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Effects of Replacement of Sorghum Grains and Wheat Bran with Graded Levels of Watermelon Bug Meal and *Zornia glochidiata* Seeds on Broiler Performance

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ABSTRACT

This study was conducted in Elobeid, Sudan aiming at evaluating of the effects of replacement of sorghum grains with graded levels of watermelon bug (*Coridus viduatus*, *Aspongopus viduatus*) meal, WMBM and groundnut seed cake, GNSC, with *Zornia glochidiata* seeds, ZGS on feed intake, growth performance, feeding cost and feed conversion ratio. One day old ninety six unsex Ross 306 chicks were divided into four groups each with four replicates of six chicks. They were housed in pens supplied with bulb lamps, watering and feeding troughs. The chick groups were fed four rations; the first one containing 60% sorghum grains and replaced by watermelon bug meal WMBM at 20, 40 and 60% in the second, third and forth rations respectively. In the same rations, groundnut meal was used at 18% in the first ration and replaced by 6, 12 and 18 % *Zorina glochidiata*, ZGS, seeds in the second, third and forth rations. The chicks were weighed first day and once weekly for five weeks and their feed intake was monitored daily during that period. The data was analyzed via analysis of variance with the differences among treatments means being detected via least significant difference test (LSD). The results indicated that no significant differences (P>0.05) were detected among the three treatment groups in feed intake and live body weight. The birds consumed 1965, 1957, 1943 and1625g/bird on rations containing 0 WMBM +0% ZGS (control), 20 WMBM +6% ZGS (II), 40 WMBM +12% ZGS (III) and 60 WMBM +18% ZGS (IV) respectively. Final weight was 1297.7, 1199.1,1203.2 and 877.0 g/ bird for group I, II, III and IV respectively. Feed conversion ratio was found being 1.513, 1.632, 1.614 and 1.851 for groups I, II, III and IV, respectively. Feeding cost significantly(P≤0,01) decreased upon replacement of sorghum grains and *Zorina glochidiata* seeds from 17.53SDG, 14.82, 11.93 and 9.40 SDG for rations I, II, III and IV, respectively. It was concluded that chick performance was similar when fed rations formulated by replacing sorghum grains with watermelon bug up to 40% and ground seed cake with *Zorina glochidiata* seeds to 12%. The study recommended using 40 % of watermelon bug meal and 12% *of Zorina glochidiata* seeds and trying similar feed sources to reduce feed cost while preserving performance.

INTRODUCTION

Poultry includes a wide range of indigenous birds and small domesticated commercially reared animal species such as chickens, ducks, pigeons, guinea fowl, geese, rabbits and turkeys. Family poultry production remains critically important, with estimates suggesting that more than 80% of the world poultry stock is kept in small numbers, from as few as one up to about 20. It plays a key role in many households for food and nutrition security with particular attention to extensive and small-scale intensive (Carter 2009). Broiler production is an important sector of the poultry industry, comprising 25% overall meat production, and has increased in 125% between 1999 -2009 (Windhorst, 2011).

The constraints to sustainable poultry production in North Kordofan and Sudan is mainly based on dependence of the industry on imported and expensive feed sources. To little extent, diseases are particularly important constraint when birds are housed under intensive conditions with birds close proximity to each other, thus affording the maximum opportunity for disease to spread from one bird to another. However, even under extensive conductions birds can easily spread diseases because they are normally close together at night in order to protect themselves from thieves and carnivorous enemies (Idris and Gibrel, 1997).

Many constraints are surrounding this industry; the most important ones include the climate change with its effects on precipitation. Low amount of rainfall leads to shortage of cereal crops production, which reflected in high cost of grains price, competition with human food, and other uses as biogas recently (Jadallae*t al.,* 2014).

Objectives of the Study

The overall objective of this study is to assist in development of low cost poultry production patterns in the Sudan and Kordofan region that the reach must look for supplementary feed stuff, plant replacer, so as to obtain nutritive value and to reduce the cost. Specifically this study aimed at integration of watermelon bug meal and *Zornia glochidiata* seed as the feed stuff on broiler rations as a source of energy to replace sorghum green.

