VOL. 5, NO. 1, JANUARY 2010 ISSN 1990-6145
ARPN Journal of Agricultural and Biological Science

www.arpnjournals.com

REPLACEMENT VALUE OF BOILED MANGO KERNEL MEAL FOR MAIZE IN BROILER FINISHER DIETS

Diarra S. S.[1], Usman B. A.[2] and Igwebuike J. U.[3]
[1]Department of Animal Health and Production, Yobe College of Agriculture, Damaturu, Nigeria
[2]Department of Animal Health and Production, Mohamet Lawan College of Agriculture, Maiduguri, Nigeria
[3]Department of Animal Science, University of Maiduguri, Maiduguri, Nigeria
E-Mail: siakadiarra@yahoo.com

ABSTRACT

The performance of finishing broiler chickens fed graded levels of boiled mango kernel meal as a replacement for maize was investigated in a 35-day experiment. One hundred and twenty (120) 28-day old Anak broiler chickens were individually weighed and randomly assigned to 4 groups/treatments of similar weight (589.70g ± 0.16 SE) containing 3 replicates of 10 birds each. Four diets in which boiled mango kernel meal replaced maize at 0.00, 20.00, 40.00, and 60.00% and clean drinking water were fed for the period of the experiment (35 days). Growth performance, hematological and serum biochemical indices, and carcass characteristics formed the response criteria. The results showed no significant (P>0.05) treatment differences in final body weight and daily weight gain. Daily feed intake and feed conversion ratio were significantly (P<0.05) improved on the 60% mango kernel diet compared to the other 3 treatments. The feed cost of meat production (₦/kg gain) was significantly (P<0.05) reduced on the 60%, followed by the 40% mango kernel diets. The hematological and serum biochemical indices, and the carcass parameters showed no significant (P>0.05) treatment differences. Thus, the cost of broiler meat production can be reduced by replacing up to 60.00% of dietary maize with boiled mango kernel meal in the finisher diet without adverse effects on growth, blood parameters and carcass measurements.

Keywords: broiler finisher, maize, mango kernel, performance.

INTRODUCTION

As climate is fast changing, the production of maize cannot keep pace with its demand for food and industrial uses such as ethanol and bio-fuel production. The result of this will be increased demand of cereals such as millet and sorghum for food, further worsening the food-feed competition in the near future. There must therefore, be growing interest in non-cereal energy sources for poultry feeding.

Mango (*Mangifera indica* L.) kernel is a good source of soluble carbohydrate [1, 2]. Its protein is comparable to that of maize, but it has higher fat than maize [1]. However, mango kernel is reported to contain some tannin which exerts antinutritive effects in poultry [3, 4] and man [5]. Boiling has been reported to be an effective method of tannin reduction. Boiling reduced up to 53% tannin in African oil bean [6] and about 55% in mango kernel [2].

Recently, [2] replaced 20% of dietary maize in broiler chickens with raw or boiled mango kernel meal and observed no significant differences in performance between the control and the boiled kernel meal diets. Because of its abundant availability and cheap cost, it would be interesting to investigate higher levels of mango kernel meal in poultry diets. This study reports the effect of increasing dietary boiled mango kernel meal as a replacement for maize on broiler finisher performance.

MATERIALS AND METHODS

Study area

The study was conducted at the Poultry Unit of Yobe College of Agriculture Livestock Farm. The college is located in Southern Yobe, half way between Gujba and Buni Yadi towns. The area is located withtin latitude 10^0 and 14^0 N and longitude 11^0 30' and 14^0 45'E with the Sudan-savannah type vegetation which consists of scrubby vegetation interspersed with tall tree woodlands [7]. Many cultivars of both indigenous and improved mango are produced in large quantities in the area with the peak production in April-May. During this period, mango seed (containing the kernel) poses a serious environmental problem because it has no food, feed or industrial use in the area.

