COST EFFECTIVENESS OF BROILER CHICKS SERVED BOILED MANGO (*Mangifera spp*) KERNEL COMPOSITE MEAL AS A REPLACEMENT FOR MAIZE.

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Supporting information

ABSTRACT: A study was carried out to investigate cost effectiveness of broiler chicks served boiled mango (*Mangifera spp)* kernel composite as a replacement for maize. A total of 180 day old broiler chicks were randomly assigned to four (4) treatments ($T1-T_4$), the experimental design used was CRD (completely randomized design). Each one of the treatments comprised of 3 replicates (fifteen birds per replicate). Feed cost was observed to have decreased as the levels of BMKCM increased in diets. Cost of feed intake was not significantly ($p>0.0$ 5) affected across the treatment groups. Feed cost/weight gain (g) increased with heavy supplementation with BMKCM. Negative values were observed with feed cost savings per gram meat, for 20% and 10% inclusions, thereby revealing that no savings accrued with supplementation of BMKCM at these levels probably because of the poor conversion ratio. However, profit and RNI tend to increase with heavy supplementation maybe because body weight was not a price determining factor. The study concludes that, for profit maximization, 15% of BMKCM should be included in chicks' diets.

Keywords: Broiler chicks, maize, boiled mango kernel, cost effectiveness

INTRODUCTION

In Nigeria, the cost of feed accounts for about 70-75% of the entire production cost. This is so because of the hike in the prices of conventional energy and protein feedstuffs; maize and soybean, respectively (Afolayan *et al*., 2012; Abang *et al*., 2013). This situation led to the quest for non-conventional feedstuffs which are readily available with little or no cost in most cases (Dafwang, 200; *Abang et al.*, 2015; Gyang *et al*., 2021; Bishop *et al*., 2021). Mango kernel is a bye-product of mango with a high carbohydrate (energy) content of about 58 -80%, fat (6-16%) and protein (6-13%) (*Abang et al.*, 2015). Mango kernel fits into this description because of its' poor usage by humans, high energy, also, its production duration (April-July) rimes with grain critical time of supply.

1.1 Objective of the Study

The objective of this study was to determine the optimum level of inclusion of BMKCM that is cost effective for the production of broiler chicks.

Materials and Method

3.1 Experimental Site

The experiment took place in the same location as described by Abang et al. (2018).

3.2 Experimental Diets

The total number of diets formulated for the research were 4 (four). Control diet was assigned T_1, for 0% BMKCM and T_2, T_3 and T_4 for 10, 15 and 20% BMKCM, respectively. The diets were analysed according to the methods of AOAC (2006).

3.5 Experimental Design

The experimental design used was completely randomized design (CRD). Each treatment was replicated thrice with ten birds for each replicate. The study duration was 8 weeks.

3.6 Experimental Animals and Management

The study was carried out with 180 day old starter broilers. The chicks were arbitrary selected and distributed to 4 treatments having three replicate with 15 birds each. The day old chicks were housed in a brooder pen within brooding guards for a period of four weeks brooding period after which they were moved into the Starter pen. In both the brooding phase and the Starter phase the birds were provided with drinkers and feeders. On the first day of arrival, the birds were given Molvait and Glucose to serve as anti – stress and energy. A strict vaccination schedule was followed. Vaccines were given against Newcastle, Gumboro and Coccidiosis. Also a strict level of hygiene was maintained serving as a preventive measure against infectious disease.

3.7 Data Collection

Data collected on performance parameters were; feed conversion, body weight and weight gain. The data were computed using the formulae as described by Abang *et al*. (2021)

3.8 Data Analysis

Data obtained were subjected to one way analysis of variance (ANOVA) technique using a statistical software; Minitab as described by Steel and Torrie (1980). Means were compared using Fisher method.

Table1: Composition of starter diets with BMKCM.

