THE EFFECTS OF FEEDING VARYING LEVELS OF DIATOMACEOUS EARTH ON THE PERFORMANCE OF BROILERS

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THE UNIVERSITY OF ZAMBIA

SCHOOL OF AGRICULTURAL SCIENCES
DEPARTMENT OF ANIMAL SCIENCE

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A RESEARCH REPORT SUBMITTED TO THE SCHOOL OF AGRICULTURAL SCIENCES OF THE UNIVERSITY OF ZAMBIA IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE DEGREE OF BACHELOR OF AGRICULTURAL SCIENCES

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DECLARATION

This thesis has been compiled by myself and has not been accepted in any previous application for a degree. The results shown herein are a true reflection of what was obtained from the study and all sources of information have been acknowledged by means of reference.

RAMANS KAYUMU

MARCH, 2008

ACKNOWLEDGEMENTS

My profound gratitude goes to Ministry of Agriculture and Co-operatives for sponsoring me to study at the University of Zambia. I feel indebted to the supervisors Dr. J.C.N. Lungu and Mr K.M. Walubita for their advice, help and support during the research. I also owe many thanks to all staff of the Department of Animal Science, Mr Namushi Sinjawe and the rest of production unit staff whose assistance in various ways will not be forgotten. Thanks are due to Mrs Mkandawire who typed this thesis. May all honour and glory be to God!

DEDICATION

To my Father, Mother, my wife and children for their sincere heartfelt love and to all livestock farmers for their relentless efforts in contributing to food production in Zambia.

ABSTRACT

The broiler industry is rising in Zambia and smallholder farmers are participating in back- yard gardens. Feed is the highest cost in broiler production. The Diatomaceous Earth (DE) is a naturally occurring inert material, which has proved to have various effects including improving growth rate of animals. A study to determine the effects of adding varying levels of DE to feed on performance of broilers was conducted for period of seven (7) weeks at the University of Zambia, School of Agricultural Sciences field station.

In the study research, using the completely randomized design with six (6) treatments and four(4) replicates a total of 240 day –old Ross chicks non sexed were used. The birds were fed Broiler Starter Mash from National Milling Company Limited for four weeks and Broiler Finisher for three weeks. The feed was supplemented with DE levels of 0% , 1%, 2%, 3%, 4% and 5% which was mixed with feed.

Data on feed consumption, body weights and feed conversion ratio was collected and statistically analyzed. The data obtained revealed that there were no significant ($p<0.05$) differences in feed consumption, body weight and feed conversion ratio between all the treatments. The analysis of the Cost Benefit Ratio (CBR) revealed that more profit can be realized at 0% DE when birds are sold at same price regardless of weight .However if birds are sold on weight basis, the 2% DE inclusion is more profitable. The results on the organoleptic test indicated that DE inclusion in the diet has no effect on eating quality of broiler meat. It is, therefore, concluded that DE can be economically included at 2% on broiler ration.

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ACRONYMS

ANOVA	: Analysis of Variance
CP	: Crude Protein
CBR	: Cost Benefit Ratio
CV%	: Coefficient of Variation
DE	: Diatomaceous Earth
FCR	: Food Conversion Ratio
g	: Grams
Kg	: Kilograms
PDTP	: Participatory Development Training Programme
SSA	: Sub-Saharan Africa
CRD	: Completely Randomized Design
ME	: Metabolizable Energy
WHO	: World Health Organization

CHAPTER ONE

1.0 INTRODUCTION

1.1 General

Diatomite or "Diatomaceous Earth" is composed of external skeletons of microscopic aquatic plants that died and settled at the bottom of seas, oceans, rivers or lakes millions of years ago. DE has a number of uses in agriculture which include: protecting stored grain, pest control, deodorization and as a source of minerals. The DE can also be used as a natural feed additives in ruminant and non ruminants.

1.2 Sources of Feed Additives

Feed additives are either of natural source or synthetic source. Natural feed additives are of natural origin without chemical treatment where as synthetic or artificial feed additives are those that undergo chemical changes. DE is a natural feed additive that has been used for over 50 years (Sinywibulula, 2005).

1.3 Roles of Feed Additives to Animal Production

Feed additives are products used in animal nutrition for purpose of improving quality of the feed; improve performance and health of animals (Fefana, 2006).

High cost in production of poultry is attributed to the high cost of feed. The use of feed additives to increase feed quality can result into more efficient use of feed resulting in efficient poultry production. DE could play that role in poultry production. Livestock production plays a significant role in the economics of Sub-Saharan Africa (SSA) countries including Zambia. It contributes about 25%

to the Agricultural domestic products (PDTP, 2001). The improvement in livestock industry will result in creation of employment opportunities, increased income and provision of high quality protein food.

1.4 Statement of The Problem/Problem Statements

Feed forms the major expense in poultry production and accounts for over two third of the cost of production. The cost of broiler production is currently very high (Farmers Gazette, 2006)

1.5 Justification

Agriculture is the second industry after mining industry and the Policy of Zambian Government is to diversify the economy. Poultry enterprise is part of several agricultural enterprises that are being promoted (Zambia Review, 2007).

Due to ever increasing Zambian population, demands for protein will continue to rise. Chicken meat and eggs provide proteins of higher biological value than red meat (Norman, 1973). Chicken meat and eggs can help to reduce nutritional problems among Zambian citizens.

Diatomaceous Earth is being imported and also being mined locally in Western Province and is promoted as a feed additive but Zambians do not have adequate information or data on the effects of DE in poultry production.

1.6 Research Objectives

1.6.1 Main objective

The main objective was to determine the effects of the inclusion of Diatomaceous Earth on the performance of broiler chickens.

1.6.2 Specific Objectives

a) To determine effects of varying levels of DE inclusion on growth rate and feed intake on broiler chickens. b) To determine Food Conversion Ratio (FCR) of using varying levels of DE. c) To determine Cost Benefit Ratio (CBR) of using DE.

1.6.3 Hypothesis of the Study

HO:

There is no difference in growth rate in broiler chicken when DE is included in the diet.

CHPATER TWO

2.0 LITERATURE REVIEW

Origin

Diatomite or "Diatomaceous Earth" is a light coloured, light weighted, friable sedimentary rock composed of the siliceous shells or fossil of external skeleton of microscopic aquatic plants called diatoms (Bates, 1969, Pough, 1960). Sinywibulula, 2005 reported that these plants have been part of this earth's ecology since prehistoric times. Diatoms are the hay of oceans and lakes : the staple of water grazers (Anon, 2007).

Diatoms

Diatoms are called floating aquatic organisms with minute specks of protoplasm. They are common in fresh, brackish and marine waters where they serve as staple food for most water organisms. They belong to a division of algae but differ from other algae because they are able to concentrate silica from surrounding water in their cell walls (Bates, 1969).

