CHAPTER ONE

1.0 INTRODUCTION

1.1General information

A quail is a species of small game bird which belongs to *Aves* class and its phylum is *Chordata,* (Fah S.H and Vohra.P, 2008).

The domesticated subspecies, *Coturnix coturnix japonica,* called Japanese quail is also known by other names such as; Common quail, Eastern quail, Asiatic quail, Pharaoh´s quail.

A full grown female Japanese quail has the body weight of 120 – 160 grams and the male weighs 100 – 140 grams. In terms of colour and pattern of feathers, males have a rusty brown throat and breast feathers, while, the females have light tan feathers with black speckling on the throat and upper breast. Also mature males have cloacal gland in bulbous structure located at the upper edge of the vent which secretes a white, foamy material.

This bird reach maturity at the age of 5 – 6 weeks and it is mostly used for meat and egg production. Its rearing is easy because less floor space is required and relatively resistant to a number of diseases. In addition, it is a good source of high quality animal protein of great benefit to human wellbeing, (Nation Research Council, 1991).

1.2 Background to the study

Poultry industry is one of the growing industries in Zambia, many people have developed interest and realized the benefits of investing in this area of production. Poultry meat is one of the most palatable of all meats, it is easily digestible and acceptable to most people (FAO, 1967). This explains part of the reason why the demand for poultry meat is on the increase. However, there is not much diversification within this sector as many people are involved so much into chicken production compared to other birds which are equally of economic, social and nutritional benefits. Producers have somehow restricted themselves to chicken production due to lack of necessary information on how other types of birds such as quails can be raised.

The increasing demand for meat protein (poultry meat) calls for diversification i.e. venturing into production of affordable and fast growing birds. Therefore, as a way of trying to meet the increasing demand for sources of meat protein, quail production was recently introduced in Zambia. Quail meat has a tasty, good flavour which is preferred by some consumers because it is different from other poultry meat (chicken) and consequently fetches a higher price.

A number of researches have been conducted locally (in Zambia) to try to come up with an appropriate standard feed ration that will suit the local conditions. Some areas have been investigated fully while others have not been dealt with adequately and this means missing information needed for establishment of nutrient requirements and formulation of appropriate feeds. Areas such as nutritional requirements of quails under local conditions are not adequately investigated since little work has been done here. Because of this quails are often raised on broiler feed ration and producers (farmers) are unable to get optimum performance from them, as confirmed by Mr. Chomba (personal communication, 2010) of Quail World.

The proposed protein levels by the Zambia Bureau of Standards (ZABS) are 27% starter and 20% grower, (not published, 2010). And the National Research Council (1994) recommends 24% crude protein at 2900kcal/kg ME for both starter and grower feed.

This research was undertaken in order to compare the different levels of protein and calorie/protein ratios reflected in these recommendations above so as to come up with an economical and efficient ration which would allow better performance of quails under the local conditions.

1.3 Problem statement

Quail production in Zambia is still in its infancy stage, and it is slowly gaining popularity among the producers (farmers). However, its progression is somehow faced with certain challenges like lack of adequate information on nutritional requirement under local conditions. Because of this some producers have resorted to use broiler feed to raise quails as there is no standard feed ration that suit the local conditions. Quails fed on broiler feed have low growth performance because they have different efficiency of use of feed and calorie utilization compared to chickens.

1.4 Justification

The research compared the recommended levels of crude protein and resultant calorie/protein ratios by the Zambia Bureau of Standard (ZABS) and National Research Council (NRC). Results can help in the establishment of appropriate standard feed ration which can allow good growth performance of quails under local conditions. This would mean positive contribution to the expansion or growth of poultry industry especially quail production. Eventually this would translate into improved livelihood of rural and urban people through improved nutrition and poverty alleviation. Further more, the economy of the country as a whole would be improved through the increased Gross Domestic Product (GDP).

1.5 Research objectives

1.5.1 Main objective

To determine the appropriate protein levels and calorie-protein ratios for the growing quail kept under local conditions.

1.5.2 Specific objectives

A) To determine the effect of different protein levels and calorie/protein ratios on weight gain.

B) To determine feed intake and efficiency in diets of different protein levels and calorie-protein ratios.

C) To determine the effect of diets with different protein levels and calorie/protein ratios on breast muscle and liver weights and liver fat contents of slaughtered birds.

