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Using the Desert Palm *(Balanites aegyptiaca)* Kernel Meal in Broiler Chicken Rations and its effects on Feed Intake, Live Weight and Carcass Characteristics

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ABSTRACT

This study was conducted in Elobeid city North Kordofan State, Sudan with the objective of studying and evaluating the effects of feeding *Balanites aegyptiaca* kernel meal at different levels on broilers feed intake, growth rates and carcass characteristics. The study used 150 one day old (Ross) chicks where every 10 birds were housed in separate units assigned to three treatments A, B and C with five replicates, on deep litter floor. The chicks were transferred periodically to ensure random housing. Starter and finisher rations were formulated for each treatment. Ration A (control ration) contained 5% super concentrate, while rations B and C contained had 2.5 and 5% *B. aegyptiaca* kernel meal respectively as a substitute for the protein super concentrate used in ration A. At the end of the experiment chicks were slaughtered for carcass cuts yield. The results indicated that feed consumption was significantly ($P<0.01$) higher in birds on ration A compared to those on rations B and C. Similarly the live weight of chickens was significantly ($P<0.01$)heaviest in group A than those of group B and C. Dressing percentage, carcass weight and weight of cuts were also significantly ($P<0.01$) higher for birds on ration A and lowest weight was recorded for those on ration B. Also the abdominal fat was higher for group A without significantly differences compared with group B. The percentage of fat in the body was higher in meat samples obtained from birds on ration C and lower for those on ration B. The study concluded that feeding *B. aegyptiaca* kernel meal to broiler chicks reduced the rate of live weight gain though increased the proportion of body fat in carcass samples. It was recommended further studies be conducted using lower levels of *B. aegyptiaca* kernel meal since it is found abundantly, can be obtained at low cost and rich in essential amino acids

INTRODUCTION:

Breeding and care of poultry in Sudan is an old profession and was practiced traditionally in most parts in rural and urban areas of the country to meet the needs of human food as it provides eggs, meat and as a source to earn petty cash when needed (Desai, 1962). Of the basic features of this practice is the lower cost of care and feeding as a secondary activity adopted feeding small herds of chickens on the municipal agricultural waste and food scraps in homes. Establishment of a center for poultry production research in Khartoum assisted in introduction of modern systems of poultry production, provision of veterinary services, feed manufacturing and the recommendation of extension services in the field of management (Osman, 1988). Many factors, during recent years, necessitate adoption of commercial production of poultry. This was manifested by the establishment of a number of companies producing poultry in many cities of the country, especially in Khartoum, and adopted the commercial breeds and hybrids importation. Although the continuous development of research in feed industry and poultry production grew enormously (Idris, 1995), but it was faced by many obstacles, mostly associated with nutrition. Perhaps this is the single cost that makes up about 75-70 % of the total production costs. To sustain high levels of production an imported concentrates and mixture of multi vitamins were necessary. Those inputs are obtained at high prices. The local raw materials used are together expensive and competed for between poultry and humans and are not always available for small private sector. The challenges that faced poultry industry necessitated search for alternatives to the feed sources that are characterized by high nutritional value, low cost and not competed for between humans and poultry in order to maximize the production and profitability.

Balanites aegyptiaca is a tree species that is adapted to the environment of North Kordofan and produces large amounts of fruits which contain oil and can also give meal for livestock feeding. Chemical analysis of the meal (tables.1 and 2) showed high content of crude protein (%45.40) and high proportion of the essential amino acids, especially lysine and methionine compared with conventional cakes used as sources of protein in poultry feed such as groundnut, sesame and cottonseed meals,(Idris, 1995). B. aegyptiaca is a saponin rich plant which is reported affecting growth. However, Zhang, *et al*., (2017) used mango saponin in broiler rations at low levels ; 0 (control), 0.14% (MS 0.14%), or 0.28% (MS 0.28%) levels and indicated that in overall, MS could be used as a feed additive in broiler chicks, and the supplemental level of 0.28% MS in diet could improve growth performance, meat quality, and plasma lipid metabolism in broiler chicks. On the other hand Hassan,(2013) also conducted a study to evaluate whether Saponin rich guar meal extract (GS) or residual Guar gum (GG) is the main anti-nutritional compound contributing to Guar meal (GM) relatively poor feeding value for poultry. The author reported that feed intake was the highest in chicks fed 5.0% GM from 1 to 7 days, but was the lowest in chicks fed 0.90% GG from 8 to 14 days. Feed conversion ratio was very poor; the highest was for chicks fed 0.250% GS as compared to other groups. The final body weight at 21 days was lower in chicks fed 0.250% GS than

chicks fed 0.90% GG and control. Total body weight gain was lower in chicks fed 0.250% GS than chicks fed 0.90% GG and control. He concluded that that there were more negative effects associated with adding 0.250% GS than 0.90% GG suggesting saponins may play a prominent role in the growth inhibition effects on feeding GM to broiler chicks.

