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Effects of Feeding Groundnut Shells enriched with Protein and Energy on Feed Intake, Nutrients Digestibility and Weight Changes of Sudanese Desert Lambs

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ABSTRACT

This study was conducted with the objective of studying the effects of using different levels of groundnut shells in rations for lambs. Twenty, 7-9 months old, castrated Desert lambs weighing 22.6 +0.500kgs were used divided into four similar groups each with five animals. The lambs were weighed ear-tagged, drenched with a broad spectrum antithelmentics for the treatment of internal and external parasites and vaccinated against diseases endemic to the area. They were individually penned and provided with feeding and drinking troughs. The rations formulated contained 0, 20, 30 and 35% groundnut shells. Ten days were allowed for adaptation of lambs to treatments and rations provided. Thereafter feed intake and live body weight changes were monitored. The last ten days were considered digestibility trial via total feces collection method. The of feed intake, total digestible nutrients intake, body weight change and feeding cost were considered a complete randomized design and were analyzed via analysis of variance. Feed intake significantly ($P< 0.01$) decreased with increment of level of groundnut shells in the ration. The lambs consumed 1215, 1124, 1015 and 1002 g/d dry matter when groundnut shells constituted 0, 20, 30 and 35 % of the ration. Similarly the nutrients' digestibility coefficients decreased upon increment of the level of the ground nut shells in the rations. The lambs' body weight change was positive at all rations though weigh gain values were significantly ($P<0.01$) greater at lower levels of the groundnut shells in the rations. The lambs gained 225, 190, 165 and 155 g per a day when their rations contained 0, 20, 30 and 35 % groundnut shells. The feeding cost reduced from 2.50 SDG per kilogram feed when the ration had no groundnut shells to 1.50, 1.20 and 0.9 SDG per kilogram feed when the rations contained 20, 30 and 35 % groundnut shells. It was concluded that though the inclusion of groundnut shells reduced feed intake, nutrients digestibility coefficients, it maintained lambs at levels above maintenance and feed cost was significantly reduced. It was recommended that more studies be conducted to make use of the large amount of this agro-industrial by product to reduce feeding cost of ruminants and environment protection.

Keywords: Desert lambs, groundnut shells, weight changes.

INTRODUCTION

Sheep of Sudan was estimated at 48.1 million heads at an annual growth rate of about 3% (MFEP, 2012). About 25.7 million heads are found in North Kordofan state. Over 67% of these animals are Desert sheep which are well recognized for their contribution in the national economy by producing good quality meat and provision live animals for export. There is a special role for sheep advantages over cattle and camels when compared for meat production. Sheep reproduce quickly and annually providing both the national and foreign markets with good quality meat (Ministry of Animal Resource and Fisheries, MARF, 2010).

In Sudan, farm animals suffer from serious shortage of feedstuffs, particularly during dry season, where the quantities available are limited, the quality of roughages is poor and nutrients are not enough to cover maintenance and productive requirements of animal species including sheep. The situation is further aggravated by overgrazing in most areas and the disappearance of legumes and perennials (EI Wakeel, 2002).Although farmers do not provide supplements to their animals, they are forced to do so at critical times. Supplements used are mainly oil seed cakes and cereal grains.The increasing demand for animal protein requires fattening lambs using the supplements mention at relatively high cost. Hence reduction of feeding cost necessitated looking for using non-conventional sources of feed for ruminants. It is also of great importance to make use of low quality roughages and to utilize the huge amounts of agro-industrial by-products, especially groundnut shells, with protein and energy source as a supplement during dry season in order to improve lambs fattening and reduce their mortality rates in North Kordofan state.

Specific Objectives Area

The overall objective of the study is to assist producers to develop low cost profitable sheep production systems based on available resources. Using agro-industrial residues in feeding ruminants is beneficial to the environment where the ground shells that are dumped around factories can be recycled and incorporated into feed. Specifically it is aimed at studying effects on supplementation of groundnut shells with protein and energy sources on feed intake, nutrients digestibility, and lambs live body weight gains.