1.5.3 Hypotheses

A) H°: The proposed protein levels by ZABS will have the same effect on the growth performance of quails as that of NRC.

$T1 = T2$

B) Ha: The proposed protein levels by ZABS will have a different effect on the growth performance of quails compared to that of NRC.

$T1 \neq T2$

CHAPTER TWO

2.0 LITERATURE REVIEW

The amount of protein and energy in poultry (quail) diets need a particular attention because of the major roles they play in influencing the growth performance of birds. It is also important to ensure that the two combine in the correct ratios in order for the birds not to suffer deficiency of either protein or energy. According to Shim and Lee (1984), proteins have diverse functions within the animal body. These include tissue maintenance, growth in lean tissue and feather development. They are also constituents of structural and protective tissues, such as; the muscles, the bones, ligaments of the skin and the internal organs (the brain, heart, lungs, intestines, liver, kidneys and others).

Due to differences in environmental conditions (such as ambient temperature and other factors) among countries many researches related to this study have been done in different parts of the world. Environmental conditions particularly temperature have considerable effect on feed intake and conversion efficiency of feed. This was confirmed by Cahaner and Leenstra (1992) who exposed broiler chicks to ambient temperature range from 20 to 33°c. From their study it was reported that body weight gain of broiler chicks was decreased when reared at 33°c compared to those reared at 20°c ambient temperature.

Japanese quails are less efficient as converters of feed to body tissue than the broiler (Shim and Vohra, 1984). Hence, quails cannot have good growth performance if fed on broiler feed which is low in crude protein.

Lee et al. (1977) evaluated protein requirements of Japanese quails in the growing period and reported better growth performance with levels of 24% to 32% crude protein.

Shim and Vohra (1984) recommended 24% in diets for growing Japanese quails, which could be lowered to 20% after three weeks of age.

Hyankova *et al*. (1997) reported that Japanese quails fed 26 and 21.6% crude protein had good performance from 1 to 21 and from 22 to 35 days of age, respectively.

In Pakistan a study was done on the effect of varying energy and protein levels on the performance of Japanese quails, by Altaf-ur-Rehman (1994) and it was found that there were non-significant differences among the treatments in everting influence on the weight gain, feed consumption, feed efficiency and muscle composition.

Another study was done in Brazil on protein requirement of Japanese quails during rearing and laying periods, by Santos et al (2003). In the study 23.08% and 21.95% crude protein levels were recommended for rearing (7 to 35 days) and laying (42 to 98 days) periods, respectively.

The Nation Research Council (1994) recommends 24% and 20% crude protein levels for rearing and production periods respectively.

Slagter and Waldroup (1990) observed that the change in the energy content of the diet will normally result in an inverse change in the total amount of feed consumed and will therefore influence the intake of essential nutrients.

Also Hunton (1995) found that nutrients intake can be influenced by different levels of energy in diet, therefore, deficiency of nutrients may occur in poultry by increasing the energy content in diet

Further more, according to De Freitas et al. (2005) quails regulate feed intake depending on the level of energy in the diet, hence, the need to have energy combing with other nutrients such as crude protein in the right ratios.

In a study by Kabichi (2009), where a calorie/protein ratio range of 123 to 131 at a crude protein level of 24% was investigated, a response to varying calorie/protein ratio was only observed in dressed weight percent and breast muscle weight percent. Both parameters gave higher weights at a calorie/protein ratio of 127.

CHAPTER THREE

3.0.MATERIAL AND METHODS

The experiment was conducted at the University of Zambia, field station. A pre-trial and two actual trials were done to investigate the effect of different protein levels and calorie/protein ratios in the diets. The pre-trial and first actual trial diets had 27% and 24% CP at 2900 kcal/kg ME with calorie-protein ratios of 107 and 121, respectively. The second trial diets had 24% and 20% CP at 2900 kcal/kg having different calorie-protein ratios of 121 and 145, respectively. The three trials covered the growing period of quails which is five weeks.

3.1 Pre-trial phase

This phase covered a period when the birds were day old up to the time when they were seven (7) days old. A total of 64 unsexed chicks which had just hatched were put into two groups randomly, and each group was given a feed under investigation. Each group was a mix of two strains, a strain known as the French type and the other known as the Japanese type, giving a total of 32 birds. Pre- trial phase was done as mixed strains in order to accommodate the birds during brooding better as facilities were limited.