Though *B. aegyptiaca* is used as medicinal plant for humans, no studies were conducted to evaluate using this plant's fruit meal as poultry feed**.**

The overall objective of the study was to assist in development of low cost poultry production systems based on locally available feed resources to maximizing profit of the poultry industry. Specifically the study of studying:

The effects of the use of *Balanites aegyptica* meal as substitute for super concentrate in the broiler chicken rations on.2 feed consumption rate, growth rates of broiler chickens. Feed conversion ratio and characteristics of the carcass, including the proportion of abdominal fat, the proportion of the various parts of the carcass and pH

MATERIALS AND METHODS

Study area: this study was conducted in Elobeid, Sheikan locality (longitudes 26^0 56' and 32^0 25' E and latitudes 12^0 00' and 16^0 35' N), North Kordofan – Sudan. The city is located at 1900 feet above sea level. Precipitation increases from 250 mm in the north to reach 300 mm in Elobeid and 350 mm in the south and this rainfall continues from May to September with peak in August (Osman, 2006). Temperatures area the highest degree during April to June; of up to 44^o Celsius and the minimum degree of 10° C during December, January and February. There are some trees forming the type of vegetation in this region, such as *Balanites aegyptiaca* and many others (Al Awad, 2009).

Collection of Balanites aegyptiaca fruits, oil extraction and preparation of the cake: Fruits were collected from the natural forests around villages in Dilling locality, south to Elobeid city. The entire fruits were fed to small ruminants and remnants of clusters were collected, washed and crushed to obtain the internal oil rich kernel. Oil was extracted mechanically in Elobied. The kernel cake was subjected to chemical analysis that was conducted to estimate the approximate nutrients ingredients at the Nutrition Laboratory of the Faculty of Animal Production, University of Khartoum according to the procedures described by AOAC, (2000).

Table 1: Chemical composition of the *Balanites aegyptiaca* kernel meal taken from four sites (%)

Site	Dry matter	Moisture	Crude protein	Crude fiber	Nitrogen free extract	Ether extract	Ash
1	92.0	5.0	11.6	20.0	57.5	1.0	5.0
2	94.5	5.5	11.2	19.8	56.2	1.3	5.5
3	94.8	5.2	11.8	20.1	56.0	1.2	5.3
4	94.8	5.3	11.5	20.0	56.2	1.2	5.3

Amino acids determination: Amino acids content of the *B. aegyptica* kernel meal was determined, by a HPLC at Soba Biochemistry lab of the Ministry of Science and Technology in Khartoum according to the methods described by (AOAC, 2000). The main amino acids and their amounts in the kernel cake are presented in Table (2).

Table 2: Amino acid contents of *Balanites aegyptiaca* kernel meal

Amino Acids	ug /8g	Mg / 100g	g /100g	g / kg	%
Aspartic acid	174.381	219.76	2.1976	0.21976	21.976
Threonine	61.061	763.26	0.76326	0.076326	7.6326
Serine	54.887	686.08	0.68608	0.068608	6.8608
Glutamic acid	302.923	3786.53	3.78653	0.378653	37.8653
Glycine	116.628	1457.85	1.45785	0.145785	14.5785
Alanine	09.993	1137.41	1.13741	0.113741	11.3741
Cysteine	21.425	267.81	0.26781	0.026781	2.6781
Valine	90.995	1137.432	1.137432	0.1137432	11.37432
Methionine	21.117	263.96	0.26396	0.026396	2.6396
Isoleucine	73.947	924.33	0.92433	0.092433	9.2433
Leucine	135.670	1695.87	1.69587	0.169587	16.9587
Tyrosine	4.491	65.13	0.06513	0.006513	0.6513
Phenylalanine	126.484	1581.05	1.58105	0.158105	15.8105
Histidine	25.454	318.17	0.31817	0.031817	3.1817
Lysine	67.790	847.37	0.84737	0.084737	8.4737
Amonia	135.110	1688.87	1.68887	0.168887	16.8887
Arginine	299.090	3738.62	3.73862	0.373862	37.3862

Formulation of experiment rations: Three rations were formulated I, II and III for each of the starter and finisher taken into account that they should be iso-nitrogenous iso- calorific in composition i.e. to be similar in energy and crude protein. Ration I was considered control and contained 5% super-concentrate and free of *B. aregyptiaca* kernel meal while the other two rations contained 2.5% and 5% of the kernel cake as a substitute for the super-concentrate (Table 3)

Table 3: percent ingredients in the experimental rations formulated using *Balanites aegyptiaca* kernel meal Rations