Ingredients	T1 0%	T2 10%	T3 15%	T4 20%
Maize	54.00	48.60	45.90	43.20
BMKM	0.00	5.40	8.10	10.80
Soybean	33.03	34.27	34.27	34.27
BDG	5.50	4.26	4.26	4.26
Blood meal	2.97	2.97	2.97	2.97
Bone meal	3.50	3.50	3.50	3.50
Salt	0.25	0.25	0.25	0.25
Lysine	0.30	0.30	0.30	0.30
Methionine	0.20	0.20	0.20	0.20
Premix	0.25	0.25	0.25	0.25
Total	**100**	**100**	**100**	**100**

Analysed Nutrients:

ME(Kcal)	2760.30	2792.02	2807.49	2823.63
CP	23.14	24.48	23.40	23.43

Lysine	1.32	1.32	1.31	1.32
Methionine	0.61	0.61	0.60	0.62
EE	3.94	3.19	4.35	4.50
CF	4.54	4.40	4.73	4.37
Ca	1.40	1.48	1.48	1.43
P	0.80	0.82	0.82	0.80

Results and Discussion

Proximate composition of BMKCM is represented in Table 2. Results of Proximate fractions were: 11.33%, 5.25%, 1.32%, 9.33%, 2.17% and 70.60% for moisture, crude protein (CP), crude fibre (CF), ether extracts (EE), ash and nitrogen free extract (NFE), respectively. The result of CP revealed that the CP (5.25%) for this current work was less than a CP of 7.00% and 11.38% reported for SMKM and FMKCM by Abang *et al*., 2016; 2018, respectively. The CP recorded by Abang *et al*., 2016 and Abang *et al*., 2018 were higher probably as a result of the different processing methods employed. Heat is said to denature protein, this could have accounted for the lower value of CP for BMKCM.

Elegbede *et al.* (1995) who worked on raw mango; reported a higher value of CF (2.5%) than the 1.32% recorded in this finding. The processing method (boiling) might have accounted for this reduction. Abang *et al.* (2018) recorded a CF of 1.49% with FMKCM. This value appears to be greater, probably, because less fibrous mango kernels dominated the composite; as different varieties have varying chemical composition. Fermentation process has been known for efficient reduction of fibre as the fungi (yeast) responsible for fermentation release enzymes that react on the cellulose (fibre).

The result of fats and oil (EE) was 9.33%. The value was less than the values of 12.8% (for RMK), 16.17% (for FMKCM) reported by Elegbede *et al.* (1995) (EE 12.8%) and Abang *et al.* (2018), respectively. This could be due to the boiling process which might have leached away the fats and oil.

The result of ash (mineral and vitamin) was 2.17%. The result was a bit higher than those reported by Abang *et al*., 2016 (ash 2.00%) and Abang *et al*., 2018 (ash 0.86%) who worked on SMKM and FMKCM respectively. This could be as a result of varietal difference in chemical composition of the used mango kernel and perhaps the processing methods used.

The result for moisture was 11.33%. This was different from the observations of Abang *et al*., 2016 (5.16%) and Abang *et al*., 2018 (8.64%) who worked with SMKM and FMKCM respectively. Probably because the kernels would have absorbed water during boiling process.

A high percentage of nitrogen free extract (NFE) was recorded (70.60%). The result was comparable with the values of 78.59 and 61.46% reported in SMKM and FMKCM by Abang *et al*., 2016 and Abang *et al*., 2018, respectively. It might be due to the different processing methods and the differences in varietal chemical composition of the mango kernels used.

Table 2: Proximate analysis of boiled mango kernel (%)

Parameters	CP	CF	EE	ASH	NFE	MOISTURE
	5.25	1.32	9.33	2.17	70.60	11.33

Cost effectiveness of feeding BMKCM to broiler chicks is presented in Table 5 and Return to

Naira Invested in Table 6. Feed cost reduced with inclusion levels of BMKCM across the treatments. Broiler chicks fed 20% BMKCM recorded least values. The observations were similar to the reports of Abang *et al*. (2016) and Abang *et al.* (2018) who noticed a reduction in feed cost with heavy inclusions of sun-dried mango kernel meal and fermented mango kernel composite meal in the diets of growing Japanese quail (*coturnix coturnix japonica*) and broiler chick across the treatments, respectively.