The feed was spread on clean news papers to allow the chicks access it without much difficulty. Clean water was provided in drinkers (one for each group) during this period. To each group an ordinary 100 watts bulb was given as a source of heat. Also an electric heater was hung outside the brooding cage to supply extra heat to both groups.

3.2 Starter feed (first trial) and Grower feed (second trial)

The first trial was observed for 14 days during which period birds received a starter feed and the second trial was for 16 days when the birds were put on a grower feed. When the birds were 7 days old, they were distributed in a 2 X 2 Factorial laid as Completely Randomized Design (CRD). The 2 X 2 factorial was chosen in order to check the effect of strains. Each treatment (feed) had four replications and there were 6 birds in each experimental unit.

3.3 Cages and Bird management

Eighty (8) cages were used and each had the following measurements; 120cm length, 45cm width and 30cm height. The cages were placed in a well ventilated house and the birds were kept in these cages up to the end of the experiment. The cages were arranged in a tier form of three units i.e. one on top of the other. Each cage had a wooden tray in which the droppings were collected.

A cage had six (6) birds representing an experimental unit, also one plastic feeder and drinker were placed in each cage. Clean water was provided on a daily basis and general cleaning was done regularly. In addition, feed was given ad libitum to allow the birds eat enough for proper growth.

3.4 Diet used.

Maize No.3 meal and soybean meal contributed the larger portion of the feed. Maize was the major source of energy and soybean the protein. The other part was made of limestone, Dicalcium phosphate, Methionine, salt, cooking oil, fish meal and broiler premix (NuTec Red, Manufactured by NuTec, 234 Royston Road, Willowton, Pietermaritzburg, South Africa). Cooking oil was only added to Starter 2 and grower 1 feed, and fish meal was added only to Starter 1 feed. These variations in ingredient composition being necessitated by the need to balance the energy and protein levels as required. The full composition of diets is given in Table 3.1

Table 3.1: Percent composition of ingredients in the Rations.

Ingredients	**Starter 1 (27%CP)**	**Starter 2 (24%CP)**	**Grower 1 (24%CP)**	**Grower 2 (20%CP)**
Maize meal	47.84	47.80	47.80	60.34
Soybean	41.30	45.20	45.20	33.66
DCP	0.83	2.27	2.27	2.40
Limestone	0.58	1.21	1.21	1.76
Methionine	0.11	0.22	0.22	0.29
lysine				0.25
Fish meal	7.86			
Salt	0.48	0.3	0.3	0.30
Oil		2	2	
Mineral premix	0.5	0.5	0.5	0.5
Vitamin premix	0.5	0.5	0.5	0.5

Table 3.2: Calculated Composition of Rations

Component	**Starter 1 (27%CP)**	**Starter 2 (24%CP)**	**Grower 1 (24%CP)**	**Grower 2 (20%CP)**
ME (Kcal/kg)	2745	2782	2782	2787
Crude protein (%)	27	24	24	20
Lysine (%)	1.69	1.41	1.41	1.3
Methionine (%)	0.6	0.6	0.6	0.6
Calcium (%)	1.2	1.2	1.2	1.4
Phosphorus (%)	0.85	0.85	0.85	0.85
Calorie/protein ratios	**102**	**116**	**116**	**139**

3.5 Data Collection

3.5.1 Pre - Trial

Upon hatching, chicks were weighed in order to know their day-old weights which were of great help in checking whether there was a significant difference between the strains. After a period of 7days again the chicks were weighed so as to determine how much they had gained in their early life, prior to commencement of the first trial phase.

The amount of feed which was consumed during the pre-trial period was not collected because feed was spread on news papers thus making it difficult to account for feed spillages.

The weighing of feed intake and body weights of birds was done by using an electronic balance (ADAM QBW 3000, ADAM Industrial Scales and Balances).

3.5.2 First trial

On day one of the first trial, and after a period of seven days, body weights were determined. Then on the last day of the trial (day 21) birds were weighed again in order to have complete information necessary to understand their response to the feed which was given to them.

The amount of feed which was consumed during this trial was collected at the end of each week. Thus the collection was done twice, on the 14^{th} and 21^{st} days of the study period.

