A STUDY OF THE EFFECT OF HOMOEOPATHIC TREATMENT ON THE FOOD CONVERSION, MORTALITY RATES AND INCIDENCE OF INFECTIOUS CORYZA AND RELATED RESPIRATORY SYNDROMES IN BROILER CHICKENS

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SUBMISSION APPROVED FOR EXAMINATION

I, JACQUELINE POLLOCK, DO HEREBY DECLARE THAT THIS DISSERTATION REPRESENTS MY OWN WORK.

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PLACE OF SUBMISSION DURBAN

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THIS DISSERTATION IS DEDICATED TO MY PARENTS,

DICK AND HETTY POLLOCK,

AND TO OUMA.

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Mom and Dad for all their patience and support.

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ABSTRACT

During the six-week life span of broiler chickens, stress, vaccination reactions and disease may lead to poor feed conversion efficiency and increased mortality rates. The purpose of this study was to determine whether homoeopathic medicines would influence the feed conversion efficiency, mortality rates and incidence of infectious coryza and related respiratory syndromes in broiler chickens.

The trial was conducted using a balanced factorial design with five replications of each of the eight treatment groups. Four hundred Ross day-old chicks, sex as hatched, were randomly selected for the trial. The trial was conducted over a four-week period.

Mortality rates were established by a daily count of dead birds. Post mortem examinations were conducted to establish the incidence of respiratory disease. The feed conversion efficiency was calculated by recording the weight, feed intake and gain of the birds at weekly intervals.

The main effects and interaction effects of Arnica Montana 9CH and Aconitum Napellus 9CH, Echinacea Purpurea 6X and Gelsemium Simpervirens 9CH, and Thuja Occidentalis in ascending potencies, were analysed for statistical differences. Analysis of variance tables, and tables of means, were constructed using Minitab and Statgraphics statistical software.

The administration of Factor A (Arnica Montana 9CH and Aconitum Napellus 9CH), might be of some value in improving weight gain in broiler chickens. Factor A had a consistent effect on weight gain, this being numerically higher each week than the negative control, and statistically significantly so during week three (P=0.045). Factor C (Thuja Occidentalis) improved weight gain significantly in week two compared with the negative control. However, this result was contrary to the effects of Factor c for other weeks, where there was a numerical advantage in not using Factor C. The interaction of Factor A and Factor C significantly increased the feed intake of the broilers for the entire trial period (week one to three (P=0.022); week three to four (P=0.008). However, this increase in feed intake did not result in a concomitant increase in weight gain, implying that this was an apparently transient effect of little commercial value.

It was concluded that although the homoeopathic treatments did not reduce mortality rates, the incidence of respiratory disease, or feed conversion efficiency, they did show significant potential to increase weight gain in broiler chickens.

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TABLE OF ABBREVIATIONS

ANOVA	**Analysis of Variance**
CH	**Centisimal Hahnemannian**
CV	**Coefficient of Variation**
df	**Degree of Freedom**
FCE	**Feed Conversion Efficiency**
FI	**Feed Intake**
F_{cal}	**Calculated F Value**
F_{tab}	**Tabulated F Value**
H_0	**Null Hypothesis**
H_1	**Alternative Hypothesis**
MS	**Mean Squares**
SE	**Standard Error**
SS	**Sum of Squares**
SV	**Source of Variation**
X	**Decimal Dilution**
α	**Alpha**

DEFINITION OF TERMS

Broiler	**Chicken raised for slaughter at six weeks, when its body weight is approximately 1.8 kg**
Feed Conversion Efficiency	**How much weight the broilers gain in relation to the amount they eat** **g gain/kg feed**
Feed Intake	**The amount of feed consumed by the birds for a given period** **g bird/d**
Gain	**How much weight the birds gain over a given period (g/bird day x 1000)**
Mortality	**Refers to the death of the birds**
Phytotherapeutic dilution	**Plant material that has been serially diluted, but still contains material of the original substance**
Potency	**The degree to which a homoeopathic medicine has been diluted and succussed**
Weight	**The body mass of the birds**

CHAPTER 1

INTRODUCTION

Broilers are chickens raised for slaughter when their body weight is approximately 1.8 kg (Bell and North 1990: 453). Due to the shortness of their life span, the birds have little time to recover from an outbreak of disease. To overcome this, disease control measures have to be aimed at prevention rather than at cure. (Horner Interview 1997.) In addition to this, many of the diseases affecting broilers do not respond well to conventional treatment (Veterinary Research Institute Onderstepoort 1987c).

Broilers are exposed to a variety of stress-inducing factors, for example handling, temperature changes and vaccinations. Stress leads to an increase in susceptibility to disease, poor food conversion efficiency and higher mortality rates. (Bell and North 1990: 862,863.)

There are a number of conventional methods used to increase broiler immunity. These include vaccinations (usually for Newcastle disease and Infectious Bronchitis), and the inclusion of a coccidiostat and low-dosage antibiotics in the feed rations. (Bell and North 1990: 763, 867-873.) However, egg yolk immunity partially neutralises vaccines and limits the ability of the chicks to respond to immunisation (Travers 1995). The use of live vaccines may also reduce the resistance of the respiratory tract, resulting in a vicious cycle of infections (Veterinary Research Institute Onderstpoort 1987b).

Respiratory diseases such as Infectious Coryza (Veterinary Research Institute Onderstepoort 1987a), Infectious Bronchitis and Chronic Respiratory Disease, have a

high incidence in poultry. As a result of the poor response to conventional treatment (often antibiotics), vaccination reactions and the effect of stress, many birds do not grow to their optimum or may even die (Horner Interview 1997). Therefore, a good disease prevention strategy must be emphasised in order to minimise losses (Pattison 1993: 141).

Homoeopathic therapy stimulates the defence mechanism of the organism, thus acting on the symptoms rather than on the biological aetiology of the disease (Jouanny 1984a: 9). The homoeopathic treatments used in this study are aimed at reducing the effect of stress on the birds, increasing their immunity and treating the symptoms of respiratory disease.

CHAPTER 2

THE REVIEW OF THE RELATED LITERATURE

2.1 INTRODUCTION

Broilers are raised for slaughter at six weeks of age, when their body weight is approximately 1.8 kg (Bell and North 1990: 453). Having such a short life span, the birds do not have time to recover from a disease outbreak. They are raised in very large numbers commercially and are thus placed under stressful conditions that render them vulnerable to disease and vaccination reactions. This lowers their feed conversion efficiency and increases mortality rates. (Horner Interview 1997.) In addition to this, many of the diseases affecting poultry, particularly viral diseases, do not respond well to conventional treatment (Veterinary Research Institute Onderstepoort 1987c). Hunton (1995: 559) stated that the industry should avoid relying on vaccinations and medication to keep poultry healthy. By implementing a good disease prevention strategy, losses to the industry would be minimised (Pattison 1993: 141).

2.2 THE BROILER INDUSTRY

The broiler industry is the fastest growing agricultural industry, and is also the most important source of animal protein, in South Africa (Nieuwoudt Interview 1997).

In 1969, the broiler industry was ranked the twelfth largest agricultural industry in South Africa in terms of gross value, but in 1991 it became the largest. This is evident in that the poultry consumption per capita in South Africa has increased from 2.36 kg (1960-

1965) to 17.37 kg (1994-1995). This equates to 44% of the meat market in South Africa. (Directorate of Agricultural Information 1996: 89.)

Poultry meat has become more important than beef, mutton or pork in terms of output, because broilers have far higher feed conversion efficiency than other animals. It is thus relatively cheap to produce. In the light of the current economic climate and the ever-increasing population of South Africa, the demand for chicken as a source of protein is set to increase. Research into improving feed conversion efficiency and lowering mortality rates is essential for improving production and keeping prices down. (Nieuwoudt Interview 1997).

2.3 FACTORS INFLUENCING BROILER PRODUCTION

2.3.1 POULTRY HOUSE MANAGEMENT

One of the primary factors influencing the incidence of disease, and thus production, is poultry house management. It is thus important to house the chicks in a sanitary, well-ventilated and well-controlled environment. (Pattison 1993: 140.)

Good ventilation ensures that the birds get enough fresh air and that air pollutants are kept to a minimum, avoiding the build up of ammonia that irritates the respiratory mucosa and promotes infection (Pattison 1993: 140).

The temperature in the poultry house has to be controlled because newly hatched chicks cannot regulate their body temperature (Pattison 1993: 146). At Ukulinga Research

Farm, the temperature in the brooding house in maintained at 32 degrees Celsius for the first two days and is then slowly reduced to between 18 and 24 degrees Celsius at 21 days of age, depending on environmental conditions (Tutt 1997 Personal communication). This is in keeping with the recommendations for heat regulation for the maintenance of broilers (Pattison 1993: 147) as well as the guidelines of the Code for Keeping Poultry as approved by the South African Poultry Association (1995).

