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PERFORMANCE OF BROILER CHICKENS FED DIETS CONTAINING DIFFERENTLY PROCESSED DESERT DATE (*Balanite aegyptiaca)* FRUIT MEAL

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ABSTRACT

The performance of broiler chickens fed differently processed desert date (*Balanite aegyptiaca*) was investigated. Three hundred and forty five (345) day old Arbor Acre breed of broiler chicks were assigned to five treatment groups each replicated thrice with twenty three chickens per replicate in a completely randomized design. Chickens in treatment one were fed the control diet while other treatment groups were fed diets containing differently processed *B. aegyptiaca* fruit meal (BAFM). *B. aegyptiaca* was processed by soaking, boiling, roasting and fermentation before incorporation in the diets at 20% for treatments two to five respectively. Weight gain among chickens fed soaked BAFM improved by 31.20 and 16.87% while feed conversion ratio improved by 30.62 and 23.86% at starter and finisher phases respectively. The performance of the birds significantly ($P<0.05$) declined in boiled and roasted, while the fermentation group recorded the poorest. The highest ($P<0.05$) water intake was observed among broiler chickens fed the control diet while others showed comparable ($P>0.05$) results. Processing by soaking showed significantly ($P<0.05$) better results compared to other processing methods. The study concluded that soaking *B. aegyptiaca* is preferable to other processing methods used in this study as it improved performance in broiler chickens.

Key words: *Balanite aegyptiaca*, broiler, performance, processing

INTRODUCTION

The high cost of conventional feed ingredients used in poultry feed formulation has necessitated the search for alternative feedstuffs in most developing countries. This is because soybean and groundnut which are conventionally consumed by man as plant protein are the major protein sources used in poultry feed formulation (Ghadge *et al*., 2009). Some factors such as population growth and urbanizationare contributors to the constant increase in cost of feed formulation as well as market prices of animal protein in Nigeria (Oboh, 2006). This underscores an imperative for animal nutritionists to search for protein sources for which there are little or no competition with man for utilization (Safaloah, 2006). According to Ayssiwede *et al.* (2011), there are a number of legumes and oil seeds whose nutritional and economic values could be determined and exploited for commercial feed formulation.

One of such legume is *Balanites aegyptiaca* fruit meal (BAFM), also known as Desert Date in English (Chothani and Vaghasiya, 2011). The authors further reported that the tree is

remarkable because of its availability during the dry season when foliage is less and prices of conventional feed protein sources are on the high side. In Nigeria, it grows in abundance in states such as Kaduna, Kano, Jigawa, Kebbi, Adamawa and Katsina. Annongu *et al.* (2009) reported that the raw fruit contains about 18% crude protein, Samuel *et al*. (1997) reported 36.26% and Lohlum *et al.* (2012) reported 31.73% crude protein. Irrespective of these variations, all the authors reported that processing improved protein level and other proximate compositions of *Balanites aegyptiaca*. Samuel *et al.* (1997) reported that the raw fruit contains high level of anti-nutritional factors such as tannin, cyanide, oxalate, phytate and saponin. The presence of these phytotoxins can limit its intensive utilization in poultry diets if not adequately processed. Hence, identifying a suitable processing method will enhance the opportunities for a versatile utilization of *Balanites aegyptiaca* fruit meal as an alternative or additional protein source in feeding farm animals. Lohlum *et al.* (2012) studied the effect of ethanol extraction on reduction of anti-nutritional factors in seeds and their reports showed that processing is a viable means of improving its inclusion level in animal diets. Annongu *et al.* (2009) also reported that processing by boiling, roasting and fermentation improved performance in pigs and it compared favourably with other standard diets.

Ghadge *et al*. (2009) reported that the processed fruit meal can be included in rabbit diet at 20% level without affecting growth performance and other productive parameters. Similarly, Annongu *et al.* (2009) found that 20% inclusion of the processed fruit meal in diet for pigs showed comparable performance with pigs on the control diet. Irrespective of the nutritional profile of *Balanites aegyptiaca* fruit and the promising results reported in studies on swine and rabbit, not much has been done on its utilization in poultry nutrition. There is a dearth of information in literature regarding the use of *Balanites aegyptiaca* in poultry feed, its optimal inclusion level and the effect on performance. This prompted the quest to investigate the performance of broiler chickens fed differently processed desert date (*Balanites aegyptiaca*) fruit meal.