	I		II		III	
Feed	Starter	Finisher	Starter	finisher	starter	Finisher
Sorghum	60	70	57	70	60	68
GNSC	15	7	19	7	15	10
Super- concentrate	5	5	0	10	0	10
Sesame seed cake	12	5	12	5	12	5
Balanites Cake	0	0	2.5	0	5	0
Wheat bran	6.5	6.5	8	6.0	6.5	5.5
Oyster	1	1	1	1	1	1
Salt	0.5	0.5	0.5	0.5	0.5	0.5

Experimental birds and their rations: The experiment used 150 one day old chicks of Ross strain that had been secured from Khartoum and the experiment lasted for 8 weeks, where it used starter rations in the first four weeks and finisher rations for the remainder of the period for all three treatments. Barn was divided into 15 separate units with an area of 1 square meter where 10 birds / unit were put in each treatment with five replicates. The floor was deep litter housing system and chicks were transferred periodically to ensure random housing. The chickens have been periodically vaccinated against Newcastle and Gomboro.

Drinking water was provided adequately on a permanent basis with the addition of a mixture of vitamins and the barn kept with lighting continuously for 23 hours/ day where each part was provided with a lamp of 50 W at an altitude of 2meters from the ground. The feed was first offered starting from 500g/ unit and then increased gradually depending on chick growth.

Data collection: the initial weight of birds was taken on the first day, when they reached the site, and then on weekly basis to calculate the growth rate. The data obtained also included feed consumption and characteristics of carcass at the end of the experiment.

At the end of the 8th week feeding troughs were lifted and chickens slaughtered in the early morning and three samples from each group were weighed after slaughter to calculate dressing percentage, abdominal fat, breast muscle and neck weight. Meat samples were analyzed at the laboratory of the Faculty of Animal Production (Shambat), University of Khartoum to estimate meat pH and chemical composition of the parts.

Statistical analysis: the experiment was considered as complete randomized design (CRD) and its data was analyzed via the analysis of variance to detect differences arising from different treatments on feed intake, growth rates, feed conversion ratio and characteristics of the carcass. For separation of differences among treatments means, Duncan multiple range test (DMRT) was used (Gomez and, Gomez 1984). The data was first transformed to convert percentages using the conversion transformation method before conducting statistical analysis using the Statistical Analysis system; SAS V9.0 as a statistical analysis tool of the data in the various recipes.

RESULTS AND DISCUSSION

The effects of inclusion of *Balanites aegyptiaca* kernel meal as substitute for super-concentrate in broiler rations on feed intake is presented in Table 3. It was observed that feed consumption decreased upon addition of *B. aegyptiaca* kernel meal in rations than the conventionally used concentrate though feed intake increased gradually over a period of time for all groups, with the growth of birds, but this consumption was highest (9600 g) in group I and less (509 g) in Group III. The decreased feed intake could be attributed to the fact that the cake contained a significant proportion of saponins which is characterized by its bitter taste and this is consistent with results found by Zeinab, (2010) who reported that poultry were more sensitive to saponin than the rest of monogastric animals as saponin was found adversely affecting the consumption of feed.

The impact of inclusion of the kernel cake as substitute for concentrate in broiler rations on the broiler live weight and were average weekly increase is presented in Table (4). There were significant differences among birds groups in feed intake and live body weight. The highest live weight (1632.2 g) was recorded in group I and less live weight (511.9 g)was in group III and that may be due to differences in feed intake. These findings are consistent with those reported by Ali (2010) who found that the presence of these substances that act as inhibitory to feed intake impede growth and hinder the utilization of nutrients in birds and must be removed and disposed of for the desired production rates. It was also found that the average weekly gained weight was

highest (375.8 g) in group I and lower (104.9 g) in III, and that may be due to the effect of source of protein on the amount of feed intake in chickens. The results of this study are similar with findings reported by Boorman, (1979), who reported that change of protein source could result in a change in the content of amino acids of the feed leading to an imbalance in feed intake very quickly in the chicken. That was shown in the decline in growth that was followed by a change of the dietary protein. The decreased weight gain was not the result of direct response to that change of protein source but as much as it was a reflection of the content of amino acids (Table 2).

The effects of replacement of super concentrate by B. aegyptiaca kernel cake on broiler carcass and partsweight: It was found that the average slaughter weight was higher (1282.2 g) in group I and lower (211.9 g) in group III (Table 4). Dressing percentage was highest (78.5 %) in group1and lowest (41.4 %) in group III Table (4).This is due to the amount of feed intake and the amount of the kernel cake that the rations contained. The findings of this study are in line with those of Zeinab, (2010) where she pointed out that the presence of saponin lead to a reduction in the rate of growth due to the lack of feed intake. The study found that the weight of muscles of the legs, chest and neck was higher in group 1 (145.7, 223.3, 100 g, respectively), and lower in Group III (104.80, 177.27 0.70 g (41.4 %), respectively) Table (4).