Chilling or overheating results in stress, starvation and dehydration of the birds (Pattison 1993: 147). Overcrowding also increases stress on the birds and must be avoided (Pattison 1993: 145).

Feed is the single largest item of cost in broiler production. The broilers must be fed well-formulated feeds in order to improve feed conversion efficiency. Nutritionally inadequate diets impair the immune system rendering the chick susceptible to infectious diseases (Pattison 1993: 148.) For the first two weeks the chicks get standard starter rations and for the next two weeks, standard finisher rations. The feed selected for this trial is mixed at Meadow Feedmills in Pietermaritzburg. This is the standard food used in trials of this nature at Ukulinga Research Farm. (Tutt Personal Communication 1997.)

2.3.2 STRESS

After hatching, the chicks are removed from the incubators and transported, often over long distances, to the buyer. During this period the chicks are not given any food or water. "Stress pacs" containing multivitamins and electrolytes or Nutrigel may be used

to reduce the chance of dehydration, although there is no specific conventional method to treat the effect of stress on the birds as such. (Horner Interview 1997.)

Due to the nature of their environment, the birds are constantly exposed to microbial challenge. This places immunological stress on the birds, affecting their metabolism and decreasing productivity even if there are no clinical signs of infection. (Hunton 1995: 95, 96.)

The effects of stress are evident in the general behaviour of the chicks. They may appear lethargic and uncoordinated as a result of over heating or an oxygen deficiency during transportation. Other signs include weakness, agitation and laboured breathing. (Pattison 1993: 243, 144.) Stress increases corticosteroid production (Hunton 1995: 528), which lowers immune resistance making the birds more vulnerable to infectious conditions (Pattison 1993: 145).

2.3.3 DISEASE

The incidence of disease plays an important role in the production of broilers. Retarded growth and reduced feed conversion efficiency as well as increased mortality rates as a result of an outbreak of disease will lead to considerable financial losses. This however is difficult to quantify in that the incidence and effect of disease varies. Thus disease control is aimed at prevention rather than at cure. (Horner Interview 1997.)

Respiratory diseases are particularly problematic to the industry due to the frequency of outbreaks and the rapid spread of the disease throughout the flock. Many of these

diseases respond poorly or not at all to conventional treatment. (Veterinary Research Institute Onderstepoort 1987c.)

2.3.3.1 VIRAL DISEASES

Newcastle disease is a highly infectious disease caused by an avian paramyxovirus. Disease signs vary considerably depending on the infecting virus. Typically there is pyrexia, difficulty in breathing, loss of appetite and diarrhoea, oedema of the head and nervous signs. The mortality rate is usually very high. There is no effective treatment; control depends solely on prevention. (Jordan 1992: 123.)

Infectious Bronchitis is also a highly contagious respiratory disease and is caused by a virus of the family *Coronaviridae.* It is characterised by listlessness, loss of appetite and retarded growth, sneezing, lacrymation and facial oedema, rales and gasping on respiration. Birds will seldom die of an uncomplicated infection. However, if the birds are infected by another pathogen at the same time, the severity and duration of the disease is increased. (Jordan 1992: 159-162.) Drug therapy is of little value and it is impractical to try to exclude infectious bronchitis by hygienic means in a commercial operation, thus control is dependent on increasing the resistance of the flock (Jordan 1992: 165).

Infectious laryngeotracheitis is of considerable economic importance because it causes high mortality resulting in reduced production. The virus affects the conjunctiva and respiratory tract causing breathing difficulties. Strains vary in virulence and young chicks

are particularly susceptible. It is often economically sound to destock completely if there is an outbreak. (Jordan 1992: 154.)

2.3.3.2 BACTERIAL DISEASES

Infectious coryza is an acute, rapidly spreading bacterial disease caused by *Haemophilus paragallinarum.* Signs include depression, facial oedema, a seromucoid nasal discharge and rales on respiration, and conjunctivitis. Although mortality is low in uncomplicated cases of the disease, it does result in inferior feed conversion efficiency in broilers. There are no effective bactericidal drugs available. This is evident in that signs recur when treatment is stopped. Convalescent birds remain carriers of the disease. In broiler flocks, complete depopulation is the only way to effectively control the disease. (Jordan 1992: 48-50.)

Secondary *Escherichia coli* infections are responsible for many of the complications of diseases affecting broilers. Poor poultry house management (resulting in stress to the birds) and the incidence of other diseases reduces the resistance of the birds and damages the mucosa of the respiratory tract. The ensuing septiceamia results in high mortality rates. (Horner Interview 1997.) Prevention of colibaccilosis is best achieved by decreasing risk factors. Vaccination only provides protection if it is specific to the strain causing the disease. (Hunton 1995: 538.)

2.3.3.3 MYCOPLASMAL DISEASES

In the broiler industry, avian mycoplasmosis, or chronic respiratory disease, caused by *Mycoplasma gallisepticum,* is of particular importance because it can be transmitted to the embryo from an infected hen (Jordan 1992: 75). Signs include a watery nasal discharge, sneezing and rales on respiration, coughing, facial swelling and listlessness. It often occurs in association with another infection and the birds are particularly susceptible to secondary bacterial infections and septiceamia. Even if the birds survive, their growth rate is retarded and thus feed conversion efficiency is impaired. The downgrading of carcasses leads to further economic loss. Broilers do not respond well to antimicrobial therapy and it is of a high cost. The draw back to using live vaccines is that this reduces the resistance of the birds and thus contributes to the disease complex. (Jordan 1992: 75-78.) It is thus essential to buy day old chicks that are *Mycoplasma gallisepticum* free (Pattison 1993: 142).

2.3.3.4 PROTOZOAL DISEASES

Coccidiosis is caused by a group of protozoa of the genus *Eimeria.* It is an infection of the digestive tract and is characterised by listlessness, diarrhoea, increased thirst and a high mortality rate. The disease occurs where there is a high stocking density (such as in the commercial poultry industry) and chicks do not receive passive immunity from the hen. Coccidiostats are routinely included in broiler rations to inhibit the growth of the parasite. These drugs are so effective at preventing infection that the birds do not develop immunity to the disease and when coccidial drug resistant strains of the parasite emerge, the coccidiostat has to be changed. (Jordan 1992: 227-241.)

2.4 CONVENTIONAL DISEASE INTERVENTIONS AND THEIR IMPLICATIONS

2.4.1 IMMUNISATION PROGRAMS

Broilers are immunised in order to limit the disease caused by a specific organism. Successful vaccination does not prevent the bird from becoming infected by the disease. The purpose of vaccination is to enable the chicken to resist the infection and thus prevent the clinical manifestations of the disease in an otherwise healthy bird. (Pattison 1993: 149.) Birds are usually immunised against Newcastle disease, Infectious bronchitis and Gumboro disease, although immunisation programs vary considerably according to local patterns of disease. (Travers 1995.)

Live vaccines contain one antigen, an attenuated form of the organism. The methods of application include the use of a coarse spray, eye drop application, or administration of the vaccine in the drinking water. Inactivated vaccines are used to a lesser extent in broilers. The concentrated antigen is used in combination with oil. These provide the birds with a longer lasting immunity. (Travers 1995.)

Although the use of live vaccines is effective in controlling Newcastle Disease (Travers 1995), those used for Infectious bronchitis and Infectious Coryza are less effective (Brag 1996).

During the broilers six-week life span, their immune system is immature and thus methods that produce rapid immunity are necessary. Vaccination failure is said to occur

if a vaccination fails to protect the flock from a given disease. It is doubtful that the vaccine itself is responsible for the lack of immune response because each vaccine lot is tested for potency. Vaccine failure can be attributed to genetic factors (genetic low responders), the effect of stress or the presence of maternal antibodies. (Pattison 1993: 150.) Antibodies from immune hens provide passive temporary immunity to the chicks. This egg yolk immunity partially neutralises vaccines given to very young birds, making them less effective. (Pattison 1993: 150.)

Young chicks also have a limited ability to respond to immunisation. Vaccinations are stressful events with adverse reactions ranging from a decrease in appetite to death (Pattison 1993: 150). Live vaccines induce a mild infection that may reduce the resistance of the respiratory tract, resulting in a vicious cycle of infections. Chicks vaccinated by the coarse spray method are less likely to receive an adequate dose of the vaccination because inhaled vaccines contain less virus on a per-chick basis. However they can contract the virus from others in the flock. This bird to bird transmission of the vaccine virus increases its pathogenicity, resulting in repeated infections at different times. (Pattison 1993: 150.) Live vaccines may cause a vaccination reaction in which the birds show respiratory symptoms like a mild cough (snicking). This reaction will be more severe if the birds have been exposed to stress inducing factors like fluctuating temperatures or over crowding. (Travers 1995.)