JUSTIFICATION OF THE STUDY

The major challenge confronting poultry production in developing countries, is the high cost of feed ingredients as it accounts for 70-80% of the total cost of production (Ghadge *et al*., 2009). Hence, more effort is needed by animal nutritionists towards discovering the potentials this novel feedstuff.

Desert date (*Balanites aegyptiaca*) is one of such alternative plants that grows abundantly in several states in Arid and semi arid parts of Nigeria and can be obtained at low cost. According to Samuel *et al.* (1997), its proximate composition shows that it requires more attention to improve on its inclusion level, digestibility and utilization in poultry diet. There are inconsistencies in literature regarding its proximate composition as Annongu *et al.* (2009) reported 18% crude protein, Samuel *et al.* (1997) reported 36.26% and Lohlum *et al.* (2012) reported 31.73% crude protein. Apparently, no study has been found in literature regarding its utilization in poultry diets in Nigeria. It is therefore intended for this study to discover the potentials and use of *B. aegyptiaca* in broiler diet. Based on this premise, the performance of broiler chickens fed differently processed desert date (*Balanites aegyptiaca*) fruit meal was investigated.

MATERIALS AND METHODS

Experimental Site

The experiments was conducted at the Teaching and Research Farm, in the poultry unit, of the Department of Animal Science Ahmadu Bello

University, Zaria. The Departmental farm is located on latitude 11^0 $9^{'}$ $45^{''}$ N and longitude 7^0 $38^{'}$ $8^{''}$ E, at an altitude of 610m above sea level. The temperature of the area ranges between 26-40^{o}C depending on the season while the relative humidity during the dry and wet seasons are 21 and 72% respectively. The wet periods in Zaria are between May and October with annual rainfall of about 1500mm (IAR, 2012).

Collection of *Balanite aegyptiaca* fruits

Raw samples of fruits were collected from various locations in Jigawa state.

Processing of fruits

The fruits were processed by soaking in water, boiling, roasting and fermentation after which they were ground for incorporation in the diets.

Soaking of fruits

Samples of the raw fruit was processed by soaking in water for 96 hours at the rate of 200g per four litter of water in a container. The water was changed at regular intervals of 8 hours. At the end of the soaking duration, the water was drained and the fruits were sun dried after which they were taken to laboratory for proximate analysis.

Boiling of fruit

Four liter of water was poured into 8 liter aluminium pot and allowed to boil. Two hundred grams of raw fruit was poured into the already boiling water and it was covered with a lid. After 60 minutes, the water was drain out and the fruits were spread to cool and dry. The samples were later taken to the laboratory for proximate analysis.

Roasting of fruit

About 250g of raw fruit sample was processed by roasting in silver pot using kerosene stove which maintained steady blue flame. While roasting, the samples were stirred to avoid charring until a consistent dark brown colour of the fruit samples is attained. The fruit was roasted for duration of 60 minutes. An aluminum spoon of about 50g capacity was used to remove the processed samples. The fruit was then allowed to cool and later taken to laboratory for proximate analysis.

Fermentation of fruit

A batch of 250g of raw fruit was soaked in four liter of water for a period of 24 hours before the water was drained. The fruit was then bagged in air tight polythene bags to promote anaerobic fermentation in four different bags of 50g weight each. The samples were allowed to ferment for 96 hours after which the fruits were removed and dried before they were taken to the laboratory proximate analysis.

Laboratory analyses

Samples of raw and differently processed *Balanite aegyptiaca* fruit were analysed for their proximate compositions at the Biochemistry Laboratory, Department of Animal Science, A.B.U. Zaria according to procedures described by AOAC (1994). Anti-nutritional factors (saponin, oxalate, phytic acid and tannic acid) were also determined according to methods described by Mega (1982) respectively.

Experimental design and management of chickens

Three hundred (345) day old Arbor Acre breed of broiler chicks were used at the starter phase. They were weighed and allotted to five dietary treatments, each replicated thrice with twenty (23) chicks per replicate in a completely randomized design. After 28-days of the feeding trial, chickens in replicates of their respective treatments were pooled together and fed a common diet for one week after which they were weighed and randomly assigned to five experimental treatment groups of 21 chickens per replicate in the finisher phase.