Feed cost per gram weight gain increased with inclusions of BMKCM in the diets resulting in negative values in cost savings per gram meat. This was in contrast with the reports of Abang *et al.,* 2016; 2018 who observed a reduction in feed cost per gram weight gain with supplementation across the diets leading to negative values in cost savings per gram meat when FMKCM and SMKM was served to growing quail and broiler chicks, respectively.

The result of average cost of feed intake was not significantly ($P>0.05$) different across the treatment group. Similar observation was made by Abang *et al.* (2018) when FMKCM was served to chicks. The observation contradicts the reports of Abang *et al.* (2016) who recorded significantly ($p<0.05$) lower values in the cost of feed consumed with heavy supplementation of SMKM across the treatments. The different processing methods adapted; sun-drying, was unable to reduce the anti-nutrients such as; tannins, saponins, pyhtates to a more tolerable level. These anti-nutrients would have reduced the palatability of the feed thereby, resulting in less consumption and subsequently reduced cost of feed intake by the quails.

Negative values were observed with feed cost savings per gram meat for 20% and 10% inclusions, thereby, revealing that no savings accrued with supplementation of BMKCM at these levels. However, Profit and RNI tend to increase with heavy supplementation of BMKCM probably, because body weight was not a price determining factor when chicks were sold. This trend was similar to the pattern of Abang *et al.,* 2016 and 2018 when SMKM and FMKCM were fed to quails and chicks, respectively.

Table 3: Cost of feed (Kg/ g (₦))

Treatments	Cost of feeds (₦/kg)	Cost of feeds (₦/g)
0%	180.65	0.181
10%	170.95	0.171
15%	166.67	0.166
20%	162.39	0.162

Table 4: Cost of feed intake per broiler chick/week/treatment ₦/g

Week	0%	10%	15%	20%
Week 1	0.085	0.081	0.082	0.084
Week 2	0.094	0.090	0.093	0.094
Week 3	0.165	0.164	0.165	0.165
Week 4	0.160	0.158	0.155	0.154

$\sum x$	91.05	84.28	82.50	80.71
$\sum \bar{x}$	22.76±0.021	21.07±0.021	20.63±0.021	20.18±0.020

Table 5: Cost effectiveness of serving boiled mango kernel composite meal to broiler chicks.

Parameter	0%	10%	15%	20%
Cost of feed (₦/g)	0.181	0.175	0.172	0.169
Average cost of feed consumed/bird/g	22.76±0.021	21.07±0.021	20.63±0.021	20.18±0.020
Feed conversion ratio	1.23	1.33	1.34	1.39
Cost of feed/g weight gain (₦/g)	27.99	28.02	27.64	28.05
Feed cost saving/g meat (₦/g)	-	-0.03	0.35	-0.06

Table 6: Return to naira invested per chick.

Expenditure	0%	10%	15%	20%
Cost of unsexed day old broiler chick	160	160	160	160
Cost of feed consumed/broiler starter (g)	22.76	21.07	20.63	20.18
Cost of transportation from Wurukum to Federal University of Agriculture Makurdi	6.66	6.66	6.66	6.66
Cost of medication/Broiler chicks	2.6 1	2.61	2.61	2.61
Miscellaneous	5.92	5.92	5.92	5.92
Total variable cost (TVC)	197.95	196.26	195.82	195.37
Revenue				
Sales per broiler Starter	700	700	700	700
Total revenue	700	700	700	700
Profit: (TR-TVC)	502.05	503.72	504.18	504.63
RNI=$\frac{profit}{total\ variable\ cost}$	2. 54	2.57	2. 57	2.58

Conclusion

It was concluded that chicks' diets could contain up to 20% BMKCM in place of maize, but for profit maximization, 15% replacement is recommended.

DECLARATIONS

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Authors' contribution

F. B. P. Abang conceived and wrote, original draft preparation, review and editing. T. N. Kperun performed editing and evaluation of manuscript before submission. T. A . Odunlade performed editing and evaluation of manuscript before submission. S. Attah performed editing and evaluation of manuscript before submission. E. J. Terwase performed editing and evaluation

of manuscript before submission.

Ethical Approval

All authors hereby declared that "The University Committee on Ethical Matters Examined and Approved all the Experiments".

Conflict of Interests

It was declared by the authors that there is no conflict of interest.

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