2.4.2 FEED ADDITIVES INCLUDING COCCIDIOSTATS, GROWTH PROMOTANTS AND ANTIBIOTICS

Coccidiostats are routinely included in broiler rations to inhibit the growth of the parasite.

Most growth stimulants that are included in broiler rations are low-grade antibiotics that act in the gastrointestinal tract and are not absorbed. Growth stimulants are added to feed because it has been demonstrated that they stimulate growth and improve feed conversion efficiency (Hunton 1995: 95,96). Veterinarian prescribed antibiotics or antimicrobials have to be withdrawn before slaughter to ensure that there are no residues left in the meat (Hunton 1995: 557).

2.5 THE ASSESSMENT OF BROILER PRODUCTION

2.5.1 MORTALITY RATES

Mortality refers to the number of birds that die. It is assessed every day by removing and counting the dead birds. It is important because it is an indication of the general condition of the flock. By establishing the cause of death by post-mortem examination, the poultry house personnel can adjust the production strategy accordingly.

The mortality rate of the flock is important to production and thus financially, both in terms of the initial cost of the chick and the loss of the potential income from selling the

carcass. In addition to this, the older the bird is when it dies the more money that is lost in terms of feed.

A mortality rate of less than six per cent is considered acceptable in commercial broiler production, however mortality rates tend to be lower under research conditions. (Horner Interview 1997.)

2.5.2 FEED CONVERSION EFFICIENCY

The aim of the broiler industry is to obtain optimum meat production at the lowest cost. Emphasis is placed on feed conversion efficiency because feed is one of the main production costs. (Hunton 1995: 123.)

Feed conversion efficiency expresses how well the birds assimilate what they eat or how efficient they are at converting feed into body parts. It is calculated in terms of how much weight the birds gain in grams divided by their feed intake in grams. This gives a figure that is <1. (Hunton 1995: 55.) It is a measure of efficiency and profit.

The broiler must reach market body mass in the shortest time possible, because the longer it takes the higher the maintenance costs. Any improvement in feed conversion efficiency will thus result in a significant reduction in production costs. (Horner Interview 1997.)

2.5.3 THE INCIDENCE OF INFECTIOUS CORYZA AND RELATED RESPIRATORY SYNDROMES

For the purpose of this study the incidence of infectious coryza and related respiratory syndromes has been evaluated by doing post-mortem examinations on the deceased birds.

2.6 THE HOMOEOPATHIC TREATMENT OF BROILERS

The trial was focused on the prevention of disease rather than on the treatment of sick birds, because, by the time veterinary intervention is required, the producer has already incurred losses in terms of decreased feed conversion efficiency, increased mortality and down-grading of carcasses on inspection (Pattison 1993: 150).

Homoeopathic medication is administered in highly diluted doses (Jouanny 1984: 10), thus there is no danger of drug residues in the meat and no withdrawal period is necessary. The remedies do not act chemically and are non-toxic (Jouanny 1991: 91).

Homoeopathic therapy stimulates the defence mechanism of the organism and thus acts on the clinical manifestation of the disease rather than on a specific pathological agent (Jouanny 1984: 9). Homoeopathic medicines act qualitatively rather than quantitatively, so the size of the dose is not proportional to its expected action (Jouanny 1991: 91).

The homoeopathic treatment used in this study was aimed at reducing the effect of stress on the birds, increasing their resistance to disease and treating the manifestations

of respiratory disease. The objective was to improve the general health of the birds and thus reduce mortality rates, improve feed conversion efficiency and reduce the incidence of respiratory syndromes whether these were due to a specific pathogen or vaccination reaction.

No legislation pertaining to the use of homoeopathy in poultry could be found.

2.6.1 DESCRIPTION OF THE HOMOEOPATHIC TREATMENTS USED IN THIS STUDY

2.6.1.1 FACTOR A

Factor A consisted of Arnica Montana 9CH and Aconitum Napellus 9CH. It was administered to the broilers from day one to day three of the trial. The chicks were particularly vulnerable during this initial period because they were so young and their immune status was relatively poor. They were also exposed to a number of stress-inducing factors. Thus this factor was aimed at reducing the effect of stress on the chicks.

Arnica Montana was selected for the trial because it was indicated for all cases of trauma, muscular strain and fatigue (Jouanny 1998a: 46), as experienced by the birds due to hatching and handling. Aconitum Napellus had also been selected for administration during this period of the trial because it was specifically indicated for anxiety and restlessness of sudden onset, especially after a change in temperature (Jouanny 1984a: 11), as experienced by the day-old chicks when they were crated and moved.

Arnica Montana and Aconitum Napellus are also both indicated for febrile states (Jouanny 1984a: 11, 46, 156-159), and the early phases of respiratory infections (Morrison 1993: 6, 37,38).

The potency, 9CH, is classified as a medium potency and has been selected on the basis of its functional and general action (Jouanny 1991: 93).

2.6.1.2 FACTOR B

Factor B consisted of Gelsemium Simpervirens 9CH and Echinacea Purpurea 6X.

Gelsemium Simpervirens had been selected because of its particular affinity for infectious states and catarrhal inflammations, especially if the onset was slow and followed a change in temperature (Jouanny 1984: 156-159). Thus its action was directed at the control of the influenza-like signs of respiratory syndromes. Fluctuations of temperature due to weather changes and moving the broilers from the brooder to larger pens for the latter part of the trial, played a role in this.

The potency, 9CH, is classified as a medium potency and has been selected on the basis of its functional and general action (Jouanny 1991: 93).

Echinacea Purpurea was selected for administration for the entire duration of the trial because it has been said to increase immunity (Vogel 1989: 376-380), and was thus aimed at treating infectious conditions and vaccination reactions. Tierra (1992: 191) points out that, when used phytotherapeutically, Echinacea Purpurea stimulates the

immune system against all infectious and inflammatory conditions by stimulating phagocytosis and T-cell formation.

The potency, 6X, is classified as a low potency (Jouanny 1991: 93), and has been selected for its action on a local or physiological level.

2.6.1.3 FACTOR C

Factor C consisted of Thuja Occidentalis.

Thuja occidentalis is used as a diasthetic remedy when there is a particular constitutional susceptibility or predisposition to a disease. It is indicated for use after curative or preventative serum therapy and after the administration of chemotherapy, including antibiotics (Jouanny 1984: 416,417). It is thus specifically indicated for vaccination reactions or failure to respond to vaccination (Morrison 1993: 387).

2.7 CONCLUSION

Disease prevention is more profitable in the long run compared to a production system that relies on vaccinations and drugs (Pattison 1993: 141), so there is a strong financial incentive to develop new ideas. It is becoming necessary for the industry to limit drug use due to increased public concern over drug and pesticide usage and the dangers of drug residues in the meat (Pattison 1993: 157). There are opportunities for development of ethically sound practices that will benefit the marketability of poultry products in the future (Hunton 1995: 577), thus it is feasible to study the effect of

homoeopathic treatment on the feed conversion efficiency, mortality rates and incidence of infectious coryza and related respiratory syndromes in broiler chickens.

CHAPTER 3

MATERIALS AND METHODS

3.1 DESIGN OF THE EXPERIMENT

3.1.1 DESIGN OF THE STUDY

The study, to determine the effect of homoeopathic medicines on the mortality rate, food conversion efficiency and incidence of infectious coryza and related respiratory syndromes in broiler chickens, was conducted at Ukulinga Research Farm, University of Natal, Pietermaritzburg.

The trial was conducted using a balanced factorial design, in which three factors were used. There were five replications of each of the eight treatment groups. There were 50 broilers in each treatment group (fifty birds for each replication), resulting in a total of 400 chickens used for this trial. Thus the means of the main effects of the factors i.e. the groups that received only one of the three factors and the means of the interaction of the factors i.e. the groups that received different combinations of the factors, could be measured, compared and analysed.

The trial was conducted over a four-week period, from day-old to 28 days old. However, data were only evaluated from day seven to day 28.

3.1.2 DESCRIPTION OF THE HOMOEOPATHIC TREATMENTS

3.1.2.1 FACTOR A

Factor A consisted of Arnica Montana 9CH and Aconitum Napellus 9CH. It was administered to the broilers from day one to day three of the trial. Thus this factor was aimed at reducing the effect of stress on the chicks.

3.1 2.2 FACTOR B

Factor B consisted of Gelsemium Simpervirens 9CH and Echinacea Purpurea 6X. This was administered for the entire trial period, from day one to day 28. This factor was aimed at treating respiratory symptoms and increasing the bird's immunity.

3.1.2.3 FACTOR C

Factor C consisted of Thuja Occidentalis. This was administered, after the broilers are vaccinated, in accordance with the ascending-scale technique described by Jouanny (1984: 423), by which 9CH was given on the first day, 12CH on the second, 15CH on the third and 30CH on the fourth day after each vaccination. This factor was aimed at reducing vaccination reactions.