At both phases, the chickens were raised on deep litter with feed and water provided *ad libitum*. Management practices ideal for broiler chickens were strictly adhered to. Parameters measured were initial weight, final weight, weight gain, feed intake and water intake. Feed conversion ratio and feed cost per kilogram

gain were calculated while mortality was recorded as it occurred.

Experimental diets

Five broiler starter and finisher diets were formulated. The test ingredient BAFM was not included in the control treatment diet. The differently processed BAFM was included at 20% in treatments diets. The compositions of the experimental diets for the starter and finisher phases are presented in Tables 1 and 2 respectively.

Data analyses

Data obtained from the experiment was subjected to analysis of variance, using the general linear model procedure of (SAS, 2001). Significant differences among treatment means were separated using the Duncan's multiple Range Test.

Table 1: Composition of broiler starter diets containing differently processed *Balanite aegyptiaca* fruit meal (0-4 weeks)

Ingredients (%)	Control	Soaked BAFM	Boiled BAFM	Roasted BAFM	Fermented BAFM
Maize	58.00	58.00	58.00	58.00	58.00
Groundnut cake	20.00	0.00	0.00	0.00	0.00
Soya cake	16.00	16.00	16.00	16.00	16.00
BAFM	0.00	20.00	20.00	20.00	20.00
Bone meal	3.00	3.00	3.00	3.00	3.00
Maize offal	1.40	1.40	1.40	1.40	1.40
Limestone	0.60	0.60	0.60	0.60	0.60
Common Salt	0.30	0.30	0.30	0.30	0.30
*Vitamin Premix	0.30	0.30	0.30	0.30	0.30
Methionine	0.20	0.20	0.20	0.20	0.20
Lysine	0.20	0.20	0.20	0.20	0.20
Total	100.00	100.00	100.00	100.00	100.00
Calculated analysis					
ME (Kcal/Kg)	2902	2925	2925	2925	2925
Crude Protein (%)	21.37	20.29	20.32	20.36	20.36
Crude fibre (%)	4.76	4.89	4.89	4.89	4.89
Ether Extract (%)	4.54	6.02	6.02	6.02	6.02
Calcium (%)	1.20	1.20	1.20	1.20	1.20
Phosphorus (%)	0.62	0.62	0.62	0.62	0.62
Lysine (%)	1.11	1.10	1.10	1.10	1.10
Methionine (%)	0.72	0.71	0.71	0.71	0.71
Feed cost/kg diet (₦)	80.20	82.10	84.61	85.97	83.11

*Biomix chick premix provide per kg of diet vit A, 10,000 I.U; vit D3, 2000 I.U; vit. E 23mg; vit K, 2.mg; calcium pantothenate, 7.5mg; B12, 0.015mg; folic acid, 0.75mg; choline chloride, 300mg; vit B1, 1.8mg; vit B2, 5mg; vit B6, 37mg; manganese, 40mg; iron, 20mg; zinc, 53.34mg; copper, 3mg; iodine, 1mg; cobalt, 0.2mg; selenium, 0.2mg; zinc, 30mg.BAFM=Balanites fruit meal

Table 2: Composition of broiler finisher diets containing differently processed *Balanite aegyptiaca* fruit meal (5-8 weeks)

Ingredients (%)	Control	Soaked BAFM	Boiled BAFM	Roasted BAFM	Fermented BAFM
Maize	61.50	61.50	61.50	61.50	61.50
Groundnut cake	20.00	0.00	0.00	0.00	0.00
Soya cake	12.20	12.20	12.20	12.20	12.20
BAFM	0.00	20.00	20.00	20.00	20.00
Bone meal	3.00	3.00	3.00	3.00	3.00
Maize offal	1.50	1.50	1.50	1.50	1.50
Limestone	0.80	0.80	0.80	0.80	0.80
Common Salt	0.30	0.30	0.30	0.30	0.30
*Vitamin Premix	0.30	0.30	0.30	0.30	0.30
Methionine	0.20	0.20	0.20	0.20	0.20
Lysine	0.20	0.20	0.20	0.20	0.20
Total	100.00	100.00	100.00	100.00	100.00
Calculated analysis					
ME (Kcal/Kg)	2932	2938	2938	2938	2938
Crude Protein (%)	20.01	19.74	19.74	19.74	19.74
Crude fibre (%)	4.96	4.95	4.95	4.95	4.95
Ether Extract (%)	4.91	4.91	4.91	4.91	4.91
Calcium (%)	1.14	1.14	1.14	1.14	1.14
Phosphorus (%)	0.61	0.62	0.62	0.62	0.62
Lysine (%)	1.20	1.17	1.17	1.17	1.17
Methionine (%)	0.68	0.65	0.65	0.65	0.65
Feed cost/kg diet (₦)	83.50	85.61	88.02	90.46	84.71