Source and processing of mango kernel meal

Mango seed was collected by children during the month of May (peak of the mango season in Gujba, the study area). The kernel was obtained by cutting the seed open using a knife. The fresh kernel was chopped to reduce the particle size, boiled in tape water at 100^oc for 30mn, sun-dried for 72 hours, ground in a hammer mill and used in the formulation of the experimental diets.

Experimental diets

Four isoproteinous finisher diets containing 19% crude protein were formulated for the experiment (Table-1). Diet 1 which was the control contained no (0.00%) mango kernel meal. In diets 2, 3, and 4 mango kernel meal replaced dietary maize at 20.00, 40.00 and 60.00%, respectively.

Table-1. Ingredient and chemical composition of the broiler finisher diets.

Ingredients (%)	**Replacement level of mango kernel meal for maize** (%)			
	0.00	**20.00**	**40.00**	**60.00**
Maize	38.97	31.18	23.39	15.60
Mango kernel meal	0.00	7.79	15.58	23.37
Wheat bran	18.98	18.98	18.98	18.98
Soybean meal (full-fat)	28.60	28.60	28.60	28.60
Sesame seed meal (full-fat)	10.30	10.30	10.30	10.30
Bone meal	2.40	2.40	2.40	2.40
Salt	0.30	0.30	0.30	0.30
[1]Premix	0.25	0.25	0.25	0.25
Methionine	0.20	0.20	0.20	0.20

[1]Bio-mix Finisher supplied/kg: Vit A = 4,000,000.00 IU; Vit D_3 = 800,000.00 IU; Vit E = 9,200.00mg; Niacin = 11,000.00mg; Vit B_1 = 720.00mg; B_6 = 1,200.00mg; B_{12} = 6.00mg; Pantothenic acid = 3,000.00mg; Biotin = 24.00mg; Folic acid = 300.00mg; Choline Chloride = 120,000.00mg; Cobalt = 80.00mg; Copper = 1,200.00mg; Iodine = 400.00mg; Iron = 8,000.00mg; Manganese = 16,000.00mg; Selenium = 80.00mg; Zinc = 12,000.00mg; Anti oxidant = 500.00mg.

Experimental birds and management

One hundred and twenty (120) Anak broilers raised together on commercial starter mash for the first 28 days and vaccinated against Gumboro and Newcastle diseases were used for the investigation which lasted 35 days. At the end of the 28th day, the birds were individually weighed and randomly allotted to four (4) treatments containing 3 replicates of 10 birds each. The birds in each replicate were housed in a floor pen measuring 1.95m^2 with the floor covered with wood shaving as litter material. The experimental diets in Table-1 and clean drinking water were provided *ad-libitum* throughout duration of the experiment.

Data collection

Data was collected on growth parameters (feed intake, weight gain, feed conversion ratio and the feed cost per weight gain), blood parameters (packed cell volume, hemoglobin concentration, red blood cell count, white blood cell count, and serum total protein, albumen, and globulin), and carcass measurements.

A weighed quantity of feed was supplied daily and the left over weighed the next day. Feed intake was determined by difference between the left over and the quantity fed the previous day. The birds were weighed weekly and weight gain calculated by difference between two consecutive weighing. Feed conversion ratio (FCR) was calculated as the ratio of the feed consumed to the weight gained (feed: gain). The cost of the feed (₦/kg) was calculated using the market price of the ingredients and multiplied by the FCR to determine the feed cost of meat production (₦/kg gain).

At the end of the experiment, 1 bird was randomly selected from each replicate (4 birds per treatment) and fasted overnight hematological and serum biochemical studies according to routinely available clinical methods as expounded by [8]. The birds were bled early in the morning (6.00 am) from the brachial vein using disposable syringes and needles (21 gauges). Samples for hematology were collected into samples tubes containing ethylene diamine tetra-acetic acid (EDTA) as anticoagulant while serological samples were collected into anticoagulant-free tubes. Serum was obtained after the blood was allowed to stand for 2 h at room temperature and centrifuged at 2,000 revolutions per minute (r.p.m) for 10 minutes to separate the cells from the serum.

