GROWTH PERFORMANCE OF WEANER RABBITS FED ON DRIED PITO MASH AS A REPLACEMENT FOR MAIZE

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ABSTRACT

Twenty four crossbred unsexed weaner rabbits of about seven (7) weeks old with mean body weight of 528.75g were used in a feeding trial involving four dietary treatments containing 0, 10, 15, and 20% inclusion levels of dried pito mash (DPM) in a completely randomized design study that lasted for seven (7) weeks. The animals were randomly divided into four (4) treatment groups consisting of six (6) animals per group. Each treatment group was replicated three (3) times with two (2) animals per replicate. The parameters studied were daily feed intake, daily weight gain, feed conversion ratio, carcass yield, organ weights, haematological and biochemical components of rabbits, and cost benefit analysis of replacing maize with DPM in rabbit diets. The inclusion of DPM in rabbit diets did not significantly ($p>0.05$) influence the daily feed intake of the animals. There was a slight reduction in the daily weight gain of animals with the inclusion of DPM from 0% to 20%. The slaughter weight and dressed weight decreased significantly ($p<0.05$) as the level of DPM in the experimental diets increased. Rabbits fed the control diet (0% DPM) and the diet containing 10% DPM had significantly higher ($p<0.05$) dressing percentage than rabbits fed diets containing 15% and 20% DPM inclusion levels. However, there were no significant ($p>0.05$) dietary treatment effect on the heart, lungs, liver, spleen and kidney weights when they were expressed as percentage of the live body weight of the rabbits fed the four treatment diets. The feeding of DPM to rabbits did not show significant ($p>0.05$) variation in both the haematological and biochemical components of the rabbits studied and they were within the normal physiological ranges for rabbits. The total feed cost/kg was significantly reduced ($p<0.05$) as the inclusion levels of DPM in the diets increased. Therefore, the control diet (0% DPM) was more expensive than the diets containing 15% and 20% DPM, respectively. Also, the cost of feed/kg live weight gain was significantly higher ($p<0.05$) for the control diet (0% DPM) when compared with the other treatment diets. The results of this study suggest that DPM could completely replace maize up to 20% without any detrimental effect on the growth performance of rabbits. And since the total feed cost was significantly reduced as the inclusion levels of DPM in the rabbit diets increased, indicate that it is possible to produce rabbits at relatively cheaper prices when the maize component of the diets is completely replaced by DPM up to 20%.

Keywords: weaner rabbits, growth performance, dried pito mash, maize, carcass characteristics, haematological and biochemical components, cost benefit analysis.

INTRODUCTION

The rabbit (*Oryctolagus cuniculus*) has the potential as meat producing animal in Ghana, particularly on subsistence-type small farms or as backyard enterprise. The characteristics such as small body size, relatively short generation interval of about 30 days, rapid growth rate and the ability to utilize forages and fibrous agricultural by-products are some of the attributes in favour of rabbit production (Cheeke, 1987; Odeyinka *et al*., 2008).

There are many potential benefits that may be realized from backyard rabbit production. As a backyard activity and relative to most livestock, rabbits are quiet, odourless and docile animals that often go unnoticed by neighbours, even in residential areas. Overall benefits from a backyard rabbit enterprise include nutritious and wholesome meat; educational experiences for youth; enjoyable occupational activity; rich manure for gardening or flower beds; and potential income generation. Educational opportunities for youth, is a wonderful learning experience in the sciences of biology, such as animal behaviour, genetics, growth development, and reproductive and digestive anatomy and function. Particularly for children, rabbits are easy to handle while representing a minor investment versus a project involving larger livestock. Rabbit production also teaches responsibility, budgeting costs and returns, care and concern for animals, and the acceptance of livestock as a source of food for humans. Meat from rabbit has low cholesterol level, is an all white meat product that is high in protein/energy ratio and is relatively rich in essential fatty acids (Iraqi, 2003). Rabbit farming compliments the efforts of the serious gardener and flowering plan enthusiast. The manure from rabbits makes excellent compost, rich in organic matter and nutrients that can produce remarkable garden and flowering results (Mikled, 2005). The small size of the backyard rabbit enterprise, typically 4 to 5 breeding does, represents steady meat production at minimal investment and operating costs. It takes little time or money to either down-scale or expand the size of the operation. Labour is ideally shared among family members. These features associate the rabbit enterprise with minimum economic risk.

