

**EVALUATION OF POST HARVEST PROCESSING METHODS
FOR IMPROVED UTILISATION OF PEARL MILLET
(*Pennisetum glaucum*) AS A SOURCE OF ENERGY IN
NON RUMINANT DIETS**

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DEDICATION

This project report is dedicated to the following people: my family, for educating me, all members of staff in the Department of Animal Science for having imparted the knowledge I have attained, and also to a person I hold so dear in my life because he has been my driving force for the most part of my school life, that is, Mtika Brighton.

ABSTRACT

The study was conducted to evaluate post-harvest treatment methods for improved utilization of pearl millet (*Pennisetum glaucum*) as a source of energy in the diets of non-ruminants. The objective of the study was to evaluate the feeding quality characteristics of pearl millet subjected to different enzymes when used in the preparation of rations for non-ruminants. The first part of the study was proximate analysis to compare pearl millet with other cereal grains. The treatment methods for pearl millet included soaking seeds in water for three days for them to germinate and then dried them in the sun for three days (3) after which they were ground using a Hilley and Willy laboratory mill. The second treatment involved use of untreated or raw seeds, for the third, fourth and fifth treatments the ground pearl millet was treated with Cellulase, Xylanase and Termamyl enzyme preparations. The enzymes were mixed at the rate of 0.5ml/kg dry matter of diet. The rats were for digestibility study and chicks were used for growth performance. The study was conducted using a completely randomized design (CRD). Daily Feed intake, live body weight gain and mortality were recorded which facilitate determination of digestibility percentage in rats, growth rate and weight gain in Rats and Chicks. From the results when compare nutrient composition of pearl millet with that of other cereal grains, the trend showed that pearl millet had highest content of dry matter, crude protein, ether extract and phosphate as compared with other cereal grains. The results growth performance of chicks fed on pearl millet after being subjected to various treatment methods showed that the chicks fed on the diet based on Xylanase had the highest growth rate followed by those fed on diet based on Germinated, Cellulase, Raw and Termamyl. The results on digestibility of nutrients for different treatments also show that the rats fed on the diet treated with Xylanase was the highest followed by those fed on diet based on Germinated pearl millet and the lowest was that of raw pearl millet.

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CHAPTER 1

1.1 INTRODUCTION

Feed production contributes about 65-75 % of total production cost for poultry and livestock production. This is because of the high cost of raw materials like maize and soya beans that make the bulk of poultry feeds (Singh, 1990; Banerjee, 1992). The price of maize keeps on rising as a result of ever increasing demand by humans for consumption and the processing industry for ethanol production. This has compelled the poultry industry to find alternatives to maize so as to reduce reliance on maize and increase the use of other grain cereals (FAO, 2010). The use of indigenous cereal crops like pearl millet has potential to reduce the proportion of maize in the poultry diets, thereby lowering the cost of production.

Pearl millet (*Pennisetum glaucum*) is widely grown in Africa and the Indian subcontinent since prehistorical times. It is generally accepted that pearl millet originated in Africa from where it was subsequently introduced into the Indian subcontinent (Tornekar A.P. et al 2009). In Zambia, pearl millet is an important cereal crop of which several improved varieties have been developed for different categories of farmers found in different agro-ecological regions. The crop is well adapted to grow in areas characterized by droughts, low soil fertility and high ambient temperatures. It performs very well in soils with low pH and low soil organic matter content (Chisi and Mukuka, 1996).

Several studies have shown that metabolisable energy in pearl millet for non ruminants is approximately equal to that of the maize (Fancher et. al., 1987). It also has high crude protein, rich in lysine, methionine and threonine, this shows that supplementation of pearl millet-soya bean diets with lysine and sulfur amino acids is unnecessary (Andrews, et. al., 1996). Since pearl millet tends to have more protein than maize, the use of pearl millet in poultry diets would reduce on the need for protein supplementation and therefore, reduce the feed cost per unit grain. However, use of pearl millet in non ruminant feed is limited due to anti nutritional factors such as tannins and high fibre content which limit the palatability and inhibits protein digestion. However, the availability of starch, protein and minerals to the animal could be improved with the use of specific food enzymes (Singh D.N., 1990).