The birds used foe blood collection were individually weighed and slaughtered for carcass measurements. Slaughtered birds were scalded in hot water (about 50^{o}c) for one (1) minute, plucked and eviscerated manually. The eviscerated chicken was dressed by removing the neck and the shanks and the dressed chicken (carcass) was weighed and carcass yield calculated by expressing the weight of the dressed chicken by the weight of the living bird before slaughter and multiplying by 100.

$$\text{Carcass yield (\%)} = \frac{\text{Weight of dressed chicken (g)}}{\text{Weight of live chicken (g)}} \times 100$$

Some cut-up parts (thighs, drumsticks, breast muscle) and the abdominal fat were also removed, weighed and expressed as percentage of their respective live weights.

Data analyses

The raw and boiled mango kernel meals and the diets were analyzed for proximate composition according to [9], and tannin content using the methods described by [10] as modified by [11]. The metabolizable energy (ME)

ARPN Journal of Agricultural and Biological Science

content was calculated according to [12] as ME (kcal/kg) = 432 + 27.91 (CP + NFE + 2.25 × EE).

Data collected on growth, blood, and carcass parameters were analysed for variance [13] using the statistical package of [14].

RESULTS

The results of chemical analyses (Table-2) showed no adverse effect of boiling on the crude protein, crude fibre, ether extract and nitrogen free-extract of the kernel. Boiling significantly (65.51%) reduced the tannin content of the kernel. The levels of ether extract, metabolizable energy, and tannin of the diets increased linearly as the replacement level of mango kernel meal increased.

From the growth performance data (Table-3), there were no significant ($P>0.05$) treatment differences in final body weight and daily weight gain. Daily feed intake and feed conversion ratio were significantly ($P<0.05$) improved on the 60% mango kernel diet compared to the other 3 treatments. The cost of the kg feed linearly reduced with increasing mango kernel meal. The feed cost of meat production (₦/kg gain) was significantly ($P<0.05$) reduced on the 60%, followed by the 40% mango kernel diets. A total of 4 birds (1, 2, 0, and 1 on the control, 20%, 40%, and 60% respectively) died during the experiment.

The results of blood analysis (Table-4) showed no significant ($P>0.05$) treatment differences in the hematological (packed cell volume, hemoglobin concentration, red blood cell count, and white blood cell count) and serum biochemical (serum protein, albumin, and globulin) indices

From the results of carcass measurements (Table-5) there were no significant ($P>0.05$) treatment effects on any of the carcass parameters (carcass yield, and the yields of the thighs, drumsticks, breast muscle, and abdominal fat) measured.

Table-2. Chemical composition of the diets and mango kernel meals.

Constituents (%)	**Replacement level of mango kernel meal for maize** (%)					
	0.00	**20.00**	**40.00**	**60.00**	**RMK**	**BMK**
Dry matter (DM)	94.72	94.67	94.68	95.01	92.84	93.22
Crude protein (CP)	19.08	19.00	18.95	18.97	8.70	8.63
Ether extracts (EE)	10.20	11.30	11.51	11.94	13.01	13.18
Crude fibre (CF)	5.75	5.29	5.25	5.15	2.02	2.10
Total ash	6.80	6.56	6.45	6.41	6.04	5.96
Nitrogen free extracts (NFE)	58.17	57.89	57.84	57.53	70.23	69.93
*ME (kcal/kg)	3,228.58	3,287.61	3,298.01	3,316.92	3,451.93	3,496.24
Tannin	0.04	0.06	0.09	0.12	12.41	4.28
Tannin reduction (%)					-	65.51%

*Metabolizable energy calculated according to (12): ME (kcal/kg) = 432 + 27.91 (CP + NFE + 2.25 × EE)

Table-3. Growth performance of finishing broilers fed graded levels of boiled mango kernel meal.