3.1.3 THE TREATMENTS

The treatments are described in Table 3.1. Zero indicates that the factor was not administered: 1 indicates that the factor was administered.

Table 3.1 Description of the Treatments

Treatment Group	Factor A	Factor B	Factor C
1	0	0	0
2	1	0	0
3	0	1	0
4	0	0	1
5	1	1	0
6	1	0	1
7	0	1	1
8	1	1	1

3.1.4 PEN ALLOCATION

The Poultry Manager at Ukulinga Research Farm randomised the pen allocation for the treatment groups, and the birds were dosed accordingly. On arrival, the day-old chicks, were allocated to the pens at random. The randomisation for pen allocation is described in Table 3.2.

Table 3.2 Randomisation for Pen Allocation for the Treatment Groups

Treatment Groups	Replication 1	Replication 2	Replication 3	Replication 4	Replication 5
1	7	10	19	28	37
2	3	11	14	24	31
3	4	18	29	33	40
4	8	21	26	32	35
5	5	12	15	25	36
6	2	16	22	27	38
7	6	9	20	23	34
8	1	13	17	30	39

3.2 THE BIRDS

Four hundred Ross Broiler chicks, sex as hatched, were used for the study. They were bought as day-olds from National Chicks Ltd. in Umlaas Road, Kwa-Zulu Natal.

3.3 THE FACILITIES

The trial was conducted at Ukulinga Research Farm in Pietermaritzburg. The chicks were housed in the brooder facilities on the farm. For the first three weeks the chicks were kept in electrical brooders. There were ten birds per pen. These pens were $0.525m^2$ in area. For the remainder of the trial period the birds were moved to another

poultry house and each replication group was divided into two pens of five birds each. These pens were $0.25m^2$. This was necessary because the birds needed more space, as they grew larger.

3.4 ETHICAL CONSIDERATIONS

The guidelines specified for the care of broilers by the Department of Poultry Science, University of Natal, Pietermaritzburg, were implemented at Ukulinga Research Farm for the duration of the trial. This protocol was based on the Code for Practice of Keeping Poultry as approved by the South African Poultry Association (1995).

3.5 THE CONTROLLED VARIABLES

3.5.1 FEEDING AND WATERING

For the first 14 days, the broilers were fed standard starter feeds. From day 15 to 28 the birds received standard finisher feeds. The feed was obtained from Meadow Feedmills in Pietermaritzburg. The birds were fed from feeder troughs and drank from water troughs. Feed and water were available ad libitum throughout the trial.

3.5.2 TEMPERATURE CONTROL

Electrical brooding was used to maintain the temperature at the optimum level for the broilers. For the first two days it was maintained at 32°C. It was then reduced by a degree per day to the ambient temperature of approximately 24°C. The thermo-neutral

temperature of the broilers also decreases with age. If the thermoneutral zone is not met, the birds will increase or decrease their feed intake in order to regulate their body temperature.

3.5.3 CONVENTIONAL MEDICATION

Clopidol was included in the starter rations. Monensin was included in the finisher rations. These are the standard coccidiostats included in feed by Meadow Feedmills in Pietermaritzburg. Zinc bacitracin was used as the standard growth-promoter and was also included in the feed. (Barnsley 1997 Telephone conversation.) No additional medication was administered to the broilers.

3.5.4 IMMUNISATION PROGRAMS

The broilers received the standard immunisation program as implemented at Ukulinga Research Farm. The day-old chicks received the IB/ND oil vaccination. This vaccinated them against Infectious Bronchitis and Newcastle Disease. At ten days of age the chicks were vaccinated against Gumboro disease using Gumbovax. At twelve days of age they were vaccinated against Newcastle Disease again, using the NC Clone 30 vaccination. The last two vaccinations were repeated on day 20 and 22 respectively. (Tutt 1997 Telephone conversation.)

3.6 THE INDEPENDENT VARIABLES

3.6.1 THE PREPARATION OF THE HOMOEOPATHIC MEDICINES

The homoeopathic medicines were prepared from mother tincture by Mr L. Tak, a pharmacist, at the research laboratory of the Department of Homoeopathy, Technikon Natal, Durban.

3.6.2 THE DOSAGE OF THE HOMOEOPATHIC MEDICINES

Factor A was administered for the first three days of the trial only. Factor B was administered for the duration of the trial. Factor C was administered for the four days following each vaccination.

The homoeopathic medicines were administered at a rate of one drop per broiler per day until the birds were seven days old. The dosage was then increased at the rate of one drop per week per bird until the end of the trial, at which stage the birds were receiving four drops of each medicine of the relevant factor or factors. This was done to ensure that each bird received a sufficient amount of medicine, although homoeopathic medicines act qualitatively rather than quantitatively (Jouanny 1991: 91), so the size of the dose is not an important factor.

Factor A was administered for the first three days of the trial only. Factor B was administered for the duration of the trial. Factor C was administered for the four days following each vaccination.

3.6.3 THE ADMINISTRATION OF THE HOMOEOPATHIC MEDICINES

The Poultry Manager administered the medicine to the birds via their drinking water. Water was withheld from the birds for a two-hour period prior to dosing to increase the probability that all the broilers would drink the medicated water.

Administering the medication via the drinking water is efficient in terms of time and labour costs. This is also a common method of administering vaccinations and is routinely used in the poultry industry. Another reason to include the medication in the drinking water, is that sick birds often will not eat, but will continue to drink (Pattison 1993:157.)

3.7 MEASUREMENTS AND OBSERVATIONS

3.7.1 MORTALITY RATES

The Poultry Manager recorded deaths daily.

3.7.2 FEED CONVERSION EFFICIENCY

Feed conversion efficiency is used to indicate how much weight the birds gain in relation to how much food they consume. This was calculated by weight gain (g/bird day x 1000) divided by the feed intake (g/bird day). The feed conversion efficiency of the broilers is influenced by their health status, so this is an appropriate way to assess the effect of illness on the condition of the birds (Tutt Personal Communication 1997).

Feed intake was measured on days seven, 14, 21 and 28. The live mass of the birds was measured on the same days. The measurements were made using Electrical Sartorius Platform Scales and crates. Standard methodologies were implemented. The researcher and the Poultry Manager recorded these data.

3.7.3 INCIDENCE OF INFECTIOUS CORYZA AND RELATED RESPIRATORY SYNDROMES

Post mortems were conducted on all the dead birds by the attending veterinary surgeon in order to determine the cause of death and the incidence of infectious coryza and related respiratory syndromes. The birds are monitored in the poultry house for signs of respiratory disease or snicking, although this is not a sufficiently accurate observation for research purposes (Tutt Personal Communication 1997).

3.8 EVALUATION OF THE DATA

3.8.1 METHOD OF DATA ANALYSIS

The multifactor Analysis of Variance (ANOVA) method with balanced designs involving three main effects of factors A, B and C, and four interaction effects of factors A and B (A*B), A and C (A*C), B and C (B*C) and A and B and C (A*B*C), were used for data analysis. The ANOVA table is shown in Table 3.3.

The mathematical model used for the construction of the ANOVA table was of the following form:

$$Y_{ijk} = \mu + A_I + B_j + C_k + A_IB_j + A_IC_k + B_jC_k + A_IB_jC_k + \in_{ijk}$$

where:

Y_{ijk} was the observation in cell (i, j, k)

μ is was the overall (common effect)

A_I was the effect of treatment A_I where I = 1, ..., a = 2

B_j was the effect of treatment B_j where j = 1, ..., b = 2

C_k was the effect of treatment C_k where k = 1, ..., c = 2

A_IB_j was the effect of the interaction between A_I and B_j

A_IC_k was the effect of the interaction between A_I and C_k

$A_IB_jC_k$ was the effect of the interaction between A_I, B_j and C_k

$\in_{ijk}$ was the random error term in cell (I, j, k)

The three-factor Analysis of Variance method was used to test the significance of the three main effects of factors A, B and C, and four interaction effects (the interaction between factor A and factor B, the interaction between factor A and factor C, the interaction between factor B and factor C and the interaction between factor A, factor B and factor C).

To test the significance of the relevant factor the null hypothesis was written as:

H_O: The effect of the factor was not significantly different to the negative control.

The alternative hypothesis was written as:

H_1: The effect of the factor was significantly different to the negative control.

α Was the level of significance of the test.