MATERIALS AND METHODS

The Study Site

Elobeid city is the largest city in western Sudan and the capital of North Kordofan State. The state of North Kordofan is located between latitudes 12.40-17.20 north and longitudes 28.40-32.20. West Kordofan State, Northern State, North Dar For State, White Nile State. The state includes six localities, which are Sheikan, Umm Rawaba, Al-Rahad, Bara, Sudri, Jabra, Sheikh and Umm Dam. The most important tribes are Kababish, Jawama, Shuweihat, Al-Badriyah, Darhamid, Al-Masbat, Kwahila and marine tribes in addition to the Nuba and various South Sudan tribes (Technoserve, 1987, AFRICOVER,1998).

Experimental chicks

In the experiment, 96 Ross hybrid chicks (Ross 306) distributed for four treatments, each treatment used four replicates, and each repeater used 6 chicks sheltered in a lamp that was lit by bulbs to provide night lighting and heating. It was sanitized with formalin and the barn was furnished with a deep brush of sawdust. Drinking and feeding utensils were set for the groups, and they were vaccinated against diseases known in the area. The primary weights were taken at the beginning of the experiment, then once a week until the end of the experiment. Four broilers were taken from each group and slaughtered for the purpose of studying the characteristics of the carcass (the final weight is the weight of the hot and cold carcass, the weights of the various pieces, and the eaten and uneaten parts in addition to the waste).

Experimental Rations

Four diets were formulated, as shown in table 1; the first is a control ration containing 60% sorghum grains and replaced with 20, 40 and 60% watermelon bug meal in rations II, III and IV respectively and 18% groundnut seed cake in the control ration that was replaced by 6, 12 and 18 % of *Zornia glochidiata* seeds in rations II, III and IV, respectively. The rations were analyzed to have iso-energy and iso- protein rations

Chemical analysis and Panel test

The feed ingredients were chemically analyzed table 2 via analysis of variance. The calculated nutritive values of the rations were checked by their chemical analysis as well. **The rations used for the broilers feeding were** analyzed using the approximate analysis according to the methods described by (AOAC, 2000) and their values are presented in table 3.

The rations were for experiment to meet the requirements of broiler chicks as stated by NRC, (1999).

Statistical analysis

Experiment data on feed intake, live weekly weight of chick groups, carcass cuts and offals were analyzed analysis of variance as outlined by Gomez and Gomez,(1996). Chai square was used for analysis of meat quality evaluation of panel test.

RESULTS AND DISCUSSION

Effect of replacement with non-conventional ingredients on feed Intake

The effect of replacement of sorghum grains with watermelon meal and groundnut seed cake with *Zornia glochidiata* seeds on feed intake of chicks is presented in table (4). Feed intake was the highest (P<0.01) for chicks that were left on rations I, II, and III when compared to IV. The rations contained sorghum grains at 60, 40, 20 and 0 while *Zornia glochidiata* seeds were used at 18, 12, 6 and 0 respectively. The increased feed intake upon replacement of sorghum grains as source of energy with watermelon bug meal as energy sources might be attributed to the rate of reaching birds to satiety to energy requirement where starch in grains supply energy to birds rapidly while lipids take longer time for conversion to energy. *Zornia glochidiata* seeds increased CF content and lowered feed energy content. Similar results were reported by Habbani (2008) who found that insects with high stored lipids were good energy source ingredient for broiler rations and their inclusion in ration significantly increased feed intake. Jadalla *et al.,* (2014) demonstrated that for energy satiety, increased fiber content in a ration initiated greater feed intake than lower fiber content rations. Another reason for improved feed intake of rations containing WMBM might be attributed to good quality protein provided from insect meal than sorghum grain gluten.

The effect of using watermelon meal and *Zornia glochidiata* seeds on live body of chicks

No significant differences (P<0.01) were observed in the average weights of chicks throughout the experimental weeks when they were fed rations containing sorghum grains and groundnut seed cake and when the two ingredients were replaced by watermelon bug meal at 20, 40 and 60% and *Zornia glochidiata* seeds at 6,12 and 18% respectively. The replacement at 60% WMBM and 18% *Zornia glochidiata* seeds resulted in decreased live body weight change throughout the experimental period. The control ration diet was using sorghum grains and groundnut seed cake without WMBM or *Zornia glochidiata* seeds. No significant differences were observed among groups in the first week. Starting from week second week weight of birds started to decrease and the decrease was significant in the third week to the end of the experimental period. Significant decrease was observed group IV and the other three groups.