1.2 PROBLEM STATEMENT

Maize is the main source of energy used in the preparation of diets for non-ruminants. The crop is also used for human consumption and in the manufacturing of ethanol both of which have contributed to the increasing demand for maize (FAO, 2010). This has resulted in a shortage of the commodity and subsequent price hikes that have had a bearing on the cost of poultry production. The rising costs for poultry production have limited the production capacity of most small scale farmers that depend on poultry for food security and income generation. In order to reduce the cost of producing poultry meat, there is a need to look for alternative sources of energy for inclusion in poultry rations. One potential source of energy for poultry rations is pearl millet that has a nutritional profile that is similar to that of maize. It is however; unfortunate that use of pearl millet as a source of energy in poultry rations may be limited by high content of fibre and other anti-nutritional factors such as tannins, which limit palatability and inhibit protein digestion. Pearl millet also contains saponins, which tends to damage membranes of the digestive tract (Burtle and Newton, 1995).

1.3 OBJECTIVES

1.3.1 OVERALL OBJECTIVE

- To evaluate the feeding quality characteristics of pearl millet subjected to different post-harvest treatment methods including use of exogenous enzymes to improve utilization of pearl millet as energy supplement for non ruminants.

1.3.2 SPECIFIC OBJECTIVES

1. To compare the content of nutrients in pearl millet with that of other grain cereals.
2. To determine the digestibility of nutrients in rats fed on meals of pearl millet after being subjected to various treatments methods.
3. To determine the growth performance of chicks fed on pearl millet after being subjected to various treatment methods.

1.4 JUSTIFICATION

In the production of poultry and other non-ruminants, feeding accounts for up to 70% of total cost of production therefore feeding plays a major role on whether the enterprise makes profit or not (Bryden, 2006). The cost of production also has a bearing on the affordability of the product by the consumers. In order to reduce the cost of producing chickens and make poultry products more affordable to consumers, there is need for cheaper sources of energy. Among the cheaper alternatives to maize that can be used as a source of energy is pearl millet. This is because when compared with maize, it has higher protein content and a profile of essential amino acids that is more balanced than that of maize. Pearl millet also has higher oil content than other common cereal grains and is a better source of linoleic acid which can promote high performance of broilers (ref). It also has agronomic advantages in that it is well adapted to droughts, high ambient temperatures and it can withstand soils with high salinity and low pH (Tornekar, 2009).

1.5 RESEARCH HYPOTHESIS

HO: Different post harvest treatment methods for pearl millet have no effect on the nutritive value and feeding quality characteristics when used in non-ruminant diets.

HA: Different post harvest treatments methods for pearl millet have an effect on the nutritive value and feeding quality characteristics when used in non-ruminants diets.

CHAPTER TWO:

2.0 LITERATURE REVIEW

2.1 Background

In the last few decades, poultry and general livestock production has experienced significant developments due to an increasing demand for food by the increasing world population. The United Nations (UN) estimates that there will be eight billion people on the planet by the year 2030, whose income will be on average of 32 per cent higher than that was in 2006. In addition, meat consumption per person per year is expected to increase by 26 per cent during the same period. This increase in the consumption of livestock products will mostly be in form of poultry products, which will lead to the rise in poultry production (FAO, 2010). Maize is the main source of energy for poultry diets but its use is limited by demand for human foods, livestock feeds and industrial application such as processed foods, brewing of beers and manufacture of bio-fuels. All these changes tends to result in the shortage of maize and a push up in the price thus, making production of poultry products expensive and subsequently less affordable to consumers. To minimize the cost of production, there is need to make use of alternative energy sources such as pearl millet

2.2 Pearl millet Production.

Pearl millet (*Pennisetum glaucum*), also commonly known as bulrush millet, is the most drought and soil acidity tolerant cereal (Singh et al 1980; National Academy 1996). It belongs to the grass family gramineae and in Zambia it can be grown in all the three agro-ecological zones. However, current production areas are mainly confined to the western and southern parts of the country. In terms of soil requirements, sandy or light loamy soils are best for pearl millet production. A combination of low rainfall (350 - 700 mm per annum) and high ambient temperatures (30 - 40 C) tend to increase growth rates. It can also withstand long spells of drought and the crop is able to regenerate and produce new basal tillers to compensate for losses caused by drought or other unfavourable conditions. The crop is, therefore, the most assuring cereal crop in high-risk drought areas (Kimberley,2008).