*Biomix chick premix provide per kg of diet vit A, 10,000 I.U; vit D3, 2000 I.U; vit. E 23mg; vit K, 2.mg; calcium pantothenate, 7.5mg; B12, 0.015mg; folic acid, 0.75mg; choline chloride, 300mg; vit B1, 1.8mg; vit B2, 5mg; vit B6, 3mg; manganese, 40mg; iron, 20mg; zinc, 53.34mg; copper, 3mg; iodine, 1mg; cobalt, 0.2mg; selenium, 0.2mg; zinc, 30mg, BAFM= fruit meal

RESULTS

Proximate compositions of raw and processed *B. aegyptiaca* Fruit Meal

The proximate compositions of raw and processed *B. aegyptiaca* fruit meal is presented in Table 3. The proximate compositions of the raw fruit were as follows; dry matter 91.35%, crude protein 17.98%, ether extract 10.98%, crude fibre 7.41%, ash 9.56% and nitrogen free extract 45.47%. There were slight effects of processing on proximate compositions between the raw fruit and differently processed BAFM. Crude protein of BAFM (19.37-20.11%) increased in all processing methods used compared to the raw form (17.98%). Similarly, there were marked decline in levels of ether extract, crude fibre and ash contents in all processed BAFM compared to the raw state.

Anti-nutritional factors in raw and differently processed *B. aegyptiaca* fruit meal

Anti-nutritional factors in raw and processed *B. aegyptaca* fruit meal is presented in Table 4.

Raw *Balanite aegyptiaca* fruit meal was found to contain 0.91% tannin, 7.00% phytate, 8.70% saponin and 129.8 mg/100ml oxalate. There were marked effects of processing on reduction of anti-nutritional factors in BAFM. The least reductions of tannin, phytate, saponin and oxalate were observed in fermented BAFM. The highest reduction of tannin, and oxalate was observed in soaked BAFM. The highest reduction of phytate was observed in roasted BAFM while boiled MAFM showed highest result in saponin reduction.

Table 3: Proximate compositions of raw and processed *B. aegyptiaca* Fruit Meal

Parameters (%)	Raw	Soaked	Boiled	Roasted	Fermented
Dry matter	91.35	91.93	87.26	93.29	89.20
Crude protein	17.98	19.92	19.37	20.11	19.86
Ether extract	10.98	8.10	10.42	8.90	9.42
Crude fibre	7.41	5.22	6.10	5.82	5.13
Ash	9.56	8.10	8.15	7.65	9.50
Nitrogen free extract	45.47	52.25	44.22	50.81	46.43

Table 4: Anti-Nutritional Factors in raw and Processed *B. aegyptiaca* Fruit Meal

Parameters	Raw	96hrs Soaked	%Red.	60mins Boiled	%Red.	60mins Roasted	%Red.	96hrs Ferm.	%Red.
Tannin (%)	0.91	0.25	72.52	0.39	57.14	0.38	58.24	0.67	35.33
Phytate (%)	7.00	1.45	79.29	2.21	68.43	1.24	82.28	2.66	62.00
Saponin (%	8.70	2.97	65.86	2.80	67.82	3.80	56.32	4.80	44.83
Oxalate (%) (mg/100)	129.8	8.80	92.31	59.40	53.85	70.40	46.15	70.60	30.44

%Red= Percentage reduction, Ferm. - Fermentation

Performance of Broiler Starter Chicks Fed Diets Containing Differently Processed *Balanite aegyptiaca* Fruit Meal (0-4 weeks)