Table (1) ingredients used in the experimental rations formulation%

Ingredients	I	II	III	IV
Sorghum Grains	60	40	20	0
GNSC	18	12	6	0
Wheat bran	12	12	12	12
Zorniaglochidiata	0	6	12	18
WMBM	0	20	40	60
Concentrate	5	5	5	5
Limestone	4	4	4	4
Salt	1	1	1	1

In this table and subsequent ones; GNSC: groundnut seed cake, WMBM: watermelon bug meal

Table 2chemical composition of the feed ingredients used in formulation of the rations were used the experiment

INGREDIENTS	NUTRIENTS						
	DM	OM	CP	CF	EE	NFE	ASH
Sorghum grains	95.5	92.9	10.9	2.3	3.2	75.31	2.6
GNSC	90.52	79.55	23.3	6.5	4.5	28.55	10.97
Wheat bran	90.78	85.38	16.92	12.5	4.0	0.13	5.40
Concentrate	91	83.5	35	4	2	42.5	7.5
WMBM	96	92.25	10.9	0	15.0	56.35	3.75
ZGS	96.32	85.61	25.76	28.19	3.74	27.92	10.71
LIMESTONE	95	0	0	0	0	0	95
OYSTER	94						
SALT	97	0	0	0	0	0	97

In this table and subsequent ones; ZGS: *Zornia glochidiata* seeds.

Table (3) the chemical composition (%) of the rations used for the broilers feeding

Constituents	I	II	III	IV
Dry Matter	80.68	79.881	80.8806	81.8038
Organic Matter	77.2726	77.3942	77.6858	79.6454
Crude Protein	18.22	18.12	20.65	16.82
Crude Fiber	4.9	4.7714	4.1128	6.6542
Ether Extract	3.05	5.3644	7.6788	9.4732
Nitrogen Free Extract	24.2675	24.2297	27.408	24.8385
Ash	3.508	4.2306	4.7512	5.3843
Energy	1811.91	1961.29	2292.96	2205.87

Metabolizeable energy of the rations was calculated using the following formula (Lodhi et al.,1976): ME=(1.459+0.102XCP+0.275XEE+0.148XNFE-0.034XCF)X239

Table (4).effects of replacement of sorghum gains with watermelon bug meal and wheat bran with *Zornia glochidiata* seeds on feed intake

	Age/days					
Age						
Treatments	**7**	**14**	**21**	**28**	**35**	**Total**
I	277.37	301.46	426.74	476.63	482.46	1964.660
II	273.18	300.55	424.30	478.56	480.36	1956.950
III	288.42	301.67	424.31	474.75	453.45	1942.600
IV	230.98	272.10	402.75	452.20	463.83	1821.86

I=0 watermelon bug and 0 Zornia glochidiata seeds *II =20+6 III=40+12 IV=60+18*

Effect of replacement with non-conventional ingredients on feed Intake

Table (5).weekly weight change of chicks as affected by replacement of sorghum grains and groundnut seed cake and wheat bran with watermelon bug meal and *Zornia glochidiata* seeds

Treatments	CONTROL	II	III	IV	SEM
Age (days)					
14	258.79^{a}	263.96^{a}	276.46^{a}	187.29^{b}	8.02
21	521.83^{a}	500.62^{a}	511.25^{a}	353.13^{b}	13.015
28	879.13^{a}	805.42^{b}	847.08^{ab}	588.72^{c}	28.34
35	1297.7^{a}	1199.1^{a}	1203.2^{a}	877.0^{b}	43.90

The effect of replacement of sorghum grains with watermelon bug meal and groundnut seed cake with *Zornia glochidiata* seeds on feed conversion ratio is presented in table (6). The replacement of SG with WMBM resulted in increased feed intake concomitant with final body weight increase and feed conversion ratio was the best when the conventional ration was offered while the three levels of replacement had similar FCR. The group on a ration without sorghum grains and groundnut seed cake had the lowest FCR. Feed conversion ratio was 1.513, 1.632, 1.614 and 1.851 for the group on a ration with 60 % sorghum grains and 18% groundnut seed cake (I), with replacement of 15% WMBM +30 % SG and 12% GNSC and 6% ZS (II), 30% WMBM +15 %SG together with 6% GNSC and 12% ZS (III) and 45% WMBM and 15% SG (IV) finally a ration containing 60% WMBM and 18% ZS(V).