Despite the many advantages, rabbit production has not yet achieved its full potential in Ghana. Productivity is far less than what is typical in temperate regions. Inadequate nutrition is a very important factor accounting for the low productivity of rabbits in the tropics apart from heat stress. The limiting nutritional factor appears to be digestible energy. Therefore, the development of feeding programmes that will incorporate agricultural by-products that are very good sources of digestible energy will be very good news to rabbit farmers.

Maize is a major feed ingredient required to formulate feed for rabbits. However, due to the great competition between humans, animals and brewing industries, the price of maize had risen astronomically beyond what the livestock producers can afford. The rising cost of feeding rabbits calls for a search for alternative feedstuff sources that could be produced cheaply and rapidly available for most part of the year, capable of being processed and stored without loss in feeding value, should not be a major food item for humans nor a major raw material for agro-based industries but should be fairly high in nutrients (Olayemi, 2004). Dried pito mash is a by-product of millet and sorghum (guinea corn) that can be fed to livestock to reduce the high feeding cost.

Millet and guinea corn are widely grown in the Savanah regions (Northern, Upper East and Upper West regions), parts of Brong Ahafo and Ashanti Regions of Ghana as a component of the traditional crop farming system. Local brewers use millet and guinea corn to brew a local beer called pito and the residue/by-products known as pito mash are often thrown away. Pito mash is commonly available in many parts of Ghana and it is far cheaper than maize. Pito mash has been used in feeding broiler chickens (Kagya-Agyemang *et al*., 2008).

The present study was designed to investigate optimum level for the inclusion of sun-dried pito mash as a substitute for maize in rabbit diets.

MATERIALS AND METHODS

The study was conducted at the animal farm of University of Education, Winneba, Mampong-Ashanti (latitude 07^0 4'N and longitude 01^0 24'W), Ghana. The sun-dried pito mash (DPM) that was used in formulating the diets for the rabbits was bought from local pito brewers in Mampong town. A total of twenty-four (24) weaner rabbits of about 7 weeks old, unsexed crossbred with initial average body weight of 528.75g were purchased from rabbit producers in Mampong town. They were carefully transported in the early hours of the day to the animal farm of the University. The animals were given prophylactic treatment which involved antibiotics (neo-terramycin) and anti-stress (aminovit) administered in the drinking water. The animals were also dewormed using coopane dewormer at the rate of 2 g per litre of water. The 24 rabbits were used in a completely randomized design (CRD) for the study that lasted for 7 weeks. The animals were randomly divided into four (4) treatment groups consisting of six (6) animals per group. Each treatment group was replicated three times with two (2) animals per replicate. The rabbits were individually housed in hutches of 60 cm x 40 cm dimension in size. The floors of the wooden hutches were covered with chicken wire mash to allow faeces and urine to run through for disposal. Cleanliness was maintained throughout the experiment.

Four diets were formulated with diets 1, 2, 3 and 4 containing DPM replacing maize at 0, 10, 15 and 20%, respectively. Representative samples of DPM were subjected to proximate analysis at the laboratory. The composition of experimental diets and the calculated analysis are presented in Table-1.

Parameters measured

Weekly live weights and feed intake were recorded but the mean daily weight gain and feed conversion ratio were calculated from the data obtained.

Carcass evaluation

Twelve (12) rabbits made up of three (3) animals from each treatment group were randomly selected and slaughtered for carcass evaluation at the end of the experiment. Before slaughtering, each animal was stunned, bled, dressed by flaying, eviscerated and split. The dressed weight and the weight of heart, lungs, liver, spleen, kidneys, loin and legs were recorded using an electronic weigh master digital scale. Dressing percentage was determined by dividing the dressed weight by the slaughter weight and multiplied the result by one hundred.

Blood collection and analysis

Blood samples were collected from one animal per replicate for haematological and biochemical analysis at the end of the feeding trial. Firstly, 1 ml of blood was collected from each animal into labeled sterile universal bottle containing anticoagulant- ethylene-diamine-tetra-acetic acid (EDTA) for the determination of haematological components. Secondly, 1 ml of blood was collected from each animal into labeled sterile bottle without EDTA for the determination of biochemical components. The blood samples were centrifuged at 500 rpm for 3 min to obtain serum for biochemical analysis using spectrophotometer (kits produced by Sentinel, Italy) at a wavelength of 500 nm.