When diatoms die, the shells pile up on the bottom of the sea to form a thick bed of sediments. The cell walls are composed of soluble silica (sand). It has been estimated that 1 cubic centimeter of this sediment may contain as much as many as 24,000 shells (or 400,000 cubic inch). The sediments called Diatomite or DE, are then mined from under water sources or from ancient dried lake bottoms (Bates, 1969, Oriana, 2006).

Classification of Diatoms

Classification of diatoms in general and species is based on the structure and ornamentation of the test. There are several species of diatoms. Some species with bilateral symmetry look like boats, feathers, ladders and needles. Others have radial symmetry, and resemble wheels, discs and golf balls. Electro-micro-graphs reveal beautiful ornamentation and highly complex surface details – ridges, spines, holes and dimples down to dimension of less than 1 micron. The variation in shape and detail is of economic as well as biological importance. It gives diatomite two (2) of its most important valuable properties, extremely large surface area and close packing resulting in high porosity (Watson, 1983).

Processing of Diatomaceous

Once DE is mined it is milled or processed in many ways. Some of it is heated to a very high temperature (about $1{,}000^0$ c or 1800^0 f).Processed Diatomite range from yellowish tan to brown, but commonly it is so light in colour that quarry faces appear brilliant white (Bates, 1969, Oriana, 2005).

Chemical Composition of DE

The chemical compositions of DE are the following: $S_i\ O_2$ (85-92%), A1 2 O_3 (4-10%), $Fe_2\ O_3$ (0.8-2.0%), CaO (0.1-2.0%), MgO (0.1-2.0%), Alkalies (0.2-1.5%). Organic matter (0-3%) (Bates, 1969, Oriana, 2005).

Uses of DE

Diatomaceous Earth is a multi-purpose product that has been used for at least 50 years. (Sinywibulula, 2005). DE is used as an additive to livestock feeds where it has been reported to improve ruminant and non ruminant production levels. The most common use (68%) of Diatomaceous Earth is as a filter medium, especially for swimming pools, it

is used in chemistry, as a filtration aid, and also to filter water, particularly in the drinking water treatment process, and other liquids such as beer. It can also filter syrups and sugar (Anon, 2007).

Diatomaceous Earth is used as an anti-caking agent, for protecting stored grains, parasite control, deodoration, absorption, insect control, source of minerals, used as filler, used in paints, cosmetics, drugs, chemicals. It is used in livestock to decrease mortality, increased milk production and decrease mastitis in cattle (Oriana, 2005).

Safety of Diatomaceous Earth

The World Health Organization (WHO) cautions that DE with a crystalline silica content of three (3) % or higher is dangerous to human (and probably pets and birds as well (Higgins, 1996).

But the kind of DE used in animal feed is referred to as natural DE; it has not been calcined or altered in any other chemical way. Natural DE is classified as amorphous silica, it has less than 1% Crystalline Silica (Oriana, 2005). Higgins (1996) reported that DE that is needed for use in food storage has been heat treated and has a crystalline silica content of no more than 1-1.5%. DE is said to be completely safe because it has no toxins and, there is no need for withdrawal period when used in animals. Parasites and insects cannot develop resistance to DE.

Mode of Action and Benefits

Diatomite binds toxins thereby reducing intestinal absorption and increasing faecal excretion of toxins. Diatomite prevents 'clumping' of feed particles. This increases surface area of the feed exposed to digestive process and thus causes more feed to be digested and utilized, more water from ingest is absorbed slowing down the feed passage enhancing digestion and allowing maximum nutrient and essential mineral absorption for body development. Internal parasite (adult or eggs) are controlled by diatomite either by

mechanical means or by its enhancement of the animal parasitic defense system. In insect control the most widely accepted explanation for the action of DE is that DE absorbs or removes the bi-lipid layers (which consist of hydrocarbons, wax esters and other organic chemical compounds) of insects outer surface and this causes excessive water loss through the cuticle of the insect and ultimately death by desiccation (dehydration) within 6 to 72 hours.

CHAPTER THREE

3.0 MATERIAL AND METHODS

3.1 Description of the Study Area

The study was carried out at the University of Zambia Field Station poultry unit. The University of Zambia is located 6.5km from the Lusaka Town centre. Lusaka is situated in Southern part of the country, approximately 100 kilometers from the border with Zimbabwe and 1,300 meters above sea levels. Lusaka the capital city of Zambia has estimated population of some three (3) million people (Zambia Review, 2006)

3.2 Materials

3.2.1 Birds

A total of two hundred and forty (240) non sexed Ross broiler chicks were purchased from Collan Poultry (Lusaka) were used in this research.

3.2.2 Housing

The birds were reared in one pen subdivided into cubicles with dimension of $1m^2$ to accommodate 10 chicks. The birds were reared under a deep litter system with bedding consisting of wood shavings. Prior to arrival of the chicks the pen was thoroughly disinfected and light up with infra – red lamps. One lamp was used to provide heat for ten (10) birds placed in different blocks. The source of heat was removed at the end of week three. A conical drinker and a tubular feeder were placed in each cubicle and were utilized until the end of the rearing period for this experiment.

3.2.3 Ration (Nutrient Content of the experimental diet)

All birds were reared on a commercial Broiler starter mash with nutrients and ration composition as shown in table 1 and 2 below.

Table 1: Broiler Starter feed Composition

Protein(min)	22%
Calcium	1.0-1.2
Phosphorus (min)	0.7
Fibre (max)	5.0
Fat (max)	5.0

This feed comes enriched with amino acids, vitamins, trace elements and coccidiostat as per requirement (National Milling Corporation Limited, 2007). In this ration different percentage (%) of DE was added.

Table 2: Broiler Finisher Ration

INGREDIENTS	**Qty (kG)**
Maize Meal	66
Soya bean meal	30
DCP	2.3
Limestone	1.2
Lysine	0.240
Methionine	0.190
Broiler Premix	0.3
Salt	0.3
TOTAL	**100.00**

NOTE: To each 50 Kg of starter and broiler feed, different level of DE was included: 1%, 2%, 3%, 4%and 5 %. O% DE was used as a control in the finisher ration as well.

3.2.4 Design and Treatment

Design

- Complete Randomized Design (CRD) was used in this experiment.

Treatments

Five (5) treatments were used/utilized in this experiment as shown below. Treatment 1 consisted of forty (40) birds fed ad – libitum from day old to seven (7) weeks of age, using ration with 0% DE, Treatment 2, ration with 1% DE, Treatment 3, ration with 2% DE, Treatment 4 with 3% DE, Treatment 5 with 4% DE incorporation and Treatment 6, ration with 5% DE inclusion. Each treatment was replicated four (4) times and each pen had ten (10) birds which were allocated randomly.