Parameters	**Replacement level of mango kernel meal for maize** (%)				
	0.00	**20.00**	**40.00**	**60.00**	**SEM**
Mean initial weight (g/bird)	589.90	589.10	590.00	589.78	0.16^{NS}
Mean final weight (g/bird)	2231.80	2222.60	2290.00	2406.33	9.19^{NS}
Mean daily feed intake (g/bird)	138.00^{a}	133.00^{a}	132.29^{a}	121.19^{b}	0.80*
Mean daily weight gain (g/bird)	38.34	38.10	40.00	43.33	0.39^{NS}
FCR (Feed: gain)	3.08^{a}	3.23^{a}	3.06^{a}	2.34^{b}	0.16*
[1]Feed cost (₦ /kg)	79.77	74.75	69.74	64.73	NA
Feed cost of meat					
Production (₦/kg gain)	198.63^{a}	180.15^{a}	164.59^{b}	139.17^{c}	1.65*
Mortality (%)	1	2	0	1	NA

a,b,c = means within the row bearing different superscripts differ significantly (P<0.05);
NS = not significant (P>0.05); SEM = standard error of the mean; * = significant (P<0.05);
[1] = calculated using the market price (₦) of the ingredients at the time of the experiment: maize = 70.59; wheat bran = 34.00, soyabean = 80.30, sesame seed = 90.10, bone meal = 40.00, salt = 33.00; methionine = 1100.00; premix = 600.00.
NA= Not analyzed

Table-4. Hematological and serum biochemical indices of finishing broilers fed graded levels of boiled mango kernel meal.

Parameters	**Replacement level of mango kernel meal for maize** (%)				
	0.00	**20.00**	**40.00**	**60.00**	**SEM**
Packed cell volume (%)	28.81	28.78	28.71	28.79	0.05^{NS}
Hemoglobin concentration (g/dl)	9.12	9.14	9.10	9.09	0.04^{NS}
Red blood cell count (10^6/mm^3)	4.80	4.74	4.79	4.82	0.05^{NS}
White blood cell count (10^3/mm^3)	24.04	23.98	24.02	24.07	0.05^{NS}
Serum protein (g/dl)	4.00	4.01	3.97	3.94	0.03^{NS}
Serum albumin (g/dl)	1.83	1.86	1.84	1.81	0.04^{NS}
Serum globulin (g/dl)	2.17	2.15	2.13	2.08	0.05^{NS}

SEM = standard error of the mean; NS = not significant (P>0.05)

Table-5. Carcass characteristics of finishing broilers fed graded levels of boiled mango kernel meal.

Parameters (% live weight)	**Replacement level of mango kernel meal for maize** (%)				
	0.00	**20.00**	**40.00**	**60.00**	**SEM**
Carcass	68.10	67.97	68.12	68.00	0.07^{NS}
Thighs	12.05	11.86	11.98	12.02	0.07^{NS}
Drumsticks	10.30	10.11	10.36	10.24	0.08^{NS}
Breast muscle	16.53	16.35	16.71	17.04	0.14^{NS}
Abdominal fat	2.11	2.06	2.10	1.97	0.06^{NS}

SEM = standard error of the mean; NS = not significant (P>0.05)

DISCUSSIONS

The higher fat in mango kernel compared to maize [1] was reflected by a steady increase in the dietary fat as the level of replacement increased. As fat is much concentrated form of energy, the increase in dietary fat resulted to an increase in the metabolizable energy (ME) as the substitution level increased. Both the crude protein (CP) and the ME were adequate for finishing broilers in the tropics as recommended by [15]. A 55% tannin reduction by boiling mango kernel (whole kernel) for the same period of time (30mn) has been reported by [2]. The higher reduction in this experiment (65.51%) was probably as a result of the increased surface area of contact with the boiling water following chopping. Since boiling didn't completely remove tannin, the increase in dietary tannin with increasing mango kernel meal was attributed to the residual tannin in the kernel. However, the tannin level in all the diets was below the threshold of 0.3% reported in chicks by [16].