Table 3.3 Analysis of Variance Table

SV	df	SS	MS	F_{cal}
A	a-1	SS(A)	MS(A)	MS(A)/MS(Err)
B	b-1	SS(B)	MS(B)	MS(B)/MS(Err)
C	c-1	SS(C)	MS(C)	MS(C)/MS(Err)
A*B	(a-1)(b-1)	SS(AB)	MS(AB)	MS(AB)/MS(Err)
A*C	(a-1)(c-1)	SS(AC)	MS(AC)	MS(AC)/MS(Err)
B*C	(b-1)(c-1)	SS(BC)	MS(BC)	MS(BC)/MS(Err)
A*B*C	(a-1)(b-1)(c-1)	SS(ABC)	MS(ABC)	MS(ABC)/(Err)
Error	n-abc	SS(Err)	MS(Err)	
Total	n-1	SS(tot)		

NOTATIONS:

SV = Source of Variation

df = degree of freedom

SS = Sum of Squares

MS = Mean Squares

$\mathbf{F_{cal}}$ = The calculated value of the F-statistic

α = The level of significance of the test

The level of significance is fixed at the $\alpha = 0.05$ level

Decision rule:

Reject H_0 if $F_{cal} > F_{tab}$ at the α level of significance.

Accept H_0 if $F_{cal} \leq F_{tab}$ at the α level of significance.

In this study the value of α was fixed at the 5% level.

3.8.2 THE PROCEDURES

3.8.2.1 PROCEDURE 1 THE CONSTRUCTION OF 11 ANALYSIS OF VARIANCE (ANOVA) TABLES

a. Objective 1

To find out whether the mortality rate was significantly reduced by the administration of factor A, factor B, factor C, the interaction of factor A and factor B, the interaction between factor A and factor C, the interaction between factor B and factor C or the interaction factor A, factor B and factor C.

H_0: The effect of the factor on the rate of mortality was not significantly different to the negative control.

H_1: The effect of the factor on the rate of mortality was significantly different to the negative control.

A total of seven results were interpreted using the ANOVA table.

b. Objective 2

To find out whether the weight at the end of week one was significantly improved by the administration of factor A, factor B, factor C, the interaction of factor A and factor B, the interaction between factor A and factor C, the interaction between factor B and factor C or the interaction factor A, factor B and factor C.

H_0: The effect of the factor on the weight at the end of week one was not significantly different to the negative control.

H_1: The effect of the factor on the weight at the end of week one was significantly different to the negative control.

A total of seven results were interpreted using the ANOVA table.

c. Objective 3

To find out whether the weight at the end of week two was significantly improved by the administration of factor A, factor B, factor C, the interaction of factor A and factor B, the interaction between factor A and factor C, the interaction between factor B and factor C or the interaction factor A, factor B and factor C.

H_0: The effect of the factor on the weight at the end of week two was not significantly different to the negative control.

H_1: The effect of the factor on the weight at the end of week two was significantly different to the negative control.

A total of seven results were interpreted using the ANOVA table.

d. Objective 4

To find out whether the weight at the end of week three was significantly improved by the administration of factor A, factor B, factor C, the interaction of factor A and factor B, the interaction between factor A and factor C, the interaction between factor B and factor C or the interaction factor A, factor B and factor C.

H_0: The effect of the factor on the weight at the end of week three was not significantly different to the negative control.

H_1: The effect of the factor on the weight at the end of week three was significantly different to the negative control.

A total of seven results were interpreted using the ANOVA table.

e. Objective 5

To find out whether the weight at the end of week four was significantly improved by the administration of factor A, factor B, factor C, the interaction of factor A and factor B, the interaction between factor A and factor C, the interaction between factor B and factor C or the interaction factor A, factor B and factor C.

H_0: The effect of the factor on the weight at the end of week four was not significantly different to the negative control.

H_1: The effect of the factor on the weight at the end of week four was significantly different to the negative control.

A total of seven results were interpreted using the ANOVA table.

f. Objective 6

To find out whether the feed intake from the end of week one to the end of week three was significantly improved by the administration of factor A, factor B, factor C, the interaction of factor A and factor B, the interaction between factor A and factor C, the interaction between factor B and factor C or the interaction factor A, factor B and factor C.

H_0: The effect of the factor on the feed intake from the end of week one to the end of week three was not significantly different to the negative control.

H_1: The effect of the factor on the feed intake from the end of week one to the end of week three was significantly different to the negative control.

A total of seven results were interpreted using the ANOVA table.

g. Objective 7

To find out whether the feed intake from the end of week three to the end of week four was significantly improved by the administration of factor A, factor B, factor C, the interaction of factor A and factor B, the interaction between factor A and factor C, the interaction between factor B and factor C or the interaction factor A, factor B and factor C.

H_0: The effect of the factor on the feed intake from the end of week three to the end of week four was not significantly different to the negative control.
H_1: The effect of the factor on the feed intake from the end of week three to the end of week four was significantly different to the negative control.

A total of seven results were interpreted using the ANOVA table.

h. Objective 8

To find out whether the weight gain from the end of week one to the end of week three was significantly improved by the administration of factor A, factor B, factor C, the interaction of factor A and factor B, the interaction between factor A and factor C, the interaction between factor B and factor C or the interaction factor A, factor B and factor C.

H_0: The effect of the factor on the weight gain from the end of week one to the end of week three was not significantly different to the negative control.

H_1: The effect of the factor on the weight gain from the end of week one to the end of week three was significantly different to the negative control.

A total of seven results were interpreted using the ANOVA table

i. Objective 9

To find out whether the weight gain from the end of week three to the end of week four was significantly improved by the administration of factor A, factor B, factor C, the interaction of factor A and factor B, the interaction between factor A and factor C, the interaction between factor B and factor C or the interaction factor A, factor B and factor C.

H_0: The effect of the factor on the weight gain from the end of week three to the end of week four was not significantly different to the negative control.

H_1: The effect of the factor on the weight gain from the end of week three to the end of week four was significantly different to the negative control.

A total of seven results were interpreted using the ANOVA table.

j. Objective 10

To find out whether the FCE from the end of week one to the end of week three was significantly improved by the administration of factor A, factor B, factor C, the interaction of factor A and factor B, the interaction between factor A and factor C, the interaction between factor B and factor C or the interaction factor A, factor B and factor C.

H_0: The effect of the factor on the FCE from the end of week one to the end of week three was not significantly different to the negative control.

H_1: The effect of the factor on the FCE from the end of week one to the end of week three was significantly different to the negative control.

A total of seven results were interpreted using the ANOVA table.

k. Objective 11

To find out whether the FCE from the end of week three to the end of week four was significantly improved by the administration of factor A, factor B, factor C, the interaction of factor A and factor B, the interaction between factor A and factor C, the interaction between factor B and factor C or the interaction factor A, factor B and factor C.

H_0: The effect of the factor on the FCE from the end of week three to the end of week four was not significantly different to the negative control.

H_1: The effect of the factor on the FCE from the end of week three to the end of week four was significantly different to the negative control.

A total of seven results were interpreted using the ANOVA table.

3.8.2.2 PROCEDURE 2 TABLES OF MEANS

Tables of means were drawn up from the ANOVA tables so that the main effects of the factors (the groups that received only one of the three factors), and the interactions of the factors (the groups that received combinations of the factors), could be compared.

3.8.2.3 PROCEDURE 3 SUMMARY STATISTICS

Summary or descriptive statistics for each of the eleven major variables of the study were also given.

3.8.3 STATISTICAL PACKAGE

The statistical packages MINITAB and STATGRAPHICS VERSION 6 were used for data entry and analysis.

CHAPTER 4

RESULTS

4.1 THE COMPARISON OF THE MEANS OF THE MAIN EFFECTS AND THE INTERACTION EFFECTS OF THE FACTORS

Tables of means were drawn up from the ANOVA tables, shown in Appendix A, to present the main effects of the factors (the groups that received only one of the three factors), and the interactions of the factors (the groups that received combinations of the factors).

Table 4.1 shows the means of the main effects of Factor A, Factor B and Factor C, with regard to mortality and the weight of the broilers at the end of each week. The main effects of the factors with regard to feed intake, gain and feed conversion efficiency are shown in Table 4.2. Table 4.3 shows the means of the interaction effects of Factors A and B, Factors A and C, Factors B and C and Factors A, B and C, on the mortality and weight of the birds. The means of the interaction effects on the feed intake, gain and feed conversion efficiency are shown in Table 4.4. The summary statistics for each of the above are presented at the end of each table.