2.3 World's Distribution

The total area cultivated with pearl millet worldwide is estimated to be 26 million ha, comprising

11 million ha each in West Africa and South Asia and 2 million ha each in Southern Africa and Brazil (FAO, 1996). India is the largest producer, with 9–10 million ha under cultivation that yields between 7 and 8 million tons of grain each year. In Africa, the largest pearl millet growing countries are Senegal, Mali, Burkina Faso, Niger, Nigeria, Chad, and the Sudan. In West and Central Africa, open-pollinated varieties are cultivated on 16 million ha, with a production capacity of 11.5 million tons per year (Vincent et. al, 2012). In Zambia the expected yield per year is about 2.8 tons/ha (Christiansen and Kimberley, 2008).

2.4 Nutritive value and use

The overall nutritive value of pearl millet grain is better than most cereals as it contains higher amounts of protein, fat (4.5 – 5.0%), minerals and essential amino acids such as lysine and tryptophan. The use of pearl millet in stock feed is also common in many countries (Burton et. al., 1972). Nutritional studies indicated that metabolized energy of pearl millet for non-ruminant animals is approximately equal to that of maize (Fancher et al., 1987).

Pearl millet is used in the same way as sorghum and maize whereby the milled flour is used to make nshima or porridge. It is also a popular grain for brewing local beer and a variety of non-alcoholic beverages in rural areas. Its' grain can also be used for feeding animals and several studies have been conducted to demonstrate its potential as a fed ingredient for various types of animals, including poultry, cattle, pigs and fish (Kimberley, 2008).

2.5 Anti-nutritional factors in Pearl millet

As is the case with other cereals, certain anti-nutritional factors, such as enzyme inhibitors, phytic acid and tannins are associated with pearl millet. These factors affect the nutritional value of the grain by inhibiting protein and starch digestibility and mineral bioavailability. It also contains saponins, which are known to damage membranes of the digestive tract, (Sodipo and Arinze 1985). Pearl millet grain also has a better mineral profile than many other cereals, although the bioavailability of these minerals is low because of the presence of some inherent anti-nutritional factors such as phytate, tannins and other poly-phenols in grain (AICPMIP, 2005). The typical grey colour of pearl millet grain and its products is due to the poly-phenolic pigments present in peripheral area of the endosperm. These tend to further restrict efficient utilization of pearl millet by non-ruminants when included in their diets (Rooney, 1978). It also contains high levels of fiber which limits the utilization of starch. Several methods have been employed to improve the nutritional quality of cereal.

2.6 Use of Enzymes in Poultry Ration

Enzymes play a key role in the digestive process in the utilization of feed ingredients. Although enzymes are produced by the animal itself or by the microbes naturally present in the digestive tract, specific activities necessary to break down some compounds in feed are not found or are at low levels in the digestive tract. Therefore, exogenous enzymes are added to the diet to break down these compounds. Many years ago, nutritionists had generally regarded enzyme addition to diets as a futile effort on the basis that proteolysis in the stomach and anterior small intestine would result in inactivation before they could be of significant digestive benefit. However, in 1946, Hastings first reported that addition of a biostatic enzyme material to a high fiber chick diet improved growth and feed efficiency. Later on, Jensen et al., (1957) found that supplementation of pearl millet - based poultry diets with a crude mixture containing cellulase activity gave a significant improvement in the performance of the birds as well as that of the litter quality. Since then, a lot of research work has been done about the use of exogenous enzymes in animal feeds. According to the of Cowan et al. (1993), xylanase breaks down cell walls to expose starch for digestion and this can help the bird digest starch. Xylanase also reduces the viscosity in most cereal grains which in turn reduces variability in the availability of its energy to the bird. Viscosity is linked to the presence of non starch polysaccharides (NSPs) such as arabinoxylans, which xylanase degrades. Another beneficial effect of using enzymes is that sticky droppings (a by-product of feed viscosity) will also be reduced.

CHAPTER 3

3.0 MATERIALS AND METHODS

3.1 Location

The study was conducted at the University of Zambia, School of Agricultural Sciences in the Department of Animal Science. The chemical analysis of cereal grains was done in the food chemistry and nutrition laboratory, while digestibility and growth feeding trials were done at the Field Station.