The higher ME (3316.92) on the 60.00% replacement could be the reason for the lower feed intake by birds on this diet as poultry consume feed to meet their energy requirement [15, 17]. The lower ($P<0.05$) feed intake and the similarity in the weight gain amongst treatments were the reasons for the significant ($P<0.05$) improvement in FCR on the 60.00% replacement diet. The reduction in the cost of the feed (₦/kg) with the increase in the level of mango kernel was the result of the price difference between mango kernel and maize at the time of the experiment. The kg of maize sold for about ₦ 70.59 while mango kernel was not purchased per se, but a little financial motivation representing about ₦ 5.00 per kg was given to the children collecting the kernel. The significant ($P<0.05$) reduction in the cost of meat production (₦ /kg gain) on the 40.00 and 60.00% replacement diets was attributed to the reduction in the feed cost on both diets and the improved ($P<0.05$) FCR on the 60.00% replacement diet. The mortality trend was not traceable to any dietary effect as the same number of birds died on the control and the 60.00% while no mortality was recorded on the 40.00% replacement diets.

All the blood parameters analyzed were comparable to values reported in literature as normal for chickens [18, 19, and 20]. This similarity in the blood parameters between treatments and their normal values are indications of nutritional adequacy of all the diets. Since the blood profile offers a valuable investigation and explanatory tool in nutritional assessment and health implications [21, 22, and 23] there is evidence to further indicate that dietary tannin levels were below the thresholds as reported by [16].

All carcass parameters measured assumed values as reported in literature [24, 25]. More so, the values were not significantly ($P>0.05$) different among the treatments. This is also an indication of nutritional adequacy of all the diets since like blood; carcass measurements are responsive to nutrition

CONCLUSIONS

It was concluded that up to 60% of the maize in broiler finisher diets can be replaced with boiled mango kernel meal without adverse effects on the growth, health and carcass parameters.

Because of the adverse effects of tannin on chicken performance, the kernel should be boiled at 100^{o}c for up to 30mn. Chopping prior to boiling may be a more efficient way of reducing tannin through increased surface area of contact with the boiling water.

REFERENCES

[1] Saadany R.M.A. Roda Y.H. and Saadany F.M. 1980. Studies on starch extraction from mango seed (*Mangifera indica*) as a new source of starch. Starch/Starke. 32: 113-116.

[2] Diarra S.S. and Usman B.A. 2008. Growth performance and some blood parameters of broiler chickens fed raw or cooked mango kernel meal. International Journal of Poultry Science. 7(4): 315-318.

[3] Jansman A.J., Verstegen M.W.A., Huisman J. and Van den berg J.W. 1995. Effects of hulls of faba beans (*Vicia faba*) with low or high content of condensed tannins on the apparent ileal and fecal digestibility of nutrients and the excretion of endogenous protein on ileal digesta and feces of pigs. Journal of Animal Science. 73: 118-127.

[4] Teguia A. 1995. Substituting mango kernels (*Mangifera indica* L.) for maize in broiler diets. Animal Feed Sci. Technol. 56: 155-158.

[5] Benjamin P.K. 2001. Mango kernel kills four more children. http://origin.timesofindia.com/articleshow.asp?art_id=1894600435.

[6] Ugherughe P.O. and Ekedolun P.A. 1986. Pasture and Range Potential of Borno State, Annals of Borno. 31: 179-192.

[7] Bush B.M. 1975. Veterinary Laboratory Manual. William Heineman Medical Book Limited, London, U.K. p. 447.

[8] A.O.A.C. (Association of Official Analytical Chemist). 1990. Official Methods of Analysis. 19th Ed. Washington D.C.