Table 4.1 Means of Main Effects of the Factors on Mortality and Weight

Factor	Level	Mortality %	Weight 1 g/bird	Weight 2 g/bird	Weight 3 g/bird	Weight 4 g/bird
A	0	5.0	136.4	321.8	636.4 b	1073.3
	1	5.0	137.9	349.6	677.8 a	1122.4
B	0	6.0	134.8	325.5	646.2	1081.4
	1	4.0	139.4	346.0	668.0	1114.3
C	0	5.0	142.0	353.0 b	670.6	1118.9
	1	5.0	132.3	318.4 a	643.7	1076.8
Sample size		40	40	40	40	40
Average		5	137.13	335.71	657.11	1097.90
SE		1.34	3.55	7.70	10.35	13.12
CV		169.50	16.39	14.51	9.97	7.56
Sig		None	None	Present a<b P=0.018	Present a>b P=0.045	None

Table 4.2 Means of Main Effects of the Factors on Feed Intake, Weight Gain and Feed Conversion Efficiency

Factor	Level	FI 1-3 g bird/d	FI 3-4 g bird/d	Weight Gain 1-3 g/bird d	Weight Gain 3-4 g/bird d	FCE 1-3 g gain/ kg feed	FCE 3-4 g gain/ kg feed
A	0	68.3	112.3	35.7 b	62.4	525.7	556.4
	1	68.8	113.6	38.6 a	63.5	561.0	559.3
B	0	68.301	113.7	36.5	62.7	537.2	546.4
	1	68.782	112.1	37.8	63.8	549.4	569.2
C	0	69.391	114.7	37.8	64.1	546.6	558.6
	1	67.692	111.2	36.5	61.9	540.0	557.1
Sample size		40	40	40	40	40	40
Average		68.54	112.86	37.14	62.97	543.32	557.81
SE		0.72	1.25	0.65	1.08	9.14	7.01
CV		6.63	7.03	11.10	10.80	10.64	7.94
Sig		None	None	Present a>b P=0.028	None	None	None

Table 4.3 Means of Interaction Effects of the Factors on Mortality and Weight

Factors	Level	Mortality %	Weight 1 g/bird	Weight 2 g/bird	Weight 3 g/bird	Weight 4 g/bird
A * B	0 0	6.0	138.1	317.3	622.3	1058.3
	0 1	4.0	133.8	326.4	650.5	1088.3
	1 0	6.0	130.7	333.7	670.1	1104.5
	1 1	4.0	145.0	365.6	685.5	1140.3
A * C	0 0	7.0	145.6	348.0	656.6	1108.9
	0 1	3.0	127.2	295.6	616.3	1037.8
	1 0	3.0	138.4	358.1	684.6	1128.9
	1 1	7.0	137.3	314.8	671.0	1115.9
B * C	0 0	8.0	137.5	334.3	644.9	1091.8
	0 1	4.0	132.1	316.6	647.6	1071.1
	1 0	2.0	146.4	371.7	696.3	1146.1
	1 1	6.0	132.4	320.2	639.7	1082.6
A * B * C	0 0 0	10.0	148.4	335.0	621.7	1085.6
	0 0 1	2.0	129.5	299.5	623.0	1031.1
	0 1 0	4.0	142.7	361.0	691.6	1044.4
	0 1 1	4.0	124.9	291.7	609.6	1044.4
	1 0 0	6.0	126.6	333.6	668.1	1098.0
	1 0 1	6.0	134.8	333.7	672.1	1111.0
	1 1 0	0.0	150.1	382.5	701.0	1159.9
	1 1 1	8.0	139.9	348.7	669.9	1120.7

Sample size		40	40	40	40	40
Average		5	137.13	335.71	657.11	1097.90
SE		1.34	3.55	7.70	10.35	13.12
CV		169.50	16.39	14.51	9.97	7.56
Sig		None	None	None	None	None

Table 4.4 Means of the Interaction Effects of the Factors on Feed Intake, Weight Gain and Feed Conversion Efficiency

Factors	Level	FI 1-3 g bird/d	FI 3-4 g bird/d	Weight Gain 1-3 g/bird d	Weight Gain 3-4 g/bird d	FCE 1-3 g gain/ kg feed	FCE 3-4 g gain/ kg feed
A * B	0 0	68.3	115.0	34.5	62.3	509.7	540.4
	0 1	68.3	109.6	36.9	62.5	541.6	572.3
	1 0	68.3	112.4	38.5	62.1	564.8	552.4
	1 1	69.3	114.7	38.6	65.0	557.2	566.2
A * C	0 0	70.9 a	117.2 a	36.5	64.6	519.2	551.0
	0 1	65.7 a	107.3 a	34.9	60.2	532.1	561.7
	1 0	67.9 a	112.1 a	39.0	63.5	574.0	566.1
	1 1	69.7 a	115.0 a	38.1	63.5	547.9	552.4
B * C	0 0	69.5	115.8	36.2	63.8	525.7	550.4
	0 1	67.1	111.5	36.8	60.5	548.8	542.4
	1 0	69.3	113.5	39.8	64.7	567.6	566.8
	1 1	68.3	110.8	36.2	63.3	531.2	571.7

A*B*C	0 0 0	71.3	121.8	33.8	66.3	480.6	541.8
	0 0 1	65.4	108.2	35.2	58.3	538.8	539.0
	0 1 0	70.4	112.7	39.2	63.0	558.0	560.2
	0 1 1	66.1	106.4	34.6	62.1	525.5	584.4
	1 0 0	67.750	109.89	38.679	61.405	570.66	558.96
	1 0 1	68.8	114.8	38.4	62.7	558.9	545.8
	1 1 0	68.1	114.3	39.3	65.6	577.4	573.3
	1 1 1	70.526	115.14	37.859	64.399	536.99	558.96
Sample size		40	40	40	40	40	40
Average		68.54	112.86	37.14	62.97	543.32	557.81
SE		0.72	1.25	0.65	1.08	9.14	7.01
CV		6.63	7.03	11.10	10.80	10.64	7.94
Sig		Present a: P=0.022	Present a: P=0.008	None	None	None	None

4.1.1 THE EFFECT OF HOMOEOPATHIC TREATMENTS ON MORTALITY RATES IN BROILER CHICKENS

The ANOVA table in Appendix A.1 shows that in all cases the F_{cal} value was less than or equal to the F_{tab} value. Therefore, at the α=0.05 level of significance, the null hypothesis was accepted. It was thus concluded that there were no statistically significant

differences between the main or interaction effects of any of the factors and the negative control with regard to mortality.

4.1.2 THE EFFECT OF HOMOEOPATHIC TREATMENTS ON THE WEIGHT OF THE BROILERS AT THE END OF WEEK ONE

The ANOVA table in Appendix A.2 shows that in all cases the F_{cal} value was less than or equal to the F_{tab} value. Therefore, at the α=0.05 level of significance, the null hypothesis was accepted. It was thus concluded that there were no statistically significant differences between the main or interaction effects of any of the factors and the negative control with regard to the weight of the broilers at the end of week one.

4.1.3 THE EFFECT OF HOMOEOPATHIC TREATMENTS ON THE WEIGHT OF THE BROILERS AT THE END OF WEEK TWO

The ANOVA table in Appendix A.3 shows that the F_{cal} value was greater than the F_{tab} value for factor C at the α=0.05 level of significance. The alternative hypothesis was accepted and it was thus concluded that the administration of this factor did improve the weight of the broilers significantly. However, in all other cases the F_{cal} value was less than or equal to the F_{tab} value. Therefore, at the α=0.05 level of significance, the null hypothesis was accepted. It was thus concluded that there were no statistically significant differences between the main effects of factors A and B or the interaction effects of the factors and the negative control with regard to the weight of the broilers at the end of week two.

4.1.4 THE EFFECT OF HOMOEOPATHIC TREATMENTS ON THE WEIGHT OF THE BROILERS AT THE END OF WEEK THREE

The ANOVA table in Appendix A.4 shows that the F_{cal} value was greater than the F_{tab} value for factor A at the α=0.05 level of significance. The alternative hypothesis was accepted and it was thus concluded that the administration of this factor did improve the weight of the broilers significantly. However, in all other cases the F_{cal} value was less than or equal to the F_{tab} value. Therefore, at the α=0.05 level of significance, the null hypothesis was accepted. It was thus concluded that there were no statistically significant differences between the main effects of factors B and C or the interaction effects and the negative control with regard to the weight of the broilers at the end of week three.

4.1.5 THE EFFECT OF HOMOEOPATHIC TREATMENTS ON THE WEIGHT OF THE BROILERS AT THE END OF WEEK FOUR

The ANOVA table in Appendix A.5 shows that in all cases the F_{cal} value was less than or equal to the F_{tab} value. Therefore, at the α=0.05 level of significance, the null hypothesis was accepted. It was thus concluded that there were no statistically significant differences between the main or interaction effects of the factors and the negative control with regard to the weight of the broilers at the end of week four.

4.1.6 THE EFFECT OF HOMOEOPATHIC TREATMENTS ON THE FEED INTAKE OF THE BROILERS FROM THE END OF WEEK ONE TO THE END OF WEEK THREE

The ANOVA table in Appendix A.6 shows that the F_{cal} value was greater than the F_{tab} value for the interaction of factor A and C at the α=0.05 level of significance. The alternative hypothesis was accepted and it was thus concluded that the interaction of these factors, when administered together did improve the feed intake of the broilers significantly. However, in all other cases the F_{cal} value was less than or equal to the F_{tab} value. Therefore, at the α=0.05 level of significance, the null hypothesis was accepted. It was thus concluded that there were no statistically significant differences between the main effects of factors or the interaction of the other factors and the negative control with regard to the feed intake of the broilers.