3.5.3 Second Trial

An electronic balance was used to get the body weights of birds under observation on 28^{th} day and 35^{th} the last day of the study.

Feed consumption for this trial was collected once on 28^{th} day of the study period. The feed intake for the second week of this trial was not collected due to some mortalities that had occurred, hence, making it difficult to measure the feed intake for the birds which had remained.

3.5.4 Breast muscle and Livers.

At the end of second trial two (2) birds from each experimental unit were slaughtered whose breast muscles and livers were weighed using an electronic balance.

3.5.5 Cost of producing each feed

The market prices of all ingredients which were used in formulating the feeds investigated were collected in order to assess the affordability of each feed under consideration.

3.5.6 Statistical Analysis

For the pre-trial period, a T-test was used to analyze differences in body weights of birds at the probability of 5%.

For the first actual observation period (first trial) data which was collected on body weight gain, feed intake and feed conversion ratios was subjected to the Analysis of Variance (ANOVA) at the probability of 5% using Gen stat software.

The T-test was used to analyze the body weights of birds in the Second trial. Then ANOVA was used to analyze the results of feed intake, feed conversion ratios, breast muscles, Livers and fats/oil extracted from Livers of birds slaughtered at the end of Second trial period.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 General health of birds

In the course of the study some mortalities were encountered. During the pre-trial and first trial (starter feed phase) period no mortality was recorded while in the second trial (grower feed phase) period about 8% mortality was recorded. This was basically due to an infection the birds had at some point during the experimental period. The infection was suspected to have occurred, though the actual cause was not investigated because of limitation in time and finance. However, during that time a drug Ampicillin 20% (W.S.P) (The Egyptian Co. 10^{th} of Ramadan City, Egypt) was introduced for about three (3) days. Its dosage was 1gram per 2 litres of drinking water. Within a short period of time the situation was under control as the birds gained their normal health very quickly. Generally the birds were free from any serious stress to affect the feed intake.

4.2 Pre-trial phase

The analysis of day-old body weights of chicks, showed a significant difference ($p \leq 0.05$) between the strains. The French strain had an average body weight of 9.61grams while the Japanese strain had an average body weight of 8.79 grams. This showed that there was a strain/type difference in body size at hatching. Because of this it was necessary to consider strain comparisons in trial phases and to group chicks by strain as experimental units.

However, mixed strains of equal proportions in each group showed no difference, birds in group one had body weight average of 9.44 grams while those in group two had an average body weight of 9.06 grams. This showed that strain variability was balanced in the two groups.

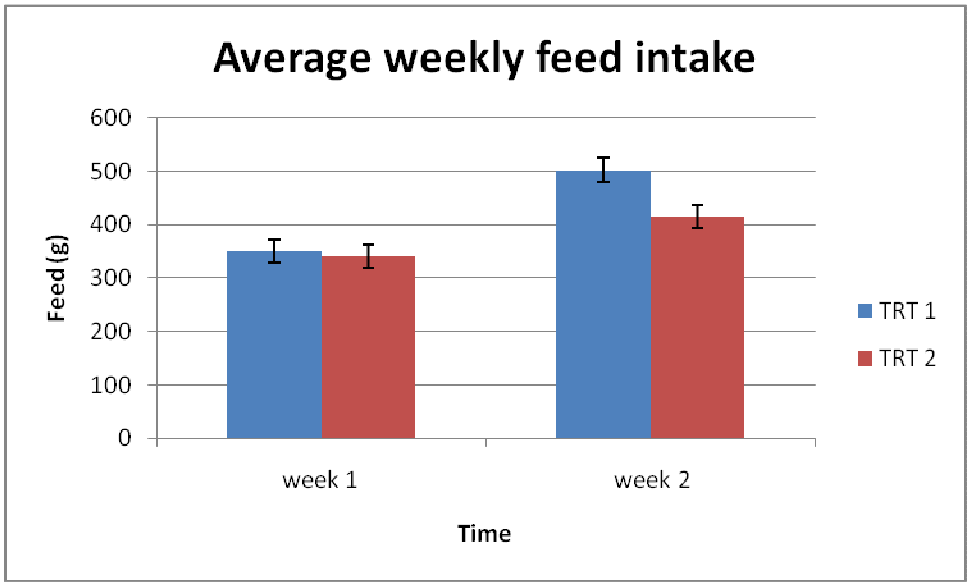
At the end of the first week, the body weights showed no significant difference between strains and starter diets. Hence, there were no dietary effects on body weights in early life.