[9] McCance R.A. and Widdowson E.H. 1935. Estimation of phytic acid. Journal of Biochemistry. 29: 2694-2695.

[10] Stewart E. 1974. Chemical Analysis of Ecological Materials. Blackwell Scientific, Oxford, UK. pp. 298-312.

[11] Ichaponani J. 1980. Developing, availability and reliable test to predict biological availability of nutrients in poultry feeds. Report of the Indian Council for Agricultural Research, India.

[12] Steel R.G.D. and Torrie J.H. 1980. Principles and Procedures of Statistics, A biometrical Approach. 2nd Ed. McGraw Hills Book Co., New York, U.S.A.

[13] SPSS. 2001. Statistical Package for Social Science. Pc Version, SPSS Inc. 444 N. Michigan Avenue Chicago, USA.

[14] N.R.C. 1994. Nutrient Requirement of Poultry. 9th Revised Edition. National Academy Press, Washington, D.C.

[15] Jansman A.J.M., Huisman J. and Vander Poel A.F.B. 1989. Faba beans with different tannin contents; Ileal and fecal digestibility in piglets and growth in chickens. In: Recent Advances in Research in Antinutritional Factors in Legume seeds (Huisman, J., Vander Poel, A.F.B. and I.E. Liener, Eds. Washington, Netherlands, Puduc. pp. 176-180).

[16] Smith A.J. 2001. Poultry: The Tropical Agriculturalist. Revised Edition. Macmillan Education, Ltd. London and Oxford.

[17] Dukes H.H. 1975. Physiology of Domestic Animals. 8th edition, 2nd printing. (Melvin, J. Swenson, editor). Cornell University Press Limited, U.K.

[18] Merck Veterinary Manual. 1986. A Handbook of Diagnosis, Therapy and Disease Prevention and Control for the Veterinarian. 6th edition (Clarence, M. Fraser, editor), Merck and Co., Inc. Ranway, N.J., USA. pp. 1-903.

[19] Awoniyi T.A.M., Aletor V.A., Adebayo I.A. and Oyekunle R.O. 2000. Observations on some erythrocyte indices of broiler chickens raised on maggot meal-based diets. In: Ukachukwu S.N.; Ibeauchi J.A., Ibe S.N.; Ezekwe, A.G. and Abasiekong, S.F. (eds), Animal Production in the New Millennium: Challenges and Options pp. 132-134. Proceedings of the 25th Annual Conference of Nigerian Society of Animal Production, Michael Okpara University of Agriculture, Umudike, Nigeria. 19-23 March.

[20] Faniyi G. F. 2002. Inclusion of discarded cashew kernels in the diets of cockerel chicks. In: Fanimo, A. O. and Olanite, J. A. (eds). Contributory Role of Animal Production in National Development. pp. 109-111. Proceedings 7th Annual Conference of Animal Science Association of Nigeria. September 16-19. University of Agriculture, Abeokuta, Nigeria.

[21] Olorede B.R., Ajagbonna O.P. and Babatunde G.M. 1995. Comparison of air-dried and oven-dried poultry droppings in broiler rations. Effect on performance, organ weights and haematological parameters. International Journal of Animal Science. 10: 289-293.

[22] Odunsi A.A. and Longe O.G. 1995. Cocoa bean cake in poultry diets. 1. Chemical composition and nutritive value of cocoa bean cake in pullet chick diets. Journal of Applied Animal Research. 7: 91-97.

[23] Oluyemi J.A. and Roberts F.A. 1988. Poultry Production in Warm Wet Climates. Low cost editions. McMillan Education Limited, London.

[24] Jourdain R. 1980. Aviculture en Milieu Tropical, imprime par Beaudoin SA. 77120 boissy-le-chatel, France.

[25] Mbajunwa O.K. 1995. Effect of processing on some antinutritive and toxic components of the African oil bean seed (*Pentaclethra macrophylla Benth*). Journal of Food Science and Agriculture. 68: 153-158.