4.1.7 THE EFFECT OF HOMOEOPATHIC TREATMENTS ON THE FEED INTAKE OF THE BROILERS FROM THE END OF WEEK THREE TO THE END OF WEEK FOUR

The ANOVA table in Appendix A.7 shows that the F_{cal} value was greater than the F_{tab} value for the interaction of factor A and C at the α=0.05 level of significance. The alternative hypothesis was accepted and it was thus concluded that the interaction of theses facators, when administered together, did improve the feed intake of the broilers significantly. However, in all other cases the F_{cal} value was less than or equal to the F_{tab} value. Therefore, at the α=0.05 level of significance, the null hypothesis was accepted.

It was thus concluded that there were no statistically significant differences between the main effects of the factors or the interaction of the other factors and the negative control with regard to the feed intake of the broilers.

4.1.8 THE EFFECT OF HOMOEOPATHIC TREATMENTS ON THE WEIGHT GAIN OF THE BROILERS FROM THE END OF WEEK ONE TO THE END OF WEEK THREE

The ANOVA table in Appendix A.8 shows that the F_{cal} value was greater than the F_{tab} value for factor A at the α=0.05 level of significance. The alternative hypothesis was accepted and it was thus concluded that the administration of this factor did improve the gain of the broilers significantly. However, in all other cases the F_{cal} value was less than or equal to the F_{tab} value. Therefore, at the α=0.05 level of significance, the null hypothesis was accepted. It was thus concluded that there were no statistically significant differences between the main effects of factors B and C or the interaction of the factors and the negative control with regard to the gain of the broilers at the end of week three.

4.1.9 THE EFFECT OF HOMOEOPATHIC TREATMENTS ON THE WEIGHT GAIN OF THE BROILERS FROM THE END OF WEEK THREE TO THE END OF WEEK FOUR

The ANOVA table in Appendix A.9 shows that in all cases the F_{cal} value was less than or equal to the F_{tab} value. Therefore, at the α=0.05 level of significance, the null hypothesis was accepted. It was thus concluded that there were no statistically significant

differences between the main or interaction effects of the factors and the negative control with regard to the gain of the broilers from the end of week three to the end of week four.

4.1.10 THE EFFECT OF HOMOEOPATHIC TREATMENTS ON THE FEED CONVERSION EFFICIENCY OF THE BROILERS FROM THE END OF WEEK ONE TO THE END OF WEEK THREE

The ANOVA table in Appendix A.10 shows that in all cases the F_{cal} value was less than or equal to the F_{tab} value. Therefore, at the α=0.05 level of significance, the null hypothesis was accepted. It was thus concluded that there were no statistically significant differences between the main or interaction effects of the factors and the negative control with regard to the feed conversion efficiency of the broilers from the end of week one to the end of week three.

4.1.11 THE EFFECT OF HOMOEOPATHIC TREATMENTS ON THE FEED CONVERSION EFFICIENCY OF THE BROILERS FROM THE END OF WEEK THREE TO THE END OF WEEK FOUR

The ANOVA table in Appendix A.11 shows that in all cases the F_{cal} value was less than or equal to the F_{tab} value. Therefore, at the α=0.05 level of significance, the null hypothesis was accepted. It was thus concluded that there were no statistically significant differences between the main or interaction effects of the factors and the negative control with regard to the feed conversion efficiency of the broilers from the end of week three to the end of week four.

4.2 THE EFFECT OF THE HOMOEOPATHIC TREATMENTS ON THE INCIDENCE OF INFECTIOUS CORYZA AND RELATED RESPIRATORY SYNDROMES

The post-mortem examinations conducted on the dead birds, showed no evidence of infectious coryza or related respiratory syndromes.

CHAPTER 5

DISCUSSION

5.1 THE EFFECT OF THE HOMOEOPATHIC TREATMENTS ON MORTALITY RATES IN BROILER CHICKENS

The administration of Factor A, Factor B, Factor C, and the interactions of these factors did not significantly reduce the mortality rate of the birds. This is shown in the ANOVA table in Appendix A. 1. The means for mortality, shown in table 4.3, indicate that the control group i.e. the group that did not receive any of the factors, had a mean mortality rate of ten per cent. The treatment group that received Factors A and B had a mean mortality rate of zero. The mortality rates for the other treatment groups were between these values. Although these results were not statistically significant, it is important to note that the control group did have a higher mortality rate than that of the treatment groups.

The failure to reduce mortality rates significantly could be attributed to several factors. Under research conditions, mortality rates are generally lower than those of commercially raised broilers (Horner Interview 1997). Poultry house management was strictly controlled, so that the birds were housed in a sanitary, well-ventilated and well-controlled environment. The birds were not overcrowded and received nutritionally adequate diets. Optimum poultry house management also reduces the incidence of disease (Pattison 1993: 140). In addition to this, the trial flock was reared separately to other flocks, so the likelihood of them contracting disease was reduced.

5.2 THE EFFECT OF THE HOMOEOPATHIC TREATMENTS ON THE FEED CONVERSION EFFICIENCY OF BROILER CHICKENS

Feed conversion efficiency is an essential measure of profit, because it shows how well the birds assimilate what they eat. It also reflects the general health status of the birds, because birds that are unwell have poor feed conversion efficiency compared to healthy birds, under the same conditions.

The ANOVA table in Appendix A. 2 indicates that neither the main effects of the factors or the interaction of the factors significantly improved the weight gain of the birds by the end of week one. However, by the end of week two, the treatment group that received only Factor C, did differ significantly from the negative control. This is shown in the ANOVA table in Appendix A.3. The means for this group are presented in Table 4.1. However, this result was contrary to the effects of Factor C for other weeks, where there was a numerical advantage to not using Factor C. This result is thus of dubious value.

Factor A had a consistent effect on weight gain, this being numerically higher each week that the negative control. The weight of the birds at the end of week three, was significantly improved only by the administration of Factor A, as seen in the ANOVA table in Appendix A.4. It would appear that the administration Arnica Montana 9CH and Aconitum Napellus 9CH, for the first three days, might be of some value in improving weight gain in broiler chickens, although these remedies are said to have duration of action of up to 10 days (Boericke 1991:76,984.)

The ANOVA table in Appendix A. 5 shows that none of the factors or their interactions significantly improved the weight of the broilers by the end of week four.

The feed intake of the broilers was calculated from the end of week one to the end of week three, and from the end of week three to the end of week four. The ANOVA tables in Appendix A.6 and A.7, indicate that the interaction of Factors A and C significantly improved the feed intake of the broilers over both periods. However, this can not be considered relevant, as there was not a corresponding significant result with regard to the gain of the birds. None of the other treatment groups showed significant differences to the negative control.

The gain of the birds was calculated over the same periods as the feed intake. The ANOVA table in Appendix A.8 shows that Factor A significantly improved the gain from the end of week one to the end of week three. In all other cases there were no significant differences to the negative control.

The feed conversion efficiency was not significantly improved by any of the factors or their interactions. This is shown in ANOVA tables in Appendix A.9 and A.10. From these tables it can be noted that the probability that Factor A improved the feed conversion efficiency almost significant at 0.051, for both periods. The trial would have to be repeated with a larger sample group, in order to establish whether this trend indicates a true improvement in feed conversion efficiency, although this is more likely to be a chance occurrence.

5.3 THE EFFECT OF THE HOMOEOPATHIC TREATMENTS ON THE INCIDENCE OF INFECTIOUS CORYZA AND RELATED RESPIRATORY SYNDROMES IN BROILER CHICKENS

Post-mortem examinations were conducted on all the birds that died. None of the birds, either from the control group or any of the treatment groups, died of infectious coryza or related respiratory syndromes. This could have been due to the high standards at which the poultry house was maintained and because the flock was relatively small and kept away from other birds.

In order to determine whether the homoeopathic treatments assisted in overcoming the effects of infection, the trial would have to be conducted in such a way that the birds are deliberately infected with a specific respiratory disease and then treated accordingly. Conducting the trial under commercial conditions could produce a truer reflection of the effects of these homoeopathic medicines.

CHAPTER 6

CONCLUSIONS AND RECOMMENDATIONS

6.1 CONCLUSIONS

It can be concluded from the results of the study that the administration of the homoeopathic treatments did not significantly reduce the mortality rates of the broilers. As the incidence of infectious coryza and related respiratory syndromes was absent, the efficacy of the treatments could not be measured. Although the treatments or their interactions did not significantly improve feed conversion efficiency, there were transient improvements in the body weight, feed intake and weight gain of the broilers on some of the treatments compared to the control. The main effect of Arnica Montana 9CH and Aconitum Napellus (Factor A) had significantly improved the feed intake of the broilers by the end of week three. This factor had also significantly improved the gain of the broilers by the end of week three. The interaction of Factor A and Factor C significantly improved the gain of the broilers over the entire trial period. Factor A exhibited a tendency to improve the feed conversion efficiency of the broilers, but this was not statistically significant. It can be concluded that the administration of Echinacea purpurea 6X and Gelsemium Simpervirens 9CH produced no significant improvements in any of the variables measured.