The serum obtained was analyzed colorimetrically for total protein (TP) by the Biuret method with kits (Plasmatec; Plasmatec Laboratory products Ltd., UK). Albumin (Ab) concentration was determined by the bromocresol green BCG) method (Peters *et al*., 1982). In this method albumins bind with BCG to form a green compound and the concentration of Ab is directly proportional to the intensity of the green colour formed. Globulin (GB) concentration was assessed as the difference between TP and Ab concentrations. Cholesterol concentration was determined using the method of Coles (1986).

Total red blood cells (RBC) and white blood cells WBC) counts, haemoglobin (Hb) concentration and packed cell volume (PCV) parameters were determined using laboratory procedures (Davice and Lewis, 1991).

Cost-benefit analysis

The cost analysis of each of the four treatment diets fed to the rabbits was estimated. The cost of each dietary ingredient (GH¢/kg) was recorded. Then the feed intake of each rabbit for the experimental period was used to multiply the cost per kg of feed to obtain the cost of feed consumed by each rabbit for the duration of experiment. The feed cost per kg live weight gain was calculated as a product of the feed cost per kg diet and feed conversion ratio for individual dietary treatments.

Statistical analysis

Results are expressed as means ± SEM. Data were evaluated by Analysis of Variance (ANOVA) procedures of Minitab for Windows (version 14; Minitab Inc., State College, PA, USA; Ryan *et al*., 1985). Means were separated by Turkey post-hoc test and a p-value of <0.05 was considered significant.

RESULTS AND DISCUSSIONS

The result of proximate analysis of dried pito mash (DPM) is shown in Table-1. DPM contained 28.76% crude protein, 9.94% crude fibre, 4.81% ether extract, 12.47% ash, 96.83% dry matter and gross energy of 1024 kcal/kg. These results are similar to those reported by Kagya-Agyemang *et al*. (2008).

Table-1. Proximate analysis of sun-dried pito mash.

Nutrient	Percentage composition
Crude protein	28.76
Crude fibre	9.94
Ether extract	4.81
Ash	12.47
Dry matter	96.83
Gross energy (kcal kg^{-1})	1024

The nutrient composition of experimental diets is shown in Table-2. The calculated crude protein for the treatment diets ranged from 17.72 to 17.49% and the calculated metabolizable energy ranged from 13.07 to 12.48 MJ kg^{-1}.

Table-2. Nutrient composition of experimental diets.

Ingredient	T1	T2	T3	T4
Maize	55	45	40	35
Pito mash	0	10	15	20
Soyabean meal	6	6	6	6
Groundnut cake	12	12	12	12
Fish meal	1.00	1.00	1.00	1.00
Palm kernel cake	10.00	10.00	10.00	10.00
Wheat bran	12.00	12.00	12.00	12.00
Dicalcium phosphate	3.25	3.25	3.25	3.25
Premix	0.25	0.25	0.25	0.25
Salt	0.50	0.50	0.50	0.50
Total	**100**	**100**	**100**	**100**
Calculated analysis				
Crude protein (%)	17.72	17.65	17.60	17.49
Crude fibre (%)	6.58	7.19	7.29	7.34
Ether extract	38.31	40.17	42.73	43.08
ME (MJ kg^{-1})	13.07	12.67	12.54	12.48

T1 (0% DPM); T2 (10% DPM); T3 (15% DPM); T4 (20% DPM)
Vitamin-mineral premix provided the following per kg of diet: Vitamin A- 400, 000 IU; vitamin D-800, 000IU; vitamin E-8000 mg; vitamin K-8000 mg; vitamin B_1-1, 200 mg; vitamin B_2-2000 mg; vitamin B_6-1800 mg; vitamin B_{12}-8 mg; niacin-18, 000 mg; calcium pantothenate-4, 000 mg; antioxidant 48, 000 mg; folic acid-400 mg; chlorine-120, 000 mg; biotin-20 mg; iron-40, 000 mg; manganese-48, 000 mg; iodine-600 mg; zinc-30, 000 mg; cobalt-120 mg; selenium-48 mg.

The performance characteristics of rabbits fed the various diets are shown in Table-3. The animals had similar body weights at the start of the experiment. The final body weight and the total weight gain decreased significantly ($p<0.05$) with increasing levels of DPM in the treatment diets.

Table-3. Growth performance of rabbits fed dried pito mash (DPM) based diets.