3.2 Source of materials

Pearl millet was procured from the Department of Plant Science at the field station, while fish meal, di-calcium phosphate (DCP), methionine, broiler premix, salt, lysine, limestone, full fat soya cake were purchased from Livestock Services Cooperative Society in Lusaka. Chicks for growth feeding trials were purchased from Ross Breeders (Z) Limited. The rats for digestibility trial were obtained from the National Institute for Scientific and Industrial Research (NISIR) in Chilanga.

3.3 Processing Methods

The first treatment involved processing of pearl millet by soaking seeds in water for three days then the water was removed and the seed was placed in a sack to allow for germination. The germinated seeds were then dried in the sun for three days and ground to pass through a 3mm sieve using a Hilley and Willey laboratory mill before use in digestibility and growth assays. The second treatment involved the use of raw pearl millet grains for the third, fourth and fifth treatments the ground pearl millet was treated with Cellulase, Xylanase and Termamyl enzyme preparations. The enzymes were mixed at the rate of 0.5ml/kg of the diet.

3.4 *Proximate analysis of cereal grains*

Samples of Pearl millet, Finger millet, Sorghum and Yellow maize were subjected to chemical composition analysis for Dry Matter (DM), Crude Protein (Kjeldahl N x 6.25), Ether Extract (using the Soxhlet method), Crude fibre, Ash, Calcium and Phosphorus using established methods of Association of official analytical chemists (AOAC 1990).

1. Dry matter

Dry matter content was determined by measuring the loss of weight after drying the sample at 105°C for 12 hours in an air flow controlled fume hood. The weighing was done after cooling the samples to room temperature in a dessicator.

2. Crude protein

The Kjeldahl method was used in the determination of the protein content in food samples. In this method the samples were oxidized in hot concentrated Sulphuric acid, where nitrogen from the samples was obtained in form of ammonium ion. The digested solutions were then treated with excess solution of 40% sodium hydroxide to release ammonia. Then the contents of the flask were steam distilled and the volatilized ammonia is collected in a receiving flask containing boric acid to form ammonium borate. This solution was then titrated with 0.01 Normal of hydrochloric acid until colour change to that of boric acid.

3. Ether extract

Determination of oil content was done according to the soxhlet method where extraction flasks were weighed before putting in 5 grams of the sample for analysis. Were measured, mixed 1 gram sodium sulphate catalyst and transferred to the extraction thimble and plugged lightly with the cotton wool. Extract of the fat was done with 200ml of Petroleum Ether for about 3 hours in the previously dried and weighed extraction flask. The solvent was evaporated with the rotary evaporator and the fat residue was dried, cooled and weighed. The oil content was determined as the difference between the weight of empty extraction flask and the weight of the extraction flask with oil

4. Crude fiber

For each analysis, 0.5g of the sample was weighed into the bags and placed in a beaker were 150ml of 1.25% of Sulphuric acid was added and boiled for 30 minutes, it was filtered and boiled again with 150ml of 1.25% sodium hydroxide in a beaker for 30 minutes before being filtered again. The bags of the samples were then taken for drying in the oven at 125°C for 2 hours, cooled in the desiccator, emptied into the crucibles and weighed them together. The crucible was placed in a muffle furnace at about 550°C for

approximately 4 hour to turn off remaining organic matter .The crude fiber content was expressed as the percentage by finding the differences between the weight of crucible with unshed sample and the weight of crucible with ash

5. Ash content

2g of the sample was placed into the crucible and heated at 550°C in a muffle furnace for 4 hours and then crucibles were placed in the desiccator for cooling before weighing them. The difference in weight between the empty crucibles and the crucibles with ash gave the ash content of the sample.