4.3 First Trial (Starter phase)

4.3.1 Feed intake

The results of feed intake during the First Trial showed a significant difference ($p \leq 0.05$) between starter 1 (27% CP) and starter 2 (24%CP) as depicted in Graph 4.2 and ANOVA table in appendix 1a. This clearly showed that the two test feeds had different effects on birds in terms of feed consumption.

Figure 4.1. Average feed consumption during the First trial



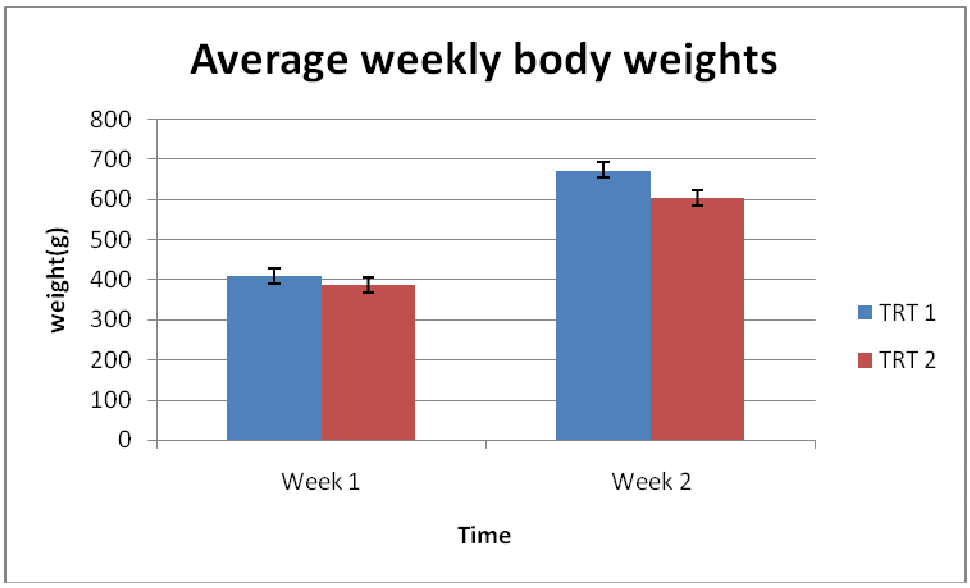
4.3.2. Body weights of birds

A significant difference ($p \leq 0.05$) was seen between starter 1 and starter 2 in terms of body weights during the First trial, as shown in Figure 4.2 and ANOVA table in appendix 2a.

Table 4.1. Average body weights (in grams) of birds during the first trial

	CP	Replications				Mean
Week 1	27%	71.7	70.8	65.5	65.5	68.4
	24%	66	62.8	64.7	65.3	64.7
Week 2	27%	115.3	117.5	108	108	112.2
	24%	96	101.8	96.8	108.2	100.7

Figure 4.2.Average body weights during the first trial.



4.3.3 Feed Conversion Ratios

The feed conversion ratios for the two weeks of the first trial are given in Table 4.1 and 4.2. The results showed no significant difference between treatment 1(27%CP) and treatment 2 (24%CP), as can be seen in ANOVA table in appendix 1b.

Table 4.2. Feed conversion ratios for the first week of first trial.

Replications	**Starter 1 (27%)**	**Starter 2 (24%)**
1	2.5:1	3.0:1
2	2.6:1	2.6:1
3	3.4:1	2.8:1
4	2.7:1	2.4:1
Mean	2.8:1	2.7:1

Table 4.3. Feed conversion ratios for the second week of first trial

Replication	**Starter 1 (27%)**	**Starter 2 (24%)**
1	1.9:1	2.1:1
2	1.8:1	1.7:1
3	1.9:1	2.1:1
4	2.0:1	1.9:1
Mean	1.9:1	1.95:1

4.3.4. Strain comparison during the first trial.

Average feed consumption, average body weights and feed conversion ratios with respect to strains were determined and the results are shown in Table 4.4. For starter 1 (27% CP), there was a significant difference ($p \leq 0.05$) between the strains in terms of body weights and feed conversion ratio. The feed consumption for starter 1 did not show a significant difference between French and Japanese stains, after subjecting the data to the Analysis of Variance.

