15
24 Sept.	7	1.80	1.30
24 Sept.	8	1.50	1.10
24 Sept.	9	1.50	1.15
24 Sept.	10	1.85	1.05
AVERAGE	1	1.645	1.20

APPENDIX H

Stress treatment group: Non-paired random values - live mass and carcass mass in kilograms at slaughter

Date	Subject	Live mass	Carcass
24 Sept.	1	1.65	1.25
24 Sept.	2	1.95	1.30
24 Sept.	3	2.20	1.40
24 Sept.	4	1.65	1.15
24 Sept.	5	2.00	1.35
24 Sept.	6	1.65	1.15
24 Sept.	7	1.80	1.15
24 Sept.	8	1.75	1.50
24 Sept.	9	1.90	1.35
24 Sept.	10	1.95	1.40
AVERAGE	1	1.85	1.30