6. Calcium content

Two grams (2g) of sample was measured into crucible, placed in a furnace and heated at 550°C for 3 hours to obtain the ash and the crucibles were cooled using desiccator. Then 10ml of 3N HCL was added to the crucible and the content was boiled on a hot plate until it turned yellowish and filtered into a volumetric flask. 50ml of the acid extract with 100ml of hot distilled water was placed in a beaker and placed on the hot plate were 1g of powdered ammonium oxalate and 5 drops methyl red indicator are added to the beaker. The beaker was then removed from the hot plate, cool for 2 hours to and filtered using filter paper. The filter paper was then transfer back to the beaker used for precipitation and dissolve Calcium carbonate in 20mls of 2N H_2SO_4 , 100mls of hot water was added to it and titrated with 0.1 Normal of potassium permanganate to pink colour

7. Phosphorus content

2g of sample was measured into crucible, placed in a furnace and heated at 550°C for 3 hours to obtain the ash and the crucibles were cooled using desiccator. Then 10ml of 3N HCL was added to the crucible and the content was boiled on a hot plate until it turned yellowish and filtered into a volumetric flask. The acid extract was filtered onto a 100ml volumetric flask, cool and dilute to the mark. 2.5ml of the acid extract was placed in to 50ml volumetric flask and filled up to the mark with distilled water. 1ml of aliquot from the acid extract was then transferred onto test tube together with standards of 4ml molybdate reagent and 3ml ANSA. The test tubes were then put in a dark place for 20 minutes for them to develop colour and then read the absorbance at 660nm.

3.4 Composition of experimental diets

The first five diets contained different treatments of pearl millet. The diets contained 32.27% metabolisable energy which consisted of 55% pearl millet and 45% basal diet. The basal diet contained fish meal, full fat soya, soya oil, limestone, DCP, salt, broiler premix, enzyme premix, methionine and lysine as shown in Table 1.

3.5 Digestibility Assays with Rats

36 Wistar rats were randomly allocated to 5 dietary treatments with 6 replications per treatment using a Completely Randomized Design (CRD). The initial body weight of each rat was taken prior to the commencement of the experiment, and the final body weight gain was determined at the end of the experiment. Body weight changes were determined by subtracting initial from final body weights.

The feed and water were offered *ad libitum*. The feeding trial lasted for a period of 10 days during which daily feed intake, change in body weight and faecal matter was recorded. The first 6 days were for adaptation of rats to dietary treatments with data on faecal matter only collected during the last 4 days. The collected faecal samples were dried at 60°C for 48 hours after which samples from each treatment were pooled together, ground and subjected to chemical composition analysis as above described under proximate analysis. Digestibility of nutrients was calculated as apparent digestibility using equations described by McDonald et al., (1986). Feed conversion ratios (FCR) among treatments were also calculated by dividing the body weight gain in 10 days into the total feed intake.

3.6 Feeding Assay with chicks

150 one-week old broiler chicks were randomly allocated to 5 dietary treatments with 6 replications per treatment using a completely randomized design (CRD) and each bird was treated as an individual experimental unit.

The feed and water were offered *ad libitum*. The feeding trial lasted for a period of 12 days during which feed intake was recorded daily by subtracting the left over feed on the following day from the quantity given on the previous day. The body weights and feed intake were averaged on daily basis for both weeks 1 and 2. Feed conversion ratios (FCR) among treatments were calculated by dividing the average daily body weight gain into the average daily feed intake.

Table 1: Nutrient composition (%) of experimental diets used for rat growth feeding trials

Ingredients(g)	Treatment Diets				
	Germinated	Raw	Cellulase	Termamyl	Xylanase
Pearl millet meal	55	55	55	55	55
Full fat soya	35	35	35	35	35
Soya oil	3.0	3.0	3.0	3.0	3.0
Limestone	0.6	3.0	3.0	3.0	3.0
DCP	2.4	2.4	2.4	2.4	2.4
Salt	0.2	0.6	0.6	0.6	0.6
Broiler premix	0.2	0.2	0.2	0.2	0.2
Methionine	0.2	0.2	0.2	0.2	0.2
Lysine	0.2	0.2	0.2	0.2	0.2
Fish meal	3.0	3.0	3.0	3.0	3.0
Total	100	100	100	100	100

Calculated nutrient analysis

Dry matter	88.66	88.66	88.66	88.66	88.66
Metabolisable energy	32.27	32.27	32.27	32.27	32.27
Crude protein	20.64	20.64	20.64	20.64	20.64
Methionine	0.60	0.60	0.60	0.60	0.60
Lysine	0.12	0.12	0.12	0.12	0.12
Cystine+Meth	0.92	0.92	0.92	0.92	0.92
Crude fibre	6.82	6.82	6.82	6.82	6.82
Ether extract	11.35	11.35	11.35	11.35	11.35
Calcium	1.09	1.09	1.09	1.09	1.09
Phosphorus	0.80	0.80	0.80	0.80	0.80