3.2.5 BIRDS AND MANAGEMENT

Feeding

Two (2) phase feeding system regime was used. Broiler starter mash from National Milling Company Limited was given to broilers for four (4) followed by Broiler finisher for another 3 weeks.

Vaccination Programme

Table 3:

DATE	AGE	VACCINE	APPLICATION METHOD	DISEASE
	Day old	Newcastle Hitcher B1	Ocular/Nasal	Newcastle
24/10/2007	7 days	Tad Gumboro	Drinking water	Gumboro
26/10/2007	9 days	NDC Lasota	Drinking water	Newcastle
01/11/2007	15 days	Tad Gumboro	Drinking water	Gumboro
04/11/2007	18 days	NCD Lasota	Drinking water	Newcastle

NB: Newcastle Hitcher B1 was given at the hatchery.

Water supply

Fresh and clean water was always available to the birds. This was made possible by refilling drinkers one (1) or two (2) times a day.

Feeding

During the first two (2) to three (3) days of the bird life, feed was provided using the newspaper. Birds were fed ad- libitum for seven (7) weeks.

Disease Control

Three weeks before arrival of chicks the experimental house was washed, disinfected and allowed to dry. This was done to prevent disease carry over. In addition foot bath with disinfectant was replenished continuously to prevent disease transfer. Bio-security precaution was also observed.

3.4.0 DATA COLLECTION METHODS

3.4.1 Body Weight

Chicks were weighed on the day of arrival. Then the weighing of all broilers was done on a weekly basis up to the end of the experiment at seven (7) weeks. Also forty eight (48) sample broiler chickens were weighed individually.

3.4.2 Feed Consumption Data

Feed consumed was determined weekly. Weekly feed consumption was obtained as the total of feed additions during the week, minus the quantity of

feed remaining unconsumed at the end of the week. The average values for each replicate were then averaged.

3.4.3 Mortality

All pens were inspected for mortality on daily basis.

3.4.4 Flies Incidences/Prevalence

Observations were made on daily basis to determine the presence/prevalence of flies in various compartments.

3.4.5 Cost Benefit Analysis

The input used to raise bird without DE 0%: Treatment 1 (control) and input used to raise birds with 2% DE: Treatment 3 was calculated.

3.4.6 Liver and Gizzard weight of 48 samples

The sampled forty eight (48) broiler chicken had their body weight, liver weight and gizzard weight taken.

3.4.7 Organoleptic Taste of Sample

The six (6) randomly selected samples one from each treatment were tested for the following: Aroma, Colour, Juiciness, Texture and Taste by use of structured questionnaire (Appendix A) which was given to the panelist.

3.5.0 DATA ANALYSIS

The data on weekly feed consumption and weekly body weight were subjected to analysis of variance (ANOVA) using GEN-STAT version 2003. Significant differences in mean among treatment were done by use of least significant difference. Microsoft excel was used for plotting of bar graph and line graph for mortality, average feed consumption per week, average body weight, feed conversion ratio, and also organoleptic graph. Cost benefit analysis was calculated on both same price basis and also on weight basis.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1.0 MORTALITY AND DISEASES

4.1.1 Mortality

Twelve (12) chicks died throughout the seven (7) weeks (Table 4). Five (5) of these chicks died in the first week. Two (2) from 0% DE, one (1) from 1% DE , one (1) from 2%DE and one (1) from 4% DE . The other chicks died as below: One (1) from week 4 from 5% DE , one in week 5 from 1% DE , week 6 one (1) from treatment for 3% DE , four (4) in week 7, one from 3% DE , one from 0% DE and one (1) from 2% DE and one (1) with 4% DE. The post mortem results from a bird which died on 25th November revealed that the bird died due to disease condition suspected: retained yolk. Sac leading to peritonitis and intestinal obstruction.

Table 4: Bird Mortality

Number of chicks' dead/Treatment

		DE TREATMENT					
WEEK	**0%**	**1%**	**2%**	**3%**	**4%**	**5%**	**TOTAL**
1	2	1	1		1		5
2							
3							
4						1	1
5		1					1
6				1			1
7	1		1	1	1		5
TOTAL MORTALITY	3	2	2	2	2	1	12

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1	2	1	1		1		5
2							
3							
4						1	1
5		1					1
6				1			1
7	1		1	1	1		5
TOTAL MORTALITY	3	2	2	2	2	1	12

These five (5) mortality in the first week were not DE related because they happened in four treatments except in treatment 4. The most probable cause of these mortalities could be temperature fluctuation. The other seven (7) mortality that happened after first week were highest in 0% DE. These Results agree with previous finding where use of D.E decrease mortality (http:// fresh water organics.com /testimonials 2.htm). The 5% mortality was within acceptable range.

4.1.2 Diseases

Among the chicks that died, one (1) of them had retained yolk sac which is caused by hatchery problems. This peritonitis is called adhesive peritonitis that which is characterized by adhesions between adjacent serous surfaces (Arey,et,al 1963).The other chick had Encephalomalancia (Crazy chicken disease) which occur due to deficiencies in vitamin E. This bird was from O% DE. Encephalomalancia occurred because of vitamin E instability under tropical conditions and it's oxidative destruction is enhanced by minerals and unsaturated fatty acid (Seneviratna, 1969, Ensminger and Olentine, 1978).

4.1.3 FEED CONSUMPTION (AVERAGE WEEKLY PER TREATMENT)

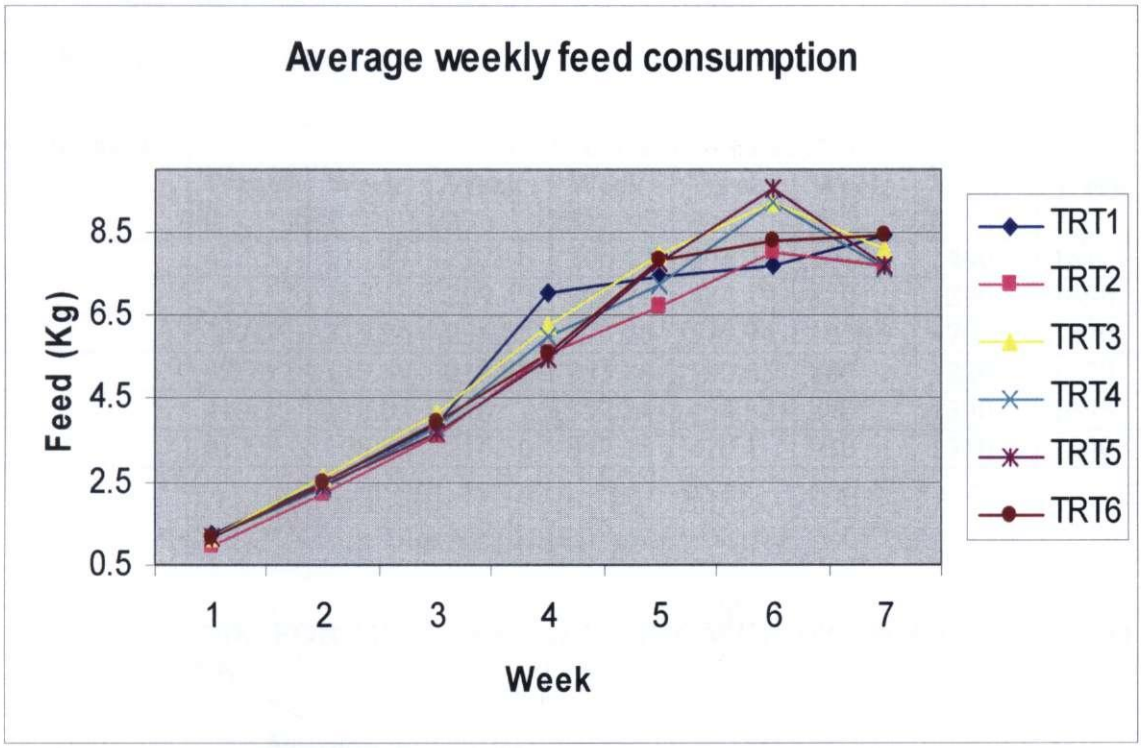
Table 5 and figure 1 shows feed consumption of the various treatments over a 7 week period.