Table (6).effects of replacement of sorghum grains with WMBM and groundnut seed cake with *Zornia glochidiata* seed on feed conversion ratio

Treatments	Average Weight	Feed Intake	Feed Conversion Ratio
I	1297.7	1964.66	1.513
II	1199.1	1965.95	1.632
III	1203.3	1942.6	1.614
IV	877.0	1623.86	1.851

Effects on Production and feeding cost

Effects of replacement of sorghum grains (SG) with watermelon bug meal (WMBM) at 0, 20, 40 and 60% and groundnut seed cake (GNSC) with *Zornia glochidiata* seeds (ZGS)at 0, 6 12 and 18% on feeding and production cost is presented on Table (7). By calculating the prices of the four dietary components and the quantities necessary to form one ton of feed and to know the prices of the inputs, the study found that a ton of rations when formed using by 60% SG and by 18% GNSC and without replacement was found thatone ton 17,530 pounds and the price decreased to 14820, 11930 and 9,340 Sudanese pounds when replacing with 20 watermelon bugs. + 6 *Zornia glochidiata* seeds, 40% watermelon bug meal + 12% *Zornia glochidiata* seeds and 60% watermelon bug meals + 18% *Zornia glochidiata* seeds in the second, third and fourth ation, respectively. Hence, the replacement led to significant reduction (P≤0.01) in the cost of feeding, as the price of one kilogram of feed decreased from 17.53 to 14.82, 11.93 and 9.34 pounds upon replacing the SG with the WMBM and GNSC with *Zornia glochidiata* seeds. As for the cost of production, it was found that find that in the experiment, one bag of (60 kilograms) of sorghum was used, the value of which was 1,250 pounds compared to the price of similar weight of WMBM pounds) that cost 120 SDG only. Since SG is the main staple food, using WMBM to feed the chicks, will reduce competition between humans and animals over this ingredient.

Table 7. Feed and feed cost as affected by replacement of sorghum grains (SG) with watermelon bug meal (WMBM) at 0, 20, 40 and 60% and groundnut seed cake (GNSC) with *Zornia glochidiata* seeds

parameters	IV	III	II	I
Total feed intake	1.821.6	1.942.6	1.965.95	1.964
Price /kg feed	9.40	11.93	14.82	17.53
Cost of feeding/SDG	17.125	23.123	29.001	34.440

The replacement SG with WMBM and *GNSC with Zornia glochidiata* seeds had no negative effects on feed consumption or quality of meat that was investigated in a separate study. he reason for the absence of the negative effect of this substitution is due to the nature of the energy source, as carbohydrates produce glucose that leads to the availability of energy to the bird quickly, unlike the watermelon bug meal, as the source of energy is the fat that takes a long time to turn into energy and the bird continues to eat food for a long time. On the other hand, the high fiber, as a result of replacing the peanut GNSC with *Zornia glochidiata* seeds, led to a decrease in the consumption at the level of the total replacement of GNSC with *Zornia glochidiata* seeds. In the latter group without SG and GNSC, the reason for the decrease in consumption was the high percentage of fiber and the possible absence of amino acids in *Zornia glochidiata* seeds , as is the case with the GNSC.

The results reported here differ from those reported by Habbani(2008) who showed that replacement of sorghum grains with watermelon bug meal increased feed intake because the author replaced only the WMBM.

This result differs from what Habbani (2008) stated, that replacing SG with MBM led to increase in feed consumption because no other ingredients were not substituted.

It was included that replacement of SG with WMBM as source of energy together with replacement of GNSC with ZG seeds had no negative effects on feed intake growth rates, final body weight and feed conversion ratio as well as drastic decrease in feeding cost. The study recommended the use of watermelon bug meal instead of SG as energy source in the broiler rations together with ZG seeds as source of protein to reduce feeding cost since that type of replacement did not have negative effects on broiler performance and after studying possible effects on meat quality and carcass characteristics.

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