Parameters	T1	T2	T3	T4	SEM
Initial body weight (g)	525^{a}	532^{a}	528^{a}	530^{a}	2.76
Final body weight (g)	1120^{a}	1055^{b}	1027^{c}	1004^{d}	8.14
Daily feed intake (g)	65.29^{a}	63.10^{a}	61.51^{a}	59.87^{a}	2.04
Total weight gain (g/day)	595^{a}	523^{b}	499^{b}	474^{c}	16.31
Daily weight gain (g/day)	12.14^{a}	10.67^{a}	10.18^{a}	9.67^{a}	0.28
Feed conversion ratio	5.38^{a}	5.91^{a}	6.04^{a}	6.19^{a}	1.96
Mortality	0.00	0.00	0.00	0.00	0.00

a, b, c, d means in the same row bearing different superscripts are significantly different at 5% ($p<0.05$).
SEM (standard error of the means); T1 (0% DPM); T2 (10% DPM); T3 (15% DPM); T4 (20% DPM)

The dietary treatments had no significant ($p>0.05$) effect on daily feed intake, daily weight gain and feed conversion ratio. The rabbits fed diet containing 20% DPM had higher feed conversion ratio than their counterparts fed the control, 10%, and 15% DPM diets. Hence, they had the least performance. The increase in fibre level brought about a decrease in body weight gain while feed conversion ratio increased with a decrease in daily feed intake. According to McDonald *et al*. (2002), millet contains a high content of indigestible fibre owing to the presence of hulls which are not removed by ordinary harvesting methods and therefore end up in DPM. Furthermore, the seeds of some sorghum species contain tannins which reduce protein digestibility and also make the seeds bitter (Kagya-Agyemang *et al*., 2008). Hence, increasing the fibre level of a diet leads to a resultant decrease in protein intake and therefore body weight (Oso *et al*. (2006).

Table-4. Carcass characteristics of rabbits fed dried pito mash (DPM) based diets.

Parameters	T1	T2	T3	T4	SEM
Slaughter weight (g)	1120^{a}	1055^{b}	1027^{c}	1004^{d}	1.64
Dressed weight (g)	754.98^{a}	654.94^{b}	548.52^{c}	511.84^{c}	3.14
Dressing percentage	67.41^{a}	62.08^{a}	53.41^{b}	50.98^{b}	5.12
Heart (% LBW)	0.02	0.02	0.02	0.02	0.09
Lungs (% LBW)	0.05	0.06	0.06	0.06	0.05
Liver (% LBW)	0.23	0.26	0.30	0.30	0.04
Spleen (% LBW)	0.01	0.01	0.01	0.01	0.08
Kidneys (% LBW)	0.06	0.06	0.06	0.06	0.07
Loin (% LBW)	0.72	0.85	0.98	1.07	0.05
Legs (% LBW)	1.06	1.28	1.67	1.78	0.46

a, b, c, d means in the same row bearing different superscripts are significantly different at 5% ($p<0.05$).
SEM (standard error of the means); T1 (0% DPM); T2 (10% DPM); T3 (15% DPM); T4 (20% DPM);
% LBW means percent of live body weight.

The carcass characteristics of rabbits fed DPM based diets are shown in Table-4. The slaughter weight and dressed weight decreased significantly ($p<0.05$) as the levels of DPM in the experimental diets increased. Rabbits fed the control diet and the diet containing 10% DPM had higher ($p<0.05$) dressing percentage than rabbits fed the diets with 15% and 20% DPM inclusion levels. The dressing percentage values were similar to the values reported by Alade *et al*. (2005) and Togun *et al*. (2006). There were no significant ($p>0.05$) dietary treatment effects on the heart, lungs, liver, spleen and kidney weights when they were expressed as percentage of the live body weight (% LBW) of rabbits fed the four treatment diets. This indicates that the inclusion of DPM in rabbit diets up to 20% had no effect on these organs and that DPM is a very good feed ingredient in rabbit diets. The loin and legs are the most economically important portions of the carcass and also provide the greatest portion of edible meat in rabbits (Fanimo *et al*., 2003). The inclusion of DPM in the diets of the rabbits consistently increased the relative weight of the loin and legs.

Table-5. Haematological and biochemical components of rabbits fed sun-dried pito mash.