Table 5:

TREAMENT %	AVERAGE FEED CONSUMPTION/TREATMENT IN GRAMS						
	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7
0	1210	2460	3840	7030	7410	7720	8420
1	970	2210	3590	5600	6710	8035	7710
2	1180	2590	4120	6220	7950	9210	8060
3	1190	2380	3790	5950	7220	9210	7600
4	1190	2390	3670	5450	7730	9525	7700
5	1170	2490	3390	5550	7820	8263	8430

Feed consumption during the seven week period was highest in 5% DE (8430g) seconded by 0% DE (8420g) and it was lowest in 3% DE (7600g). There was a reduction in feed consumption post 6 weeks except for broilers without DE supplementation.

FIGURE 1: TRENDS FOR MEAN WEEKLY FEED CONSUMPTION



Smith and Baranowskish, 1979 reported that the decreased food at high ambient temperature may be caused by a direct effect on various regions in the brain in the food intake control mechanism of the bird. It was not clear why broilers that were not supplemented with DE did not have reduced feed consumption in the last week. It is possible that DE had a depressing effect on feed consumption in the seventh (7^{th}) week.

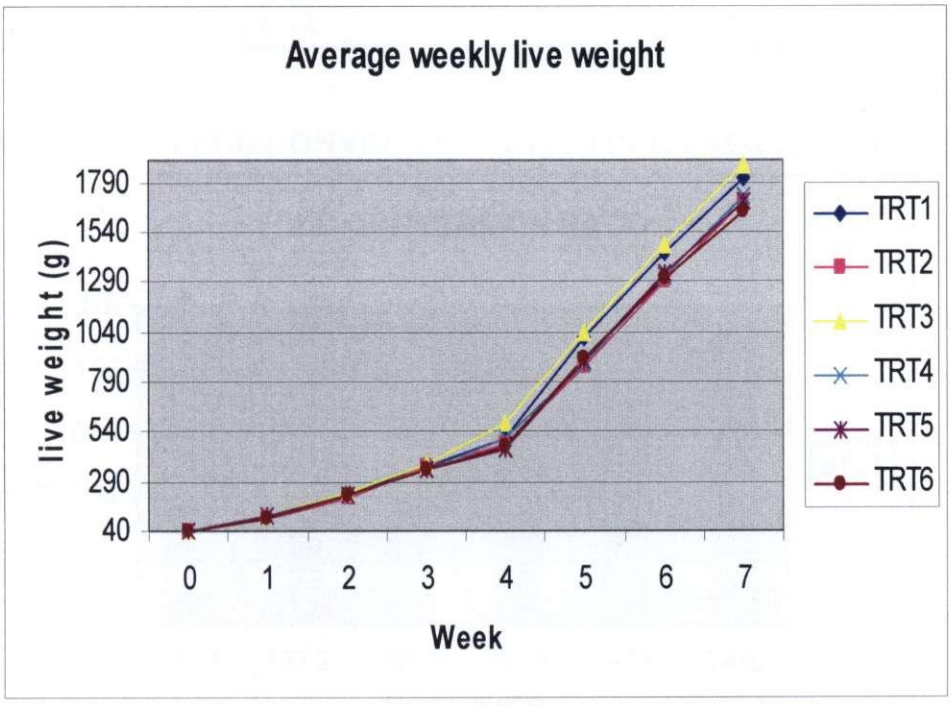
4.1.4 BODY WEIGHT CHANGES (AVERAGE WEEKLY WEIGHT IN GRAMS)

Table 6 and figure 2 shows average body weight of broiler groups during the 7 weeks. The 2% DE had the heaviest birds at seven (7) weeks (1870g) and the least was birds supplemented by 5% DE (1640g).

Table 6:

Treatment %	AVERAGE WEIGHT/WEEK IN GRAMS							
	Week 0	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7
0	42.35	113.21	227.56	366.67	502.44	1010	1440	1810
1	42.13	105.16	209.49	366.71	484.19	870	1290	1690
2	43.65	115.26	236.05	373.26	579.74	1030	470	1870
3	42.73	113.59	218.87	353.88	502.63	880	1220	1720
4	41.83	112.05	216	352.24	454.32	890	1330	1695
5	41.55	108.88	216.50	347.15	470.1	910	1310	1640

FIGURE 2 TRENDS FOR MEAN WEEKLY LIVE WEIGHT FROM WEEK1 TO WEEK 7



The body weight at seven (7) weeks was lower than expected which should have been an average of over 2kg. The low body weight gain could be attributed to genetic. The other reason may be because they were the first batch from the parent broilers. Also other factors could be attributed to use of broiler mash. Olsen and Slinger (1968) reported improved protein digestibility with pelleting. Pattern et al (1937) reported that broiler chicks fed on pelleted rations gained more weight and consumed less feed than chicks fed on mash. These results also agree with the report by Jansen et al (1962) who observed that birds fed diets in mash form spent time feeding than those given pellets and suggested that chicks utilized pellets more efficiently than mash because they spend less energy consuming the feed (http:// fresh water organics.com /testimonials).