MATERIALS AND METHODS

The Study Area: Abu Zabad locality covers approximately 4800 km^2 and located 163 km south west of EL Obeid town (longitudes $28^0$45' to 29^0 45' E and latitudes12^0 20' to 12^0 50' N). The inhabitants are mostly agro-pastoralist and animal husbandry is of a paramount importance with sheep being the most valued farm animal and act as the most important source of cash (Abu Zabad Sudanese Survey Department office, 2013).
The study site lies within low rainfall savanna, with average rainfall ranges between 250 mm in the north to 400 mm/year in the south which allows growing a variety of crops and raising many species of livestock. Millet and sorghum are grown as staple food and straws left are fed to animals though their nutritive value is low. Watermelon, sesame, Roselle and ground nut are grown as cash crops.

The experimental animals

Twenty castrated lambs of Sudan Desert sheep subtype Hamari castrated (7-9 months old with average weight of22.6 kg +0.500) were used in this study. The animals were ear tagged, vaccinated against diseases endemic in the study area, treated with *ivermectin* 1% (at a rate of 10 mg / 50 kg body weight) for internal and external parasites control and then divided randomly into four groups (I,II,III and IV).Animals were individually penned under the same shade and fed with their respective diets for 60 days. In addition each lamb fed daily 700–1000 gm roughage. Feed intake was estimated daily by subtracting the refusals from feed offered the day before. The first ten days were considered as an adaptation period.
Animals in group (I) offered a control diet. The other three groups (II, 111, IV) offered a diet composed of 20%, 30% and 35% groundnut shells, respectively. Table (1) presents ingredients used for the four formulated rations for the experimental groups.

The Digestibility Trial

The last ten days were considered digestibility trial where lambs were provided by canvas bags attached to their rear by harness. Feces voided were collected and dried under shade, then mixed thoroughly and sampled from each lamb and analyzed using proximate analysis as described by AOAC,(1997).Feed samples were analyzed and nutrients digestibility

coefficients determined by total feces collection method (McDonald et al, 2010).

Chemical analysis: Feed proximate analysis was done in the Agricultural Research Corporation and Animal Production Laboratory in El Obeid. The samples were analyzed according to the methods described by Association of Official Agricultural Chemists (AOA C, 2000). Fecal samples were also analyzed via proximate analytical methods and forage fiber method to calculate nutrients apparent digestibility. The total digestible nutrients (TDN) were calculated, after determining the digestibility coefficients, by the following formula (Crampton *et al*., 1962, and Mc Donald et al., (2010):

TDN Kg / 100 kg = % C Pdig + % CF dig + 2.25 % EE dig + % NFE dig

Data collection and recording: The data obtained were feed consumption, nutrients digestibility coefficients and live body weight changes. A spring balance of maximum load 50kgwas used for recording live body weights of lambs weekly in the morning after an overnight fast except for water, to minimize error due to variation in gut fills.

Table 1: Percentage of ingredients used in formulation of the experimental rations

Ingredients	Rations			
	I	II	III	IV
Sorghum grains	39	35	35	30
Groundnut cake	35	32	24	24
Wheat bran	15	12	10	10
Ground nut shells	0	20	30	35

Table 2: chemical composition of the ingredients used in formulation of rations of the study Nutrients

Feed	M.E Kcal/ kg DM	DM	OM	CP	CF	NFE	EE	Ash	Ca	P
S.grains	3641.1	92.57	88.77	8.70	2.3	76.00	2.00	3.80	0.05	0.33
GN cake	2741.6	90.52	71.55	23.3	6.5	1.44	4.50	10.97	0.60	0.6
Wheat bran	1892.3	90.78	85.38	16.92	11.3	61.60	4.00	5.40	0.20	0.7
GN shells		90.84	77.89	8.40	51.2	31.60	3.00	12.95	0.28	0.50

Table 3: chemical composition (as %)of the rations used in the experiment

Nutrients	Rations			
	I	II	III	IV
DM	91.87	91.18	90.18	94.27
OM	81.9	83.14	82.14	85.25
CP	16.31	15.46	15.47	15.47
CF	24.70	25.80	26.80	28.81
EE	4.70	4.86	4.86	4.77
NFE	40.78	37.8	36.8	36.94
Ash	9.96	8.92	10.83	9.02
Ca	1.23	1.23	2.13	2.63
P	1.71	1.45	2.09	2.27