The performance of broiler starter chicks fed diets containing differently processed *Balanite aegyptiaca* fruit meal (BAFM) is presented in Table 5. It was observed that chickens fed the control diet and diet containing soaked BAFM showed significantly ($P<0.05$) better results in weight gain compared to other treatment groups. This performance was followed by chickens fed boiled BAFM based diets which were significantly ($P<0.05$) better than roasting and fermenting methods of processing. There was significant ($P<0.05$) increase in feed consumption among chickens fed the control

diet compared to all other chickens fed differently processed BAFM based diets. Chickens fed the control diet and diet containing soaked BAFM showed the best results (P<0.05) in feed conversion ratio. Feed conversion ratio was significantly (P<0.05) better for chickens fed boiled BAFM based diets while processing by roasting followed. The poorest result in feed conversion ratio was observed for chickens fed diet containing fermented *Banlanite aegyptiaca* fruit meal. No significant (P>0.05) difference was observed in feed cost per kilogram gain for chickens in all treatment groups. There was significant (P<0.05) difference in water intake as chickens fed the control diet and diet containing soaked BAFM showed the highest values. No significant (P>0.05) difference was observed in water intake among chickens in other treatments groups. No mortality was observed among chickens across all treatment groups.

Table 5: Growth Performance of Broiler Starter Chicks Fed Diets Containing Differently Processed *Balanite aegyptiaca* Fruit Meal (0-4 weeks)

Parameters	Control	Soaked BAFM	Boiled BAFM	Roasted BAFM	Fermented BAFM	SEM
Initial weight (g)	40.00	40.00	39.99	40.00	40.00	0.01
Final weight (g/b)	778.26^{a}	788.41^{a}	613.04^{b}	602.90^{b}	555.07^{c}	18.84
Weight gain (g/b)	738.26^{a}	748.41^{a}	573.04^{b}	496.23^{c}	514.89^{c}	29.65
Feed intake (g/b)	1385.51^{a}	1342.03^{b}	1285.51^{c}	1344.64^{b}	1326.09^{b}	18.89
Feed conversion ratio	1.88^{a}	1.79^{a}	2.25^{b}	2.37^{c}	2.58^{d}	0.08
Feed cost per kg gain (₦)	148.04	131.92	129.88	129.28	133.04	14.49
Water intake (ml/b/d)	313.02^{a}	293.85^{b}	306.29^{ab}	300.50^{b}	299.92^{b}	3.40
Mortality (%)	0.00	0.00	0.00	0.00	0.00	0.00

a, b, c, d= Means with different superscript on the same row differ significantly (P<0.05), SEM= Standard error of means, g/bird= gram per bird

Performance of Broiler Finisher Fed Diets Containing Differently Processed *Balanite aegyptiaca* Fruit Meal (5-8 weeks)

The performance of broiler finisher chickens fed diets containing differently processed *Balanite aegyptiaca* fruit meal (BAFM) is presented in Table 6. Chickens fed the control diet showed significantly (P<0.05) higher weight gain compared to other treatment groups. This performance was followed by chickens fed diets containing soaked and boiled BAFM. No significant (P>0.05) difference was observed in weight gain among chickens fed roasted and fermented BAFM as they showed the poorest result. Chickens fed the control diet showed significantly (P<0.05) higher feed consumption. Chickens fed diets containing soaked, boiled and roasted BAFM showed similar (P>0.05) results in feed intake. The poorest result was observed among chickens fed diet containing fermented BAFM. Feed conversion ratio was comparable (P>0.05) among chickens fed the control and diet containing soaked BAFM based diets. This performance was followed by chickens fed diet containing boiled BAFM. Chickens fed diet containing roasted BAFM showed significantly (P<0.05) better feed conversion ratio compared to those fed

fermented BAFM based diet. Chickens fed the control diet and diet containing soaked and boiled BAFM showed significantly (P<0.05) better feed cost per kilogram gain compared to others. This was followed by chickens fed roasted BAFM based diet which was significantly (P<0.05) better than chickens that consumed fermented BAFM. Water consumption was highest among chickens fed the control diet. Chickens in other treatments showed similar (P>0.05) results in water consumption.

