**Effects of supplementation of the natural grazing with *Roselle* seeds on dry mater intake and performance of Desert sheep lambs in West Kordofan, Sudan**

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**J.B. Jadalla 1,\* D.M. Mekki 1, S. A. Bukhari 2 andN A Eshag3**

1 Department of Animal Production, Faculty of Natural Resources and Environmental Studies, University of Kordofan, Elobeid, Sudan.

2  Department of Animal Production, Faculty of Natural Resources and Environmental Studies, University of Elssalam, Alfoula, Sudan

3 Department of Animal Production, Faculty of Agricultural Sciences, University O Dallanj, Sudan

\*Corresponding Author email: jumaajadalla@yahoo Tel: +24 9 912619847

**Abstract**:

A study was done to investigate the effects of supplementation of dry season grazing with *Roselle* seeds or groundnut seed cake on total voluntary dry matter intake, nutrient digestibility coefficients, total digestible nutrients, lambs live weight changes, body measurements and water consumption of Sudanese Desert sheep. The study was done at Abuzabad, El Nuhud District in West Kordofan State. Fifteen castrated lambs from Hamari sub-type of Sudan Desert sheep were sub-divided into three equal groups (5 lambs each). One group was offered natural grazing (NG), the second group was given natural grazing plus groundnut seed cake (NG+GNSC) and the third was fed on natural grazing plus *Roselle* seeds (NG+RS). Water was provided ad lib. The treatments lasted 77 days. Feed intake and water consumption were estimated daily while body measurements and body weight were taken weekly. Feed and faecal samples were taken for chemical analysis Statistical analysis indicated significant increase in total voluntary dry matter intake. It increased from 522g/day when lambs were fed on un-supplemented NG, to 810 and 845 g/day upon supplementation with GNSC and RS, respectively. The nutrients digestibility coefficients increased significantly (P<0.01) with supplementation, but no differences were observed in dry matter, organic matter and nitrogen free extract digestibility coefficients that could be attributed to type of supplement. Total digestible nutrients increased with supplementation (P<0.05) from 51 for NG to 56.9 and 61.5% upon supplementation with groundnut seed cake and *Roselle* seeds, respectively. Body weight increased from 20.10kg for lambs on NG to 24.50 and 25.70 kg upon supplementation with groundnut seed cake and *Roselle* seeds respectively. Feed conversion ratio improved from -22.32 for the animal groups on GN to 6.30 and 5.70 and daily growth rate from -27.50 when lambs left on GN only to 91.70 and 109.40 g/day upon supplementation with groundnut seed cake and *Roselle* seeds, respectively. Chest depth increased from 31.50 cm to 34.70 and 35.60 cm ; height at shoulder increased from 65.20cm to 68.00 cm and 69.00 cm ; and heart girth from 57.90cm to 64.70 cm and 66.50 cm upon supplementation with GNSC and *Roselle* seeds, respectively. No significant differences were observed in body length among the three groups. Water consumption increased from 1.126 to 1.476 L/day upon supplementation with GNSC and RS respectively. The study revealed that both supplements could improve nutritional status of the weaned lambs and that RS that are not usually used, could replace the cake in supplementation of lambs on NG during the dry season hence enabling producers and feedlot centers to reduce cost of production. Further studies are needed to evaluate effects of feeding lambs with *Roselle* seeds on meat quality.

**Key: Sheep nutrition, lambs weight change, supplementation, Roselle seeds**

 **