Statistical Analysis

Data of feed consumption, nutrients digestibility coefficients, total digestible nutrients of the rations offered, TDN intake of different groups and live body weight changes were all considered as complete randomized design (Gomez and Gomez,1977) and were analyzed with the aid of MSTAT computer software for analysis of variance (Sencendor and Cochran,1976). Least significance value was used to detect difference among treatment means.

RESULTS AND DISCUSSION

Voluntary dry matter intake of sheep as affected by inclusion of groundnut shells: Lambs did not suffer from digestive disorders due to consumption of rations containing different levels of GNS.

The dry matter intake of lambs on rations containing different levels of GNS is presented in table (4). The control group consumed significantly (P<0.01) greater amount of feed compared to the groups that were offered rations with different levels of GNS. The group of lamb son a ration formulated having 20% GNS consumed significantly (P<0.01) higher amount of feed compared with the other two groups that were left on rations containing 30 and 35 % GNS, respectively. It is clear that feed intake decrease was concomitant with increment of GNS increase in rations. This could be attributed to decreased dry matter and organic matter digestibility coefficients in rations with increased levels of GNS. These findings are in line with results reported by some authors (Mohammed and Salih, 1991; Jadalla, 1995 and Thomas, 1974). Also Thomas (1979) has shown that supplementation of poor quality roughage had a depressive effect on voluntary feed intake by sheep at certain levels. Mohammed and Salih, (1991) have shown that low quality roughage of the low protein and high fiber was consumed at low levels due to decreased dry matter and organic matter digestibility coefficients with increase in fiber content of the ration. Jadalla, (1995) reported that this situation could be reversed if the low quality roughage is properly supplemented to increase DMD and OMD. The author found that high quality legume was able to increase nutrients digestibility and dry matter intake.

Nutrients digestibility of sheep on rations containing ground nut shells

The effects of inclusion of groundnut shells, at different proportion, in sheep rations on nutrients' digestibility is shown in table (4). The DM and OM digestibility coefficients differed with the level of GNS.Their values decreased with the increased GNS in the ration. Lowest DMD was recorded for the group that consumed ration with 35 % GNS (group IV). The crude protein digestibility also had the same trend. The decreased dry matter digestibility for the rations formulated using groundnut shells might be due to high levels of tannins that affects digestibility of fiber, protein overall dry matter and organic matter digestibility leading to restricted feed intake. Tannins can only affect sheep when their levels reach 5% or above since those ruminant species have shown to have bacterial strains that can resist tannin effects and feed intake can still be normal and benefiting animals through protecting proteins from degradability in the rumen.

Crude fiber digestibility coefficients were lower for rations that had high levels of GNS percentage though the differences between control ration and the ration that contained 20% GNS were not significant(P>0.05). Significant (P<0.01) differences were found between rations III and IV in CPD and between the two rations and ration I and II, respectively.

Effects of inclusion groundnuts shells in rations and nutrient digestibility

Rations with higher levels of GNS have shown lower dry matter, organic matter and crude protein digestibility coefficients. The DMD decreased from 72% when GNS level was 0 % to 62%, 59 and 52% when the percent GNS in rations increased to20, 30 and 35 % respectively.

This decreased level of proteins digestibility coefficients might be attributed to the increased levels of crude fiber in rations with increment of levels of GNS. The possible increase in tannin content could also have had the same effect. Similarly Fick *et al.*, (1973) have reported that CF level in ration had depressive effects on nutrients digestibility coefficients. The authors reported that decreased level of CF could increase nutrients digestibility and vice versa. Chappell and Fontenot (1968) and Andrews *et al*,(1969) reported that the level of protein alone had no effect on nutrients digestibility if CF was still high.Blaxter *et al*.,(1962)showed that crude protein and crude fiber together had effect on digestibility coefficients i.e. in increased CP should be followed by decreased CF to have positive effect on nutrients digestibility.