3.6 Statistical analysis

All collected data was subjected to Analysis of variance (ANOVA) using MINITAB 16 Statistical Software Package. The ANOVA was used to determine the differences among the mean at $P < 0.05$ using the F values. Significant differences among means were separated using Turkey's comparison test

CHAPTER 4

4.0 RESULTS AND DISCUSSION

4.1 Chemical composition of cereals grains

The results on chemical composition of cereal samples are in Table 2. In terms of dry matter there were significant differences between Pearl millet and Yellow maize and not with Finger millet and Sorghum ($P=0.05$). For ether extract results shows that there were significant differences for Pearl millet with Finger millet and Sorghum ($P = 0.05$). The results for Calcium content showed that there were significance differences between Pearl millet and Finger millet and not with Sorghum and Yellow maize ($P = 0.05$).

TABLE 2: Chemical/Nutritional composition of pearl millet in comparison with that of finger millet, sorghum and yellow maize

Nutrients	Treatments				SEM
	Pearl millet	Finger millet	Sorghum	Yellow maize	
Dry matter	89.12±0.204 ^a	86.93±0.787 ^{ab}	87.04±0.367 ^{ab}	86.48±1.324 ^b	0.801
Crude protein	11.77±1.16 ^a	10.98±0.43 ^a	12.22±0.41 ^a	10.16±1.53 ^a	1.004
Crude Fiber	4.36±0.6 ^a	3.65±1.19 ^a	3.17±1.35 ^a	4.02±1.46 ^a	1.196
Ether Extract	3.65±0.58 ^a	1.13±0.59 ^c	1.52±1.02 ^{bc}	3.29±0.75 ^{ab}	0.76
Ash	1.87±0.74 ^a	2.23±0.89 ^a	2.42±1.05 ^a	1.88±0.48 ^a	0.82
Calcium	0.79±0.03 ^b	1.25±0.06 ^a	0.74±0.24 ^b	0.94±0.03 ^{ab}	0.122
Phosphorus	0.25±0.05 ^a	0.30±0.02 ^a	0.28±0.01 ^a	0.26±0.02 ^a	0.031

Means in the same column with same superscript were not significant different from each other at $P\leq0.05$

4.2 DIGESTIBILITY ASSAY WITH RATS

The results shown in below are for the period of 10 days and it shows that there were no

significant differences ($P=0.05$) among the rats fed on different treatments. However, the general trend of feed consumption shows that the rats fed on diet treated with Xylanase recorded the highest followed by those fed on diet containing germinated pearl millet and cellulase. The last two were raw and Termamyl.

The results on bodyweight changes show that there were significant differences ($P=0.05$) between rat fed on diet withdraw pearl millet grains and those fed on diet treated with cellulase but not with the rats fed on Germinated, Termamyl and Xylanase. The rats fed on untreated pearl millet performed better than those fed on treated diets although it had lowest feed intake as compared with other diets. This could have been because of differences in the efficiency of feed utilization in to the body weight by the rats.

The results on the digestibility of nutrients showed that for crude protein digestibility there were significant differences ($P=0.05$) between the rats fed on the diet treated Germinated and Cellulase and not with those fed on diet treated with Termamyl, Xylanase and that of raw pearl millet. For ether extract digestibility results showed that there were significant differences ($P= 0.05$) between and the rats that fed on Xylanase and those fed on the treatments of Germination, Raw and Termamyl and not with those fed on Cellulase there. In terms of crude fibre digestibility the results showed that there were significant differences between rats fed on the diets treated with Xylanase and germinated pearl millet and those fed on diet treated with Cellulase. The trend for dry matter digestibility showed that it was highest for the rats fed on the diet treated with Xylanase followed by those fed on the diet based on the germinated pearl millet. Form these results it shows that fed on the diet treated with Xylanase recorded the highest for dry matter digestibility and ether extract digestibility seconded by those fed on the germinated pearl millet based diet.