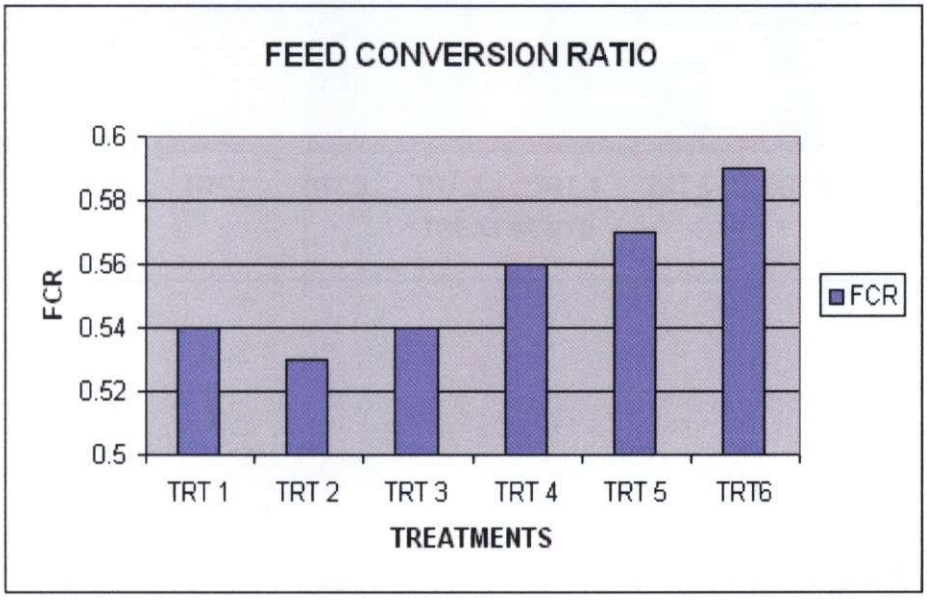
4.1.5. FEED CONVERSION RATIO (FCR)

Table 7 and figure 3 show the feed conversion ratio which is the amount of feed consumed per kg weight. The results show that the increase in DE inclusion causes increase in feed conversion ration. The birds use more feed to produce a kg of body weight as you increase DE%. However feed conversion ratio in the control was the same as in 2% DE.

Table 7

TRT 1	TRT 2	TRT 3	TRT 4	TRT 5	TRT 6
0.54	0.53	0.54	0.56	0.57	0.59

FIGURE 3: FEED CONVERSION RATIO PER TREATMENT



Results indicate increase in FCR as DE inclusion increased.

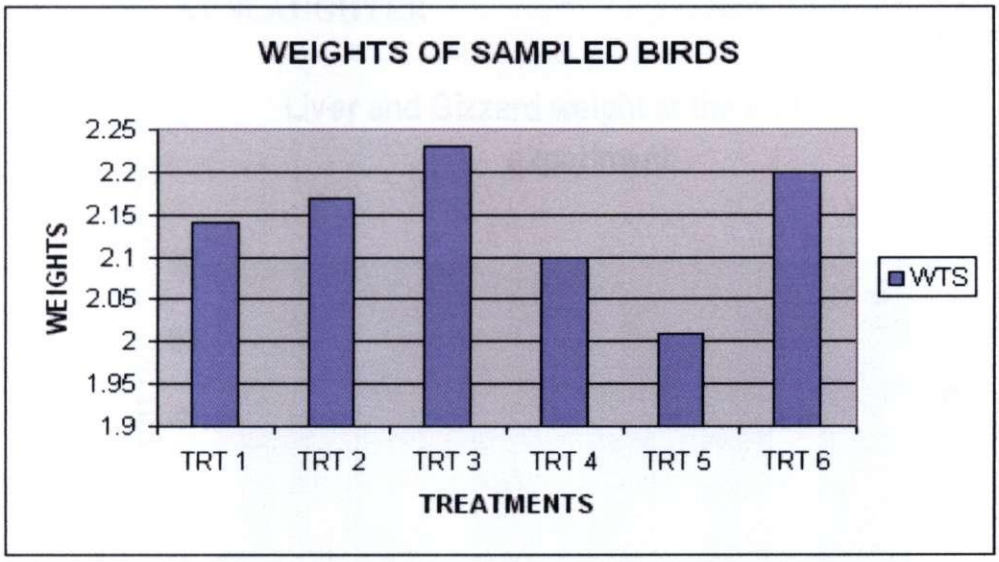
4.1.6 WEIGHT OF 48 SAMPLED CHICKEN IN (KG) AT END OF 7 WEEKS

Table 8 and Figure 4 shows weight of 48 sampled birds. Birds supplemented with 2% DE had the highest weight at seven weeks 2.23kg.

Table 8

		TRT 1 0 %	TRT 2 1%	TRT 3 2%	TRT 4 3%	TRT 5 4%	TRT 6 5%
B1	1	2.315	2.205	2.245	2.100	1.980	1.945
	2	2.055	1.930	2.425	1.900	2.320	2.065
B2	3	2.190	2.125	2.360	2.000	1.920	2.450
	4	2.360	2.355	2.100	1.999	2.100	2.240
B3	5	1.935	2.105	1.690	2.110	2.010	2.315
	6	2.230	2.250	2.380	2.260	1.860	2.070
B4	7	2.085	2.200	2.280	2.105	2.200	2.205
	8	1.920	2.210	2.365	2.300	1.670	2.295
		AV = 2.14	AV = 2.17	AV = 2.23	AV = 2.10	AV = 2.01	AV = 2.20
		SD = 0.16	SD = 0.12	SD = 0.24	SD = 0.13	SD = 0.20	SD = 0.16