Parameters	T1	T2	T3	T4	SEM
Haematological components					
Red blood cell (x10^6/µl)	5.98	6.15	6.07	6.19	0.37
White blood cell (x10^3/dl)	5.14	5.62	5.23	5.51	0.39
Haemoglobin (g/dl)	9.11	9.25	8.70	8.64	0.94
Packed cell volume (%)	31.65	33.40	32.02	31.83	1.06
Lymphocytes (%)	36.72	35.89	38.10	36.74	1.42
Neutrophils (%)	40.57	41.72	37.66	39.93	2.03
Eosinophils (%)	1.26	1.08	1.52	2.10	0.87
Biochemical components					
Total serum protein (g/dl)	6.17	5.83	5.56	6.19	0.29
Albumin (g/dl)	3.05	2.37	2.71	3.11	0.20
Globulin (g/dl)	2.30	1.97	2.11	2.04	0.87
Cholesterol (mg/dl)	50.10	48.59	50.36	51.06	0.92

SEM (Standard error of the means). T1 (0% DPM); T2 (10% DPM); T3 (15% DPM); T4 (20% DPM)

The haematological and biochemical components of rabbits studied are shown in Table-5. The feeding of DPM to rabbits did not show significant ($p>0.05$) variation in the blood chemistry of the animals. The haematological components measured were within the normal physiological ranges reported for rabbits: haemoglobin (8.0-17.5 g dl^{-1}), packed cell volume (30 -50%), red blood cell (4.0-8.0 x 10^6 /µl), white blood cell (5.0-12.0 x10^3/dl), neutrophils (35-55%), lymphocytes (25-50%) and eosinophils (0.0-5%) (Jenkins, 1993; Hillyer, 1994; Nuhu, 2010). Also, there were no significant ($p>0.05$) dietary treatment effects on the biochemical components of the rabbits fed DPM. In this study, the values of biochemical components fell within the normal physiological ranges for rabbits: total serum protein (5.4-7.5 g/dl), albumin (2.5-4.5 g/dl), globulin (1.9-3.5 g/dl) and cholesterol (35.0 - 60.0 mg/dl) (Jenkins, 1993; Hillyer, 1994; Nuhu, 2010). These results appear to indicate that the nutrients in the different treatment diets fed to the rabbits were balanced and hence supported their normal performance to maintain the normal haematological profile (Madubike and Ekenyem, 2006) and biochemical components of the animals. These results together with the fact that there was no mortality or health related problems recorded during the study indicate that DPM can completely replace maize up to 20% without adverse effects on growth performance of rabbits if good sanitation practices are maintained.

Table-6. Cost benefits analysis of replacing maize with dry pito mash in rabbit diets.

Parameters	T1	T2	T3	T4	SEM
Total feed intake (kg)	3.199	3.092	3.014	2.934	0.72
Unit cost of feed (GH¢)	1.25	1.01	0.99	0.98	0.09
Total feed cost/kg (GH¢)	4.00^a	3.12^{ab}	2.98^b	2.88^b	0.91
Cost of feed/kg live weight gain (GH¢)	21.52^a	18.44^b	18.00^b	17.83^b	3.56

a, b, means in the same row bearing different superscripts are significantly different at 5%($p<0.05$).
SEM (standard error of the means); T1 (0% DPM); T2 (10% DPM); T3 (15% DPM); T4 (20% DPM)

The cost benefit analysis of replacing maize with dry pito mash (DPM) in rabbit diets is shown in Table-6. The total feed cost per kilogramme was significantly ($p<0.05$) reduced as the inclusion levels of DPM in rabbit diets increased. The control diet (T1; 0% DPM) recorded the highest feed cost when compared with T3 (15% DPM) and T4 (20% DPM) (Table-6). This occurred as a result of the high quantity of maize that was contained in the control diet which made it very expensive when compared with DPM which is generally very cheap. Furthermore, the cost of feed per kilogramme live weight gain was significantly ($p<0.05$) higher for the control diet (T1; % DPM) when compared with the other treatment diets (Table-6). As a result, it was relatively cheaper to produce a kilogramme of live weight gain when rabbits were fed 10, 15 and 20% DPM, respectively.

CONCLUSIONS

The results of the present study have shown that dry pito mash (DPM) is suitable for replacing maize in the diets of rabbits. This is because the replacement of maize by DPM in rabbit diets up to 20% showed no deleterious effect on the growth performance of rabbits. Again, the total feed cost was significantly reduced as the inclusion levels of DPM in rabbit diets increased. Therefore, it is possible to produce rabbits at relatively cheaper prices when the maize component of rabbit diets is completely replaced by DPM up to 20%.

ACKNOWLEDGEMENTS

The authors gratefully acknowledge the support from the Department of Animal Science Education, College of Agriculture Education, University of Education, Winneba, Mampong-Ashanti, Ghana.

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