Table 6: Growth Performance of Broiler Finisher Chickens Fed Diets Containing Differently Processed *Balanite aegyptiaca* Fruit Meal (5-8 weeks)

Parameters	Control	Soaked BAFM	Boiled BAFM	Roasted BAFM	Fermented BAFM	SEM
Initial weight (g)	952.38^{b}	1028.65^{a}	780.95^{c}	761.90^{d}	733.33^{e}	3.71*
Final weight (g/b)	2634.25^{a}	2176.19^{b}	1882.54^{c}	1750.79^{d}	1687.30^{d}	52.57*
Weight gain (g/b)	1681.87^{a}	1147.54^{b}	1101.59^{b}	988.89^{c}	953.97^{c}	51.94*
Feed intake (g/b)	3598.41^{a}	2917.46^{b}	2892.06^{b}	2831.75^{b}	2668.25^{c}	62.49*
Feed conversion ratio	2.15^{a}	2.33^{a}	2.63^{b}	2.87^{c}	3.06^{d}	0.09*
Feed cost per kg gain (₦)	317.80^{a}	307.18^{a}	341.48^{a}	371.26^{b}	406.48^{c}	11.96*
Feed cost per diet (₦)	148.0	132.9	131.8	129.8	129.2	0.00
Water intake (ml/b/d)	313.02^{a}	293.85^{b}	306.29^{b}	300.50^{b}	299.92^{b}	3.40*
Mortality (%)	0.00	0.00	0.00	0.00	0.00	0.00

a, b, c, d, e= Means with different superscript on the same row differ significantly (P<0.05), SEM= Standard error of mean

DISCUSSION

Proximate Composition of Raw and Differently Processed *B. aegyptiaca* Fruit Meal

The dry matter content observed for raw *Balanites aegyptiaca* (91.35%) is lower than 955.00 g/KgDM (95.5%) reported by Njidda and Ikhimioya (2010). Crude protein content of raw *Balanites aegyptiaca* was found to be 17.98%, which is higher than 15.0% reported by Abbator and Kibon (1999). Kamal and Nour (2016) reported 17.33% as crude fibre for raw *Balanites aegyptiaca*, which is higher than 7.41% obtained in this study. Kamal and Nour (2016) also reported ether extract content of 6.15% for raw *Balanites aegyptiaca*, which is lower than 10.98% obtained in this study.

The ash content of raw *Balanites aegyptiaca* (9.56%) is lower than 15.0% reported by Lepanga *et al.* (2009). Njidda and Ikhimioya (2010) reported nitrogen free extract of 581.80 g/KgDM (58.18%) for raw *Balanites aegyptiaca*, which is higher than 45.47% obtained.

Anti-nutritional factors of Raw and Differently Processed *B. aegyptiaca* Fruit Meal

All anti-nutrients in *Balanite aegyptiaca* fruit meal showed remarkable reduction post processing. It has been established that processing exert beneficial effect by destroying the anti-nutritional factors inherent in some legume seeds (Balogun *et al.*, 2001). However, Ologhobo *et al.* (1993), reported that

leguminous oil seeds contain some residual anti-nutrients which processing may not eliminate totally. In comparism with other processing methods, the highest reductions of tannin and oxalate were observed at 96 hours of soaking duration. Osman (2004) reported similar observation and stressed that tannin and phytic acid are heat stable and more easily removed by fermentation. Boiling and roasting BAFM showed best results in reduction of saponin and phytate respectively. The least reduction of all anti-nutritional factors observed in fermented BAFM may have resulted from the hardness of the seed coat.

Performance of Broiler Starter Chicks Fed Diets Containing Differently Processed *Balanite aegyptiaca* Fruit Meal (0-4 weeks)

The processing of BAFM by soaking showed better weight gain in the chickens compared to other processing methods probably because soaking results in leaching of anti-nutrients in water while protein level remains intact. Abeke (1997) reported that anti-nutritional factors in legume seeds are reduced by leaching when seeds are soaked in water. Abdullahi (2012) found that processing mango seed kernel by soaking in water was more ideal than other methods used in his study as it improved weight gain and other productive parameters. Abdullahi (2012) further reported that charring may result from roasting while protein denaturation may also result from boiling, both of which can affect performance indices. This could have attributed to the poor performance obtained in chicks fed diets containing boiled and roasted BAFM. Although processing BAFM reduces feed anti-nutrients, its residual content may have attributed to the reduction in feed consumption by chickens fed diets containing differently processed BAFM. The reduction in feed intake observed by chicks fed differently processed BAFM based diets could also be attributed to its astringent taste which may result from the tannin content. Duwa *et al.* (2012) reported similar observation when diets containing differently processed Roselle seeds was fed to broiler chickens.