FIGURE 4: AVERAGE WEIGHT FOR SAMPLED BIRDS PER TREATMENT



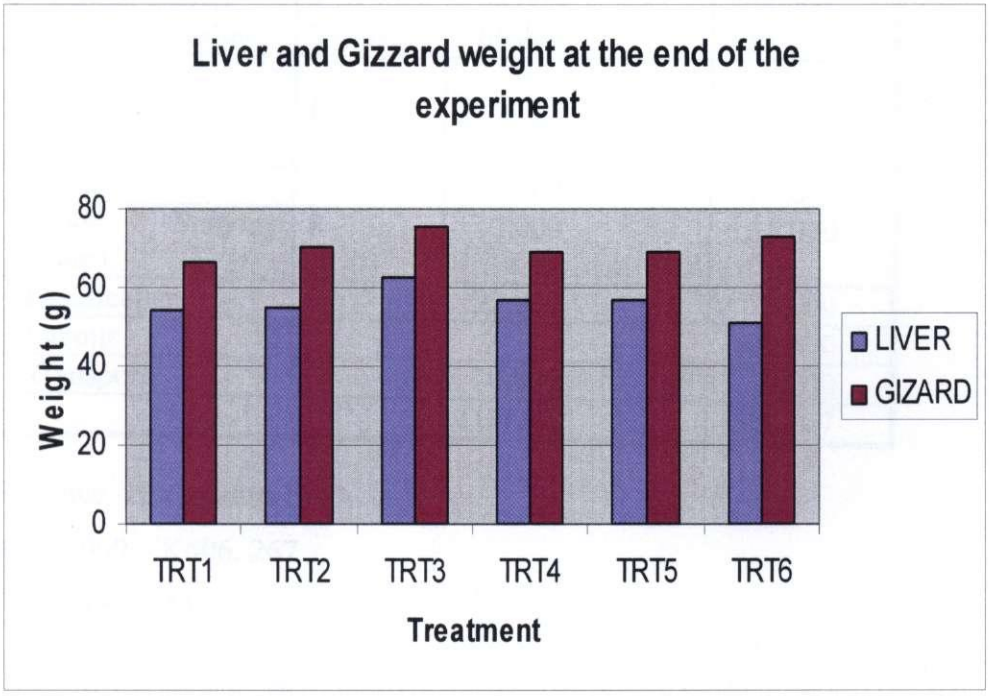
4.1.7 AVERAGE LIVER/GIZZARD WEIGHT AT SLAUGHTER IN GRAMS

Table 9 and Figure 5 shows the liver and gizzard weights at slaughter in the various treatments. The 2% DE had the heaviest Liver (62.3g) and Gizzard (75.6g) and the least Liver at 5% DE (51.2g) and Gizzard 0% DE (66.5g). The heavy liver and gizzard in 2% DE could be related to high weight of the birds in this treatment.

Table 9

TREATMENT DE %	LIVER (g)	GIZZARD (g)
0	53.9	66.5
1	54.6	70.4
2	62.3	75.6
3	57	68.9
4	57	69
5	51.2	73.1

FIGURE 5: LIVER AND GIZZARD WEIGHTS FOR SAMPLED BIRDS AT SLAUGHTER



4.1.8: ORGANOLEPTIC TASTE (EATING QUALITY)

The results show that DE inclusion has no effects on eating quality. This is shown in the appendices 3,4,5,6 and 7. DE inclusion has no detrimental effect on eating quality of the meat.

4.1.9 (a) COST BENEFIT RATIO (CBR): SAME PRICE BASIS

Table 10 shows the cost of producing 40 broilers without DE supplementation while Table 11 shows the cost of producing 40 broilers supplemented with 2% DE. It costs K606,261 to produce 40 broilers without DE supplementation and K641,267 to produce 40 broilers with 2% DE supplementation. If the broilers are sold on a unit basis, that is K20,000 per broiler, the profit margin is higher (193,733) when DE is not added compared to K158,733 profit when 2% DE is added. It is not profitable to sell on a unit basis. These results have not taken into account mortality because there was not difference between treatments.

Table 10 Treatment 1: 0% DE

	ITEMS	QTY	UNIT COST (K)	COST (K)
1	Chicks (D.O.C)	40	3,100	124,000
2	Feed - Broiler Starter - Broiler Finisher	 1.5x50kg 2x50kg	 104,000 65,000	 208,000 130,000
3	Vaccine - 2 Gumboro - 2 Newcastle	 0.6L 0.6L		 1,667 3,600
4	Stress Pac	3	7,000	21,000
5	Wood Shaving (litter)	8	2,000	16,000
6	Disinfectant	1	22,000	22,000
7	Labour			122,000
8	Transport		20,000	20,000
			TOTAL	606,267

Profit = Revenue – Expenditure

= K800, 000 – K606, 267

= **K193, 733**

Table 11 Treatment 3: 2% DE

	ITEM	QTY	UNIT COST (K)	COST (K)
1	Chick (D.O.C)	40	3,100	124,000
2	Feed - Broiler Starter - Broiler Finisher	 1.5 x 50kg	1 104,000 65,000	156 156,000
3	Vaccine - 2 Gumboro - 2 New Castle	 0.6L 0.6L		 1,667 3,600
4	Stress pack	3	7,000	21,000
5	Litter (Wood shaving)	8	2,000	22,000
6	DE	3.5kg	10,000	35,000
7	Disinfectant	1 Liter	22,000	22,000
8	Labour	1		122,000
9	Transport		20,000	20,000
			TOTAL	641,267

Profit = Revenue – Expenditure

= 800,000 – 641,000

= K158, 733

4.2.0 (b) COST BENEFIT RATIO (CBR): WEIGHT BASIS

When the broilers are sold according to the final weight at K12,000 per kg, broilers without DE supplementation will yield K343,893 profit compared to K375,613 profit from broilers supplemented with 2% DE. It is thus worth while to supplement with 2% DE and sell on a weight basis, because the final weight of birds was higher in the birds supplemented with 2% DE than those without supplementation. These results have taken mortality into consideration.

Assumption: 1kg sold at K12,000 or K12,000/kg

Treatment 1: 0% DE

Average weight: 2.14kg

∴ 2.14 kg x K12,000 = K25.680 per bird

So K25.68 x 37 birds = K950.16

Profit = Revenue – Expenditure

= K950.160 – K606.267

= **K343.893**

Treatment 3:2% DE

Average weight: 2.23kg

∴ 2.23Kg x K12,000 = K26.760 per bird

So K26.760 x 38 birds =K1,016.880

Profit = Revenue – Expenditure

= K1,016.880 – K641,267

= **K375.613**

When sold on weight basis the inclusion of DE at 2% proved more profitable and these results do agree with Sinywibulula, 2005.

CHAPTER FIVE

5.0: CONCLUSION AND RECOMMENDATION

5.1 Conclusion

The following are the observations in the experiment:

(i) Although 0% DE (control) recorded the highest mortality of birds, there was no significant difference in mortality between treatments.

(ii) Adding 1% DE gave the best feed conversion ratio which was 0.53 but the final body weight was highest in 2% DE.

(iii) Highest profit margin was recorded in birds supplemented with 2% DE because they attained the highest final weight.

(iv) Inclusion of DE above 2% is detrimental because it increases cost, reduces feed conversion ratio (FCR) and reduces weight gain.

(v) The eating quality of meat was not affected by DE.

5.2: Recommendations

(i) More research must be done on quality of DE sold in Zambia especially levels of Silica.

(ii) Research in fecal matter quality.

(iii) More research on whether you can stop using vaccine and antibiotics with use of DE.

(iv) 2% DE can be added in broiler rations to increase weight gain; however this needs to be verified using larger groups of birds.

6.0: REFERENCES

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7.0: APPENDICES

APPENDIX 1: WEEKLY FEED CONSUMPTION

ANALYSIS OF VARIANCE (ANOVA)

SOURCE OF VARIATION	df	ss	ms	v.r	f pr.
Rep stratum	3	0.021250	0.007083	2.83	
Treatment	5	0.024533	0.004907	1.96	0.144
Residual	15	0.037600	0.002507		
Total	23	0.083383			

N.B. Since calculated F is larger than F from the table, there is no significant difference in feed intake at 0.05% probability.