That could be attributed to the amount of feed intake by birds as group 111ration contained high kernel cake instead of the concentrate, which had a negative impact on the average rates of carcass cuts as a result of the presence of inhibiting factors for growth. Those result are consistent with those mentioned by Zeinab, (2010) where she indicated that there are benefits to use protein sources of plant origin except that they contain constituents that are characterized having growth retardant properties which limit or impede the use of these sources in nutrition in its raw material form and they must be removed and disposed of to get the desired production traits.

Table 4: Nutritive value of the rations used in the study Rations

	I		II		III	
	Starter	finisher	starter	finisher	starter	finisher
Energy(Kcl/kg)	3140.5	3229.2	3138. 3	3271.4	3166.5	3246.2
Protein %	22.8	19	22.7	19	21.5	19
Ca %	1.2	1.1	0.8	0.8	0.7	0.8
P %	0.7	0.6	0.5	0.4	0.5	0.5
Energy: protein	1:139	1.165	1:138	1.166	1:147	1.162

The percentage of abdominal fat was equal (30g) in group I and II and less in group III (Table 4). That may be due to the difference in the rate of growth and this is consistent with results reported by North (1989) who attributed most of the difference in the amount of abdominal fat to differences in the rate of growth and found that the decline in the proportion of energy in the feed or the high proportion of protein leads to increase in their growth rates, and thus increase the amount of abdominal fat and the size of the back of the abdominal fat. Moisture content of meat was higher (77.74 %) in group I and less (68.20 %)

in group II. The ash was close in group I and II (0.76 and 0.77%, respectively) and higher (0.88 %) in III, while the protein was found to be similar in ratio in all groups and also the *p*H (Table 6). This is consistent with the findings reported by Abou El wafa, (2003) who showed that the carcass and blood components were not affected by sources of protein either of plant or animal origin in protein and total amino acids content.

The juiciness was higher (1 %) in group III and less (0.77%) in II (Table 6) and this could be due to increase in the percentage of body fat due to the high fat diet in group III, and this is consistent with (North, 1989) who reported that the body weight and percentage of fat in the abdomen increases when the level of fat in the meat chicken feed is increased.

Table 5: Live weight, carcass and cuts weight as affected by the level *Balanites aegyptiaca* kernel meal Treatments

Parameters	I	II	III	SD
Live weight (g)	1632.2	757.6	511.9	277.5
carcasses weight g	1282.2	427.6	211.9	266.8
Dressing %	78.5	56.4	41.4	8. 76
Average breast muscle weight g	223.4	195.0	177.3	10.64
average leg weight g	145.7	125.5	104.8	9.64
Average abdominal fat weight	30	30	20	2.72
Average neck weight	100	80	70	7.20

Table 6: performance of broiler chick fed rations containing different levels of *Balanites aegyptiaca* kernel cake Treatments

Parameters measured	I	II	III	SE
No of chicks	50	50	50	0
Weeks on trial	8	8	8	0
Average initial weight (g)	35	35	35	0
Average final weight (g)	1632.2	757.6	511.9	277.5
Average total weight gain (g)	1597.2	722.6	476.9	277.5
Average daily gain (g)	53.68	24.03	14.98	9.54
Average total feed intake (g)	39375	28348	21017	435.62
Average daily feed intake (g)	6.26	8.88	9.76	0.85
Feed conversion ratio	0.703	0.506	0.38	0.08
Feed cost SDG	257.9	222.6	228.3	8.93

SDG= Sudanese Pound SE Standard Error

Table 7: Effects of inclusion of Balanites *aegyptiaca* kernel meal in broiler rations on chemical composition and quality of meat (%) treatments

Chemical Composition	I	II	III	SE
Moisture	77.74	68.20	77.7	2.59
Ash	o.76	0.77	0.88	0.03
Crude Protein	18.39	19.0	19.29	0.21
Ether Extract	0.92	0.77	1.0	0.05
*p*H	5.21	5.23	5.34	0.03

CONCLUSION

The study showed that *B. aegyptiaca* kernel cake contained a high proportion of amino acids, crude protein and ether extract. Hence it was concluded that kernel meal might be used as substitute for super-concentrate in broiler rations to reduce feeding cost taking in

consideration that it contained some anti-nutritional factors such as tannins and saponin.

RECOMMENDATIONS

The study recommends more research to be conducted to study effects of use of *B. aegyptiaca* kernel cake as substitute for the expensive super concentrate and the role of the growth inhibitory substances it contained such as saponin to take advantage of these fruits that is found in great abundance at very low cost.

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