6.2 RECOMMENDATIONS

The failure to produce any results with regard to the incidence of infectious coryza or related respiratory syndromes could be attributed to the lack of microbial challenge. It would therefore be recommended that the trial be redesigned in such a way that the standard of poultry house management is lowered and thus the likelihood of infection is increased. This could be achieved by altering the controlled variables and thus introducing specific stressors to the birds. The temperature at which the brooders are maintained could be increased. Ventilation could be made inadequate. Immunisation programmes could be changed and coccidiostats and growth promotants could be removed from the feed. Alternatively, the birds could deliberately be infected with a particular pathogen and then be treated accordingly.

The failure to produce significant results with regard to mortality rates, feed conversion efficiency and the incidence of respiratory disease could be due to the use of inappropriate remedies or potencies. It could therefore be recommended that the trial be repeated using the same remedies, but in different potencies, or using entirely different remedies.

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APPENDIX A ANALYSIS OF VARIANCE TABLES

1. Table 1 Analysis of Variance for Mortality

Source	DF	SS	MS	F_{cal}	F_{tab}	P	Sig.
A	1	0.00	0.00	0.00	4.17	1.000	None
B	1	40.00	40.00	0.52	4.17	0.474	None
C	1	0.00	0.00	0.00	4.17	1.000	None
A*B	1	0.00	0.00	0.00	4.17	1.000	None
A*C	1	160.00	160.00	2.10	4.17	0.157	None
B*C	1	160.00	160.00	2.10	4.17	0.157	None
A*B*C	1	0.00	0.00	0.00	4.17	1.000	None
Error	32	2440.00	76.25				
Total	39	2800.00					

2. **Table 2 Analysis of Variance for Weight at the End of Week One**

Source	DF	SS	MS	F_{cal}	F_{tab}	P	Sig.
A	1	21.0	21.0	0.04	4.17	0.841	None
B	1	210.1	210.1	0.41	4.17	0.527	None
C	1	942.1	942.1	1.84	4.17	0.185	None
A*B	1	947.5	947.5	1.85	4.17	0.184	None
A*C	1	749.3	749.3	1.46	4.17	0.236	None
B*C	1	186.1	186.1	0.36	4.17	0.551	None
A*B*C	1	235.4	235.4	0.46	4.17	0.503	None
Error	32	16407.5					
Total	39	19699.0					

3. **Table 3 Analysis of Variance for Weight at End of Week Two**

Source	DF	SS	MS	F_{cal}	F_{tab}	P	Sig.
A	1	7734	7734	4.04	4.17	0.053	None
B	1	4207	4207	2.20	4.17	0.148	None
C	1	12006	12006	6.27	4.17	0.018	Present
A*B	1	1300	1300	0.68	4.17	0.416	None
A*C	1	3154	3154	1.65	4.17	0.208	None
B*C	1	2856	2856	1.49	4.17	0.231	None
A*B*C	1	0	0	0.00	4.17	0.998	None
Error	32	61234	1914				
Total	39	92491					

4. **Table 4 Analysis of Variance for Weight at End of Week Three**

Source	DF	SS	MS	F_{cal}	F_{tab}	P	Sig.
A	1	17111	17111	4.35	4.17	0.045	Present
B	1	4738	4738	1.21	4.17	0.280	None
C	1	7251	7251	1.85	4.17	0.184	None
A*B	1	413	413	0.11	4.17	0.748	None
A*C	1	1790	1790	0.46	4.17	0.505	None
B*C	1	8749	8749	2.23	4.17	0.145	None
A*B*C	1	1454	1454	0.37	4.17	0.547	None
Error	32	125742	3929				
Total	39	167249					

5. **Table 5 Analysis of Variance for Weight at End of Week Four**

Source	DF	SS	MS	F_{cal}	F_{tab}	P	Sig.
A	1	24073	24073	3.80	4.17	0.060	None
B	1	10838	10838	1.71	4.17	0.200	None
C	1	17727	17727	2.80	4.17	0.104	None
A*B	1	85	85	0.01	4.17	0.909	None
A*C	1	8423	8423	1.33	4.17	0.257	None
B*C	1	4576	4576	0.72	4.17	0.402	None
A*B*C	1	222	222	0.04	4.17	0.853	None
Error	32	202576	6330				
Total	39	268518					

6. **Table 6 Analysis of Variance for Feed Intake from the End of Week One to the End of Week Three**

Source	DF	SS	MS	F_{cal}	F_{tab}	P	Sig.
A	1	2.51	2.51	0.12	4.17	0.726	None
B	1	2.32	2.32	0.11	4.17	0.737	None
C	1	28.86	28.86	1.43	4.17	0.240	None
A*B	1	3.16	3.16	0.16	4.17	0.695	None
A*C	1	117.74	117.74	5.84	4.17	0.022	Present
B*C	1	5.26	5.26	0.26	4.17	0.613	None
A*B*C	1	0.01	0.01	0.00	4.17	0.981	None
Error	32	645.33	20.17				
Total	39	805.19					

7. **Table 7 Analysis of Variance for Feed Intake from the End of Week Three to the End of Week Four**

Source	DF	SS	MS	F_{cal}	F_{tab}	P	Sig.
A	1	16.41	16.41	0.32	4.17	0.576	None
B	1	23.45	23.45	0.46	4.17	0.504	None
C	1	123.95	123.95	2.42	4.17	0.130	None
A*B	1	151.26	151.26	2.95	4.17	0.096	None
A*C	1	410.61	410.61	8.01	4.17	0.008	Present
B*C	1	6.02	6.02	0.12	4.17	0.734	None
A*B*C	1	80.39	80.39	0.57	4.17	0.220	None
Error	32	1640.74	51.27				
Total	39	2452.83					

8. Table 8 Analysis of Variance for Weight Gain from the End of Week One to the End of Week Three

Source	DF	SS	MS	F_{cal}	F_{tab}	P	Sig.
A	1	81.29	81.29	5.31	4.17	0.028	Present
B	1	15.06	15.06	0.98	4.17	0.329	None
C	1	15.13	15.13	0.99	4.17	0.328	None
A*B	1	13.33	13.33	0.87	4.17	0.358	None
A*C	1	1.14	1.14	0.07	4.17	0.787	None
B*C	1	32.57	32.57	2.13	4.17	0.154	None
A*B*C	1	14.59	14.59	0.95	4.17	0.336	None
Error	32	489.83	15.31				
Total	39	662.94					

9. **Table 9 Analysis of Variance for Weight Gain from the End of Week Three to the End of Week Four**

Source	DF	SS	MS	F_{cal}	F_{tab}	P	Sig.
A	1	12.09	12.09	0.24	4.17	0.624	None
B	1	25.39	25.39	0.51	4.17	0.479	None
C	1	47.00	47.00	0.95	4.17	0.337	None
A*B	1	17.78	17.78	0.36	4.17	0.553	None
A*C	1	49.95	49.95	1.01	4.17	0.322	None
B*C	1	13.68	13.68	0.28	4.17	0.602	None
A*B*C	1	57.40	57.40	1.16	4.17	0.289	None
Error	32	1581.88	49.43				
Total	39	1805.17					

10. **Table 10 Analysis of Variance for Feed Conversion Efficiency from the End of Week One to the End of Week Three**

Source	DF	SS	MS	F_{cal}	F_{tab}	P	Sig.
A	1	12475	12475	4.12	4.17	0.051	None
B	1	1485	1485	0.49	4.17	0.489	None
C	1	434	434	0.14	4.17	0.708	None
A*B	1	3897	3897	1.29	4.17	0.265	None
A*C	1	3813	3813	1.26	4.17	0.270	None
B*C	1	8854	8854	2.92	4.17	0.097	None
A*B*C	1	2382	2382	0.79	4.17	0.382	None
Error	32	96892	3028				
Total	39	130231					

11. **Table 11 Analysis of Variance for Feed Conversion Efficiency from the End of Week Three to the End of Week Four**

Source	DF	SS	MS	F_{cal}	F_{tab}	P	Sig.
A	1	84	84	0.04	4.17	0.844	None
B	1	5217	5217	2.45	4.17	0.127	None
C	1	23	23	0.01	4.17	0.917	None
A*B	1	822	822	0.39	4.17	0.538	None
A*C	1	1501	1501	0.71	4.17	0.407	None
B*C	1	417	417	0.20	4.17	0.661	None
A*B*C	1	498	498	0.23	4.17	0.632	None
Error	32	68024	2126				
Total	39	76586					