Table3. Daily feed intake, body weight gains and digestibility of dry matter, crude protein and ether extract in rats

Treatment	Feed intake	Weight gain	DMD	CPD	EED
Germinated	123.67±9.45	12.17±9.68 ^{ab}	68.97±13.51	96.37±2.25 ^a	78.27±9.67 ^b
Untreated	106.97±48.75	27.30±9.61 ^a	60.63±13.44	91.53±3.02 ^{ab}	73.28±9.33 ^b
Cellulase	113.00±6.96	13.83±4.27 ^b	65.48±17.21	85.73±8.56 ^b	78.45±6.07 ^{ab}
Termamyl	110.00±4.86	22.67±9.52 ^{ab}	61.23±9.86	89.95±2.49 ^{ab}	74.73±5.39 ^b
Xylanase	137.83±18.86	15.17±7.36 ^{ab}	76.98±5.22	94.90±1.20 ^a	90.30±2.28 ^a
SEM	24.07	8.357	12.52	4.36	7.097

Means with different superscript letters within the same column were significantly different from each other at p= 0.05 level. DMD- Dry matter digestibility, CPD- Crude Protein Digestibility, EED- Ether Extract Digestibility

4.3 Chicks feeding trial

From Table 4, the results showed that there were no statistical differences (P = 0.05) in feed in take among chicks fed on different treatment diets. However, the trend showed that in week 1 chicks fed on diet treated with Xylanase recorded highest feed intake followed by those fed on diets treated with Germinated, Cellulase, Termamyl and Raw had the lowest. In second week rats fed on diet based on Germinated had the highest record followed by those fed on diets treated with Xylanase, Cellulase, Termamyl then Raw. The overall results indicate that feed intake was high for chicks fed on Germinated and Xylanase and low for chicks fed on Raw, Cellulase and Termamyl.

The results for weight gains in week 1 indicate that chicks that were fed on diet based on Xylanase had the highest body weight gain followed by those fed on diets based on

Germinated, Termamyl, Raw and cellulase. For week 2 body weight gains were highest for chicks fed on Xylanase followed by those fed on diets based on Cellulase, Raw, Germinated pearl millet and Termamyl.

Feed conversion ratio (FCR) showed that there were no significant differences ($P = 0.05$) among the chicks fed on diets based on treatments for both weeks. However, the trend for week 1 showed that chicks fed on diet based on Xylanase had highest feed conversion ratio followed by those fed on diets based on Cellulase, Germinated, Raw and Termamyl

Table 4 shows the results on weight gain, daily feed intake and feed conversion ratio of different treatments

Treatment	Week 1 (7 days)			Week 2 (5 days)		
	Weight gain	Daily feed intake	Feed conversion ratio	Weight gain	Daily feed intake	Feed conversion ratio
Germinated	128.55±16.65	331.00±15.37 ^a	2.64±0.45	150.09±22.76	477.00±18.82	3.17±0.44
Untreated	130.45±7.77	312.76±11.03 ^{ab}	2.08±1.06	154.00±39.15	451.97±9.54	3.05±0.57
Cellulase	116.55±57.39	328.31±6.17 ^{abc}	3.58±2.0	179.93±38.75	448.60±27.27	2.58±0.55
Termamyl	141.45±40.90	318.00±6.47 ^{bc}	2.45±0.06	127.47±38.59	443.13±27.27	3.93±1.89
Xylanase	141.10±3.34	335.00±6.3 ^a	3.38±0.06	185.53±110.47	471.70±18.78	3.044±1.04
SEM	32.14	58.75	21.03	58.75	21.17	1.04

Means with different letters within the same column are significantly different with ($p < 0.05$)

CHAPTER 5

5.0 CONCLUSION AND RECOMMENDATIONS

5.1 CONCLUSION

From the results when compare nutrient composition of pearl millet with that of other cereal grains, the trend showed that pearl millet had highest content of dry matter, crude protein, ether extract and phosphate as compared with other cereal grains. The results growth performance of chicks fed on pearl millet after being subjected to various treatment methods showed that the chicks fed on the diet based on Xylanase had the highest growth rate followed by those fed on diet based on Germinated, Cellulase, Raw and Termamyl. The results on digestibility of nutrients for different treatments also show that the rats fed on the diet treated with Xylanase was the highest followed by those fed on diet based on Germinated pearl millet and the lowest was that of raw pearl millet.

5.2 RECOMMENDATIONS

1. The study should be carried out with trials extending to grower and finisher phase of broilers
2. A further study on the in-vitro and in-vivo digestibility should be carried out.

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