Starter 2 (24% CP) did not show a significant difference between the strains with respect to amount of feed that was consumed, body weights and feed conversion ratio.

Table 4.4. Average feed intake, body weights and FCR for the strains.

Diet	Strains	Feed intake(g)	Body weights (g)	FCR
Starter 1 (27% CP)	French	128.2	174.6	1.2
	Japanese	122.8	162	2.3
Starter 2 (24% CP)	French	99	148.4	1.5
	Japanese	111	153.7	1.9

4.4. Second trial of the study

4.4.1. Feed consumption during the second trial.

The results of amount of feed which was consumed by the birds during the second trial are shown in Table 4.5. Analysis of Variance showed on the amount of feed which was consumed showed no significant difference, appendix 2b.

Table 4.5.Average feed consumption (in grams) for the second trial.

Diet	Replications			Mean
Grower 1 (24%)	133.33	102	125	120.1
Grower 2 (20%)	160	104	133.33	132.4

4.4.2. Body weights of birds

The T-test was used to analyze the results of body weights of birds during the Second trial, and the analysis showed no significant difference between Grower 1 (24%CP) and Grower 2 (20%CP). Average body weights were 134.9g and 125.89g for grower 1 and grower 2 respectively.

Table 4.6. Average body weights (in grams) during the second trial.

	CP	Replications				Mean
Week 1	24%	122.6	124	127.5	128.8	125.7
	20%	136.8	137	132	127.3	133.3
Week 2	24%	143	131	146	132	138
	20%	144.5	143	141	130	139.6

4.4.3. Feed conversion ratios.

Table 4.7 shows the feed conversion ratios of birds during the second trial, and ANOVA on this data showed no significant difference between grower 1 and grower 2, appendix 3a.

Table 4.7.Feed conversion ratios for the second trial

Diet	Replications			Mean
Grower 1 (24% CP)	4.32	5.09	3.62	4.3
Grower 2 (20% CP)	5.49	4.24	4.17	4.6

4.4.4 The breast muscles of slaughtered birds.

The average weights of breast muscles of birds which were slaughtered at the end of the second trial are given in Table 4.8. Analysis of Variance on the breast muscle weights showed no significant difference between grower1 (24%CP) and grower 2 (20%CP), appendix 3b.

Table 4.8. Average breast muscles (in grams) of slaughtered birds.

Diet	Replications			Mean
Grower 1(24% CP)	32	31.5	20.5	28
Grower 2 (20% CP)	41.5	30.5	24	32

4.4.5. Livers of slaughtered birds

The average Liver weights of slaughtered birds were determined and results are given in Table 4.9. The weights were subjected to ANOVA and showed no significant difference between the two treatments under consideration, appendix 4a.

Table 4.9. Average Liver weights (in grams) of birds slaughtered

Diet	Replications			Mean
Grower (24% CP)	3	4	4	3.7
Grower (20% CP)	3	3.5	2.5	3.0

4.4.6 Extracted fat from Livers of slaughtered birds.

The results of extracted fat from livers of birds which were slaughtered at the end of Second trial showed no significant difference between treatments, the averages for grower 1 and grower 2 were 0.454g and 0.503g respectively. The ANOVA table is shown in appendix 4b

4.5. Cost of producing each feed.

The market prices of ingredients which were used in formulating the feeds that were investigated are shown in Table 4.9. The total of K48,105.00 is required to make 18kg of Starter 1 (27% CP), and the cost of making 18kg of Starter 2 (24% CP) is K43,518.00.

Also to make a 12 kg feed of Grower 1 (24%) a total of K36,500.00 is required, while to produce 12 kg of Grower 2 (20%) K30,900 is needed.

Further more, total cost required to formulate feeds (18kg,starter and 12kg,grower) based on protein levels recommended by ZABS is K 79,005.00. While the cost to make feeds of quantities mentioned above based on protein levels recommended by NRC is K 80,018.00. Hence, from this it can be seen that there is no much difference between ZABS and NRC recommendations in terms of how it cost to formulate a particular feed.

Table 4.10: Market price for each ingredient used in feed formulation.