Table 4: Nutrients digestibility as affected by inclusion of groundnut shells at different proportions in sheep rations

Rations	DM	OM	CP	CF	EE	NFE
I	69.87	70.9	25.6	45	55.34	70.3
II	67.18	69.15	22.7	44	49.56	69.1
III	65.18	67.14	21.8	42	47.23	69.3
IV	65.00	67.11	20.7	40	45.21	69.2

Digestible nutrients intake of lambs as affected by the level of GNS in the ration: Total digestible nutrients (TDN) were significantly (P<0.01) higher in the group that were on the control ration (zero GNS) and the ration that was formulated with 20% GNS. The other two groups that consumed rations

with 30 and 35% GNS had low TDN. The ME intake also had similar trend.

As the result of the improved OM digestibility coefficients total digestible nutrients, protein and minerals intake of sheep were also increased by supplementation of sheep with protein and energy sources when their rations were formulated using groundnut shells as presented in table (4).

Live body weight of lambs fed rations formulated using GNS: The overall performance of the experimental animals as affected by the level of groundnut shells in the ration offered is presented in table (4). The animals gained weight at varying levels according to the type of ration consumed. The first group had significantly (P<0.01) greater live body weight during the experimental period. Improved nutrients digestibility coefficient coupled with increased dry matter intake and total digestible nutrients (TDN) intake and energy intake resulted in increased live body weight gains of lambs in this study. That was the case when the lambs were left on the control ration. Inversely, decreased feed intake, decrease nutrients digestibility coefficients and energy intake led to decreased live body weight gains or even body weight loss. The decreased live body weight gains were attributed to decrease in energy intakes of the groups that were offered rations containing different levels of groundnut shells. The results reported here are similar to EL Hag and Mukhtar (1978) who reported increased live body weight gains upon supplementation of ruminants to decrease crude fiber and increase crude protein and energy contents in rations.

Feed conversion ratio and feeding cost upon inclusion of GNS: Feed conversion ratio (kilogram feed per kilogram live body weight) of the four experimental groups are presented in table (4). The feed conversion ratio was found to be best for the first group followed by group II, III and IV, respectively. Accordingly feed cost SDG per kilogram live body weight has shown to be lowest for group IV followed by III and then II, but was highest for group I.

Table 5: Effects of inclusion of groundnut shells, protein and energy supplements on feed intake and body weight changes in Desert sheep

Parameters	I	II	III	IV
No of animals	5	5	5	5
Experiment period (days)	70	70	70	70
Dry matter intake (g/day)	1215^{A}	1124^{A}	650^{B}	676^{B}
Initial weight	22.70	22.70^{A}	22.60	22.70
final Weight (kg)	31.744^{A}	31.04^{A}	29.613^{B}	30.20^{B}
Live body weight gain (kg/60d)	9.44^{A}	8.34^{B}	7.30^{C}	7.50^{C}
Live weight change (g/day)	151.133^{A}	139.9^{B}	116.883^{C}	108.33^{C}
Feed conversion ration	8.925^{A}	9.384^{A}	10.254^{B}	12.364^{C}
Feed cost SDG	2.50^{A}	1.50^{B}	1.20^{C}	0.90^{D}

Rows with different superscripts are significantly different (P<0.01)

The ingredient conventionally used in formulation of rations for lambs fattening are of high quality energy and protein sources and hence always expensive. Some of those ingredients like cereal grains, oil seed cakes, salts and other expensive materials are competed for use between humans and animals and are only available when their production is sufficient for human food and prices are relatively low to justify feeding to animals. On the other hand, groundnut shells are agro-industrial by product that is not used for a definite purpose, and can be available at a cheap price and sometimes given free. Hence replacement of any ingredient could lead to marked reduction in feeding cost. In this study replacement of 20, 30 and 35 % of all ingredients has led to 10, 15 and 25 % of feeding cost and still the lamb groups gained weight and at the end when comparing feeding cost for weight gain it was found that replacement was of financial benefit to the producers.

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