LSD = 0.0755 C.V = 4.6%

APPENDIX 2: WEEKLY BODY WEIGHT PER TREATMENT

ANALYSIS OF VARIANCE (ANOVA)

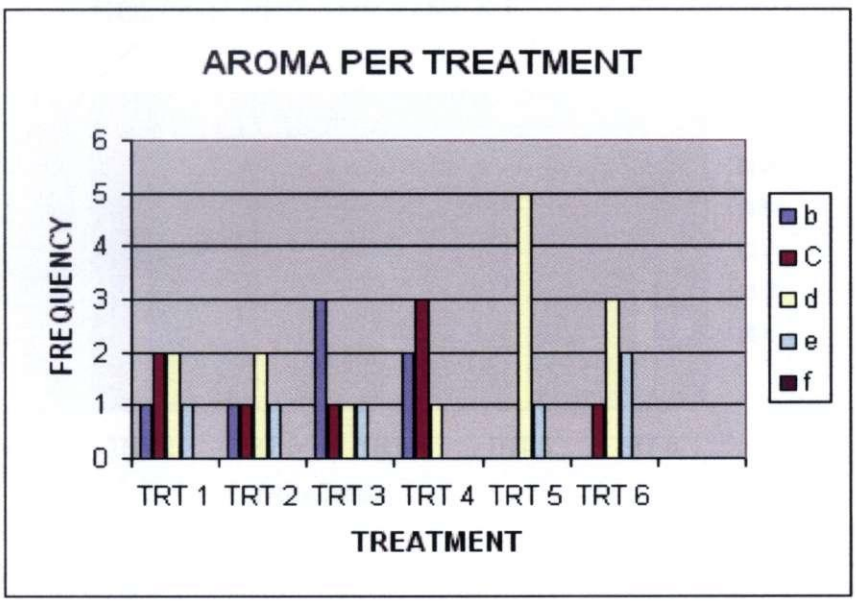
SOURCE OF VARIATION	df	ss	ms	v.r	f .p
Rep	3	0.3049	0.1016	0.97	
Treatment	5	0.9022	0.1804	1.72	0.190
Residuals	15	1.5713	0.1048		
Total	23	2.7784			

NB:
Since calculated F is bigger than that F from the table, there is no significance Differences in body weight at 0.05% probability.

LSD= 0.4878 C.V=2.4%

APPENDIX 3: AROMA PER TREATMENT.

	AROMA				
	b	C	d	e	f
TRT 1	1	2	2	1	0
TRT 2	1	1	2	1	0
TRT 3	3	1	1	1	0
TRT 4	2	3	1	0	0
TRT 5	0	0	5	1	0
TRT 6	0	1	3	2	0

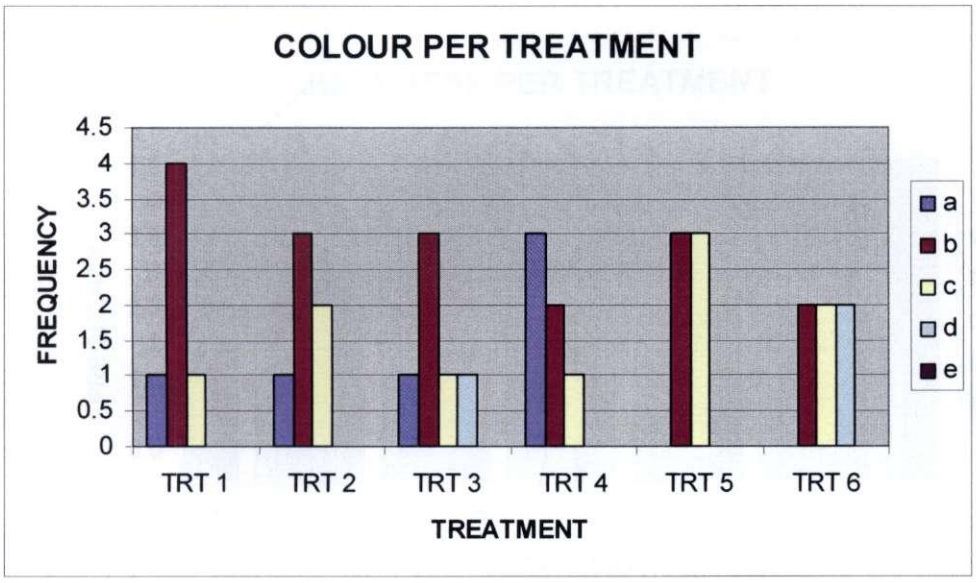


KEY:-
b)- Very appetizing c)- Appetizing d)-Some What appetizing e)- Not appetizing f)- other explain.

Generally: Aroma varied from very appetizing to some what appetizing.

APPENDIX 4: COLOUR PER TREATMENT.

COLOUR					
	a	b	c	d	e
TRT 1	1	4	1	0	0
TRT 2	1	3	2	0	0
TRT 3	1	3	1	1	0
TRT 4	3	2	1	0	0
TRT 5	0	3	3	0	0
TRT 6	0	2	2	2	0



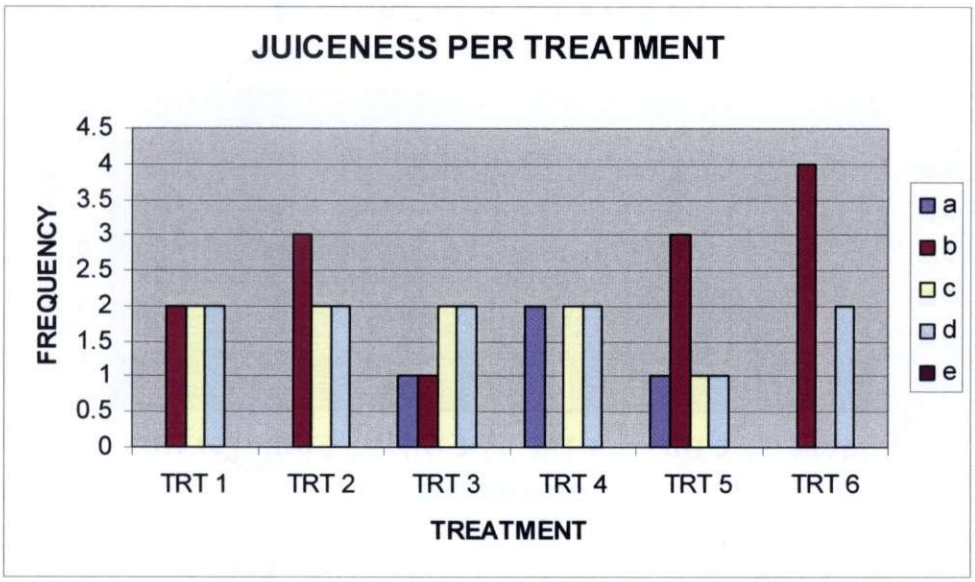
KEY:-

a) - Very Appealing b) - Appealing c) - Some What Appealing d)-Bad e) Other explain

Generally: Colour ranged from very appealing to some what appealing.