Ingredients	**Quantity**	**Price (ZMK)**
Maize	50kg	65,000.00
Soya bean solvent extract	50kg	117,780.00
Lysine	1kg	16500.00
DL-Methionine	1kg	31980.00
Limestone	50kg	13600.00
DCP	25kg	109,610.00
Broiler premix	3.3kg	71,540.00
Fish meal	5kg	49500.00
Cooking oil	750ml	15000.00
Salt	2kg	5000.00
Total 3.3		**490,510.00**

CHAPTER FIVE

5.0 CONCLUSIONS

In the First trial there was a significant difference ($P \leq 0.05$) in terms of feed intake and body weights between Starter 1 (27%) and Starter 2 (24%).

During the first trial the analysis of body weights and feed conversion ratio for starter 1 (27% CP) showed a significant difference between French and Japanese strain.

In the second trial no significant difference was observed between grower 1 (24% CP) and grower 2 (20% CP) for feed intake, body weights and feed conversion ratios.

Further more, the analysis of breast muscle, Livers and fat extracted from Liver samples did not show a significant difference between the two treatments.

Hence, the ZABS recommendations gave good growth performance of birds in the first trial than the recommendations of NRC. In the second trial there was no significant difference between the ZABS and NRC recommendations.

Appendix 1a

Analysis of Variance: Feed intake in the First Trial

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Trt	1	9457.6	9457.6	12.04	0.005
Time	1	50737.6	50737.6	64.60	<.001
Trt.Time	1	6123.1	6123.1	7.80	0.016
Residual	12	9424.8	785.4		
Total	15	75742.9			

Coefficients of Variation (CV) = 7.0%

Appendix 1b

Analysis of Variance: Feed conversion Ratios during the First Trial

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Trt	1	0.00250	0.00250	0.04	0.852
Time	1	2.72250	2.72250	39.36	<.001
Trt.Time	1	0.02250	0.02250	0.33	0.579
Residual	12	0.83000	0.06917		
Total	15	3.57750			

Coefficients of Variation = 11.3%

Appendix 2a

Analysis of Variance: The body weights of birds during the First Trial

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Trt	1	8281.0	8281.0	13.38	0.003
Time	1	229441.0	229441.0	370.81	<.001
Trt.Time	1	2209.0	2209.0	3.57	0.083
Residual	12	7425.0	618.8		
Total	15	247356.			

Coefficients of Variation = 4.8%

Appendix 2b

Analysis of Variation: Feed intake for Second Trial

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Trt	1	491.4	491.4	1.00	0.337
Time	1	2208.8	2208.8	4.50	0.055
Trt.Time	1	880.2	880.2	1.79	0.205
Residual	12	5890.6	490.9		
Total	15	9470.9			

Coefficients of Variation = 17.8%

Appendix 3a

Analysis of Variation: Feed Conversion Ratios for the Second Trial

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Trt	1	0.4389	0.4389	0.68	0.425
Time	1	2.7806	2.7806	4.33	0.060
Trt.Time	1	0.0176	0.0176	0.03	0.871
Residual	12	7.7143	0.6429		
Total	15	10.9513			

Coefficients of Variations = 15.2%

Appendix 3b

ANOVA: Breast muscles of slaughtered birds at the end of Second Trial.

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Trt	1	24.00	24.00	0.59	0.523
Rep	1	136.69	136.69	3.35	0.209
Trt.Rep	1	22.69	22.69	0.56	0.534
Residual	2	81.62	40.81		
Total	5	265.00			

Coefficients of Variation = 21.3%

Appendix 4a

ANOVA: Livers of slaughtered birds at the end of Second Trial

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Trt	1	0.6667	0.6667	2.67	0.244
Rep	1	0.3333	0.3333	1.33	0.368
Trt.Rep	1	0.3333	0.3333	1.33	0.368
Residual	2	0.5000	0.2500		
Total	5	1.8333			

Coefficients of Variation = 15.0%

Appendix 4b

ANOVA: For oil/fats extracted from livers of slaughtered birds at the end of Second Trial

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Rep	1	0.013954	0.013954	3.51	0.202
Trt	1	0.001261	0.001261	0.32	0.630
Rep.Trt	1	0.000807	0.000807	0.20	0.696
Residual	2	0.007950	0.003975		
Total	5	0.023972			

Coefficients of Variation = 13.4%

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