Makkar (2000), Onyango *et al.* (2003) and Tijani (2007) found by quantification that high levels of saponins, phytate, tannins and nitrites were present in unprocessed BAFM of which processing only reduces some fraction of it thereby affecting intake and weight gain. The decline in feed conversion ratio from the control group across the different processing methods may indicate the palatability of the feed. The possible reason for the poorest result which was observed in feed conversion ratio by chicks fed diet 5 (fermented BAFM) is not clear as literature is inconsistent in this regard. Mu'azu *et al.* (2017) compared the effect of soaking and fermentation of African locust bean seed meal fed to broiler chickens and reported that both methods were comparable in feed conversion ratio and feed cost per kilogram gain at 15% level of inclusion. Udensi *et al.* (2008) juxtaposed the effects of processing by soaking and fermentation on the performance of broiler chickens and his report showed that both methods were comparable to each other. Result obtained in this study contradicts this finding as fermentation showed the poorest result probably because the hardness of the shell of BAFM may limit fermentation. The effect of soaking BAFM on water intake by broiler chicks when compared to other processing methods used in this study is still unknown. The test ingredient BAFM did not pose any detrimental effect on the chicks as mortality was not observed across the treatment groups.

Performance of Broiler Finisher Chickens Fed Diets Containing Differently Processed *Balanite aegyptiaca* Fruit Meal (5-8 weeks)

Chickens fed diets containing soaked and boiled BAFM showed the best results in weight gain compared to other processing method exception for the control. This gave an impression that both processing methods (soaked and boiled) improved nutrient utilization by the chickens. There are

inconsistent reports in literature regarding the poor performance or otherwise of broiler chickens fed fermented oil seed based diets. This inconsistency maybe buttressed by the report of Christiana and Marcel (2008) who stressed that fermentation results to increased loss of carbohydrate as sugars which are used by fermenting microorganisms for metabolic activities. Christiana and Marcel (2008) further reported that other reports in literature showed that fermentation may increase crude protein content of feed due to growth of microorganisms on the fermented feedstuff. Fermentation did not improve weight gain in this study as chickens fed diets containing fermented BAFM showed poor result which was comparable to processing by roasting. This is because fermentation may be effective on *Balanite* fruit while the seed coat which contains most of the anti-nutritional factors may limit to the process due to its hardness. Similar to the starter phase, the increased feed intake observed among chickens fed the control diet could be attributed to the astringent taste of non-conventional leguminous feedstuffs such as BAFM as reported by Duwa *et al*. (2012). The decline in feed conversion ratio and feed cost per kilogram gain from the control group across the different processing methods used in the treatments may be indications of the declining levels of palatability of BAFM. This was evidenced by the declining feed consumption across the various treatments from control group to chickens fed fermented BAFM based diet. The highest water intake observed by chickens fed the control diet is a reflection of their level of feed consumption which was higher than other groups. According to Ologhobo *et al.* (1993), leguminous oil seeds contain some residual anti-nutrients which processing may not eliminate totally. This did not affect the survival percentage of the chickens fed differently processed BAFM based diets. This was also similar to the chickens fed the control diet as mortality was not observed among them.

CONCLUSION

Processing of *B. aegyptiaca* fruit meal at 96 hours of soaking duration and included in broiler diet at 20% level of inclusion, was found to significantly improved weight gain by 31.20 and 16.87% at starter and finisher phases respectively compared to other processing methods with exception of the control group. Similarly, feed conversion ratio also showed 30.62 and 23.86% improvement at starter and finisher phases, respectively among chickens fed soaked BAFM based diet. The study conclude that soaking *Balanite aegytiaca* fruit meal for (96 hours) can be used in broiler diets at 20% level of inclusion for better performance.

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