APPENDIX 5: JUICENESS PER TREATMENT

JUICENESS					
	a	b	c	d	e
TRT 1	0	2	2	2	0
TRT 2	0	3	2	2	0
TRT 3	1	1	2	2	0
TRT 4	2	0	2	2	0
TRT 5	1	3	1	1	0
TRT 6	0	4	0	2	0



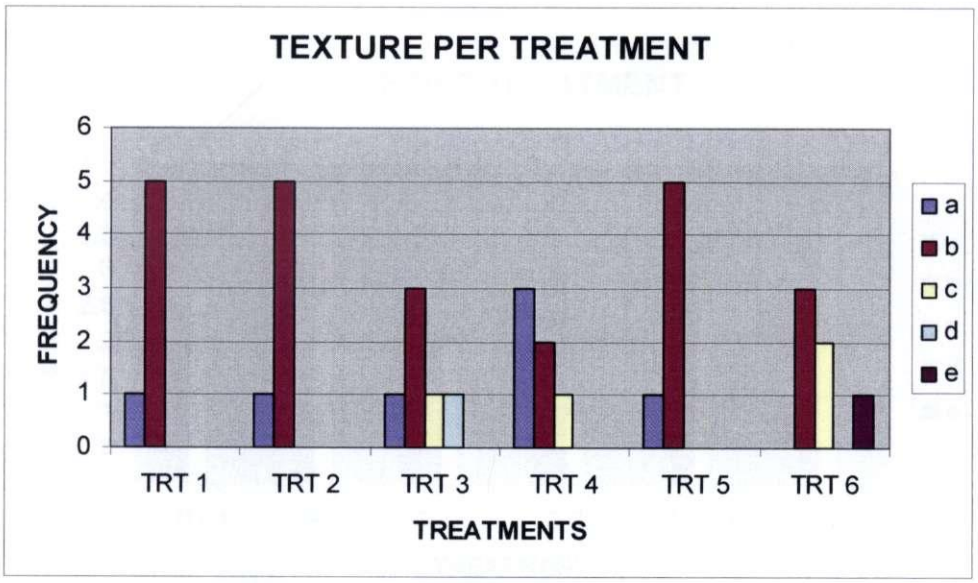
KEY:-

a) - Very Juicy b)-Juicy c) - Some What Juicy d) - Dry e) - Other Explain

Finding: Results above shows that juiciness ranged from very juicy to Some What juicy.

APPENDIX 6: TEXTURE PER TREATMENT

TEXTURE					
	a	b	c	d	e
TRT 1	1	5	0	0	0
TRT 2	1	5	0	0	0
TRT 3	1	3	1	1	0
TRT 4	3	2	1	0	0
TRT 5	1	5	0	0	0
TRT 6	0	3	2	0	1



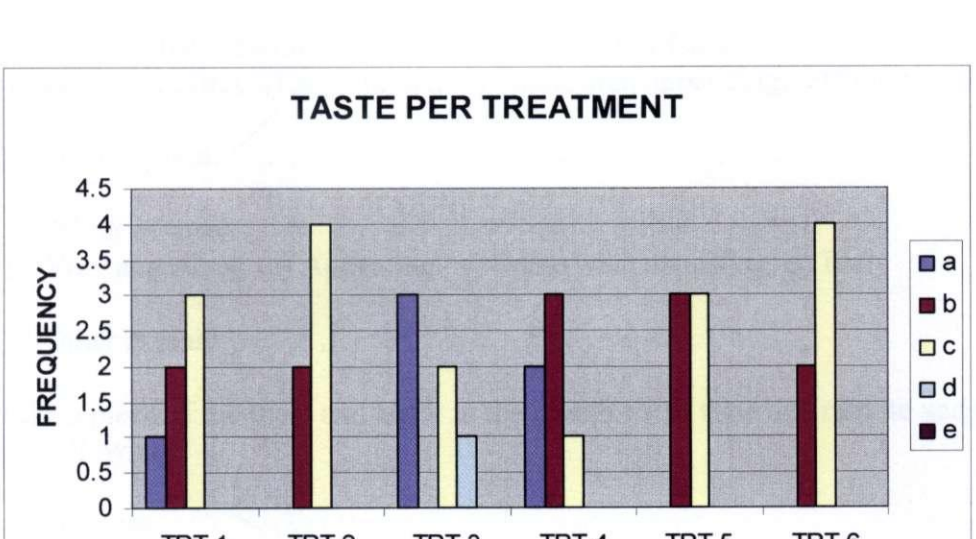
KEY:-

a)- Very Soft b)-Soft c)- Some What Soft d)- Hard e) - Other explain

Results: As observed above texture was within soft and somewhat soft.

APPENDIX 7: TASTE PER TREATMENT

TASTE					
	a	b	c	d	e
TRT 1	1	2	3	0	0
TRT 2	0	2	4	0	0
TRT 3	3	0	2	1	0
TRT 4	2	3	1	0	0
TRT 5	0	3	3	0	0
TRT 6	0	2	4	0	0



KEY:-

a) – Very delicious b) – Delicious c) – Somewhat delicious d) – Bad taste
e) – Others explain

Finding:- Study showed that meat taste ranged from very delicious to somewhat delicious.

APPENDIX 8: TASTE PER TREATMENT

PANELLIST QUESTIONS TO BE ANSWERED

Instructions

A. Rinse your mouth with 15mls of very dilute lime cordial juice.
B. Take a good look at the meat(turn it with the fork)and
C. Read through all instructions before starting to eat.
D. Proceed step by step.

Please circle the most appropriate answer:

1. Aroma of the meat:

a) Did you smell the meat from far or close? Far or Close
b) Very appetizing, c) Appetizing, d) Somewhat appetizing, e)Not appetizing

f) Other explain.....

2. Colour of meat

a) Very appealing, b) Appealing, c) Some what appealing, d) Bad

e) Other explain.....

Take a piece of the meat and chew in the mouth for at least one minute and answer the following:

3. Juiciness

    a) Very juicy, b) Juicy, c) Some what juicy, d) Dry

    e) Others explain.....

4. Texture

    a) Very soft, b) Soft, c)Some what soft, d) Hard

    e) Other explain.....

5. Taste:

    a) Very delicious, b) Delicious, c) Some what delicious, d) Bad taste

    e) Other explain.....

Remember each time you take a bite to rinse your mouth with lime cordial juice.
Give 5-10 minutes intervals between samples
If you smoke or drink a lot, please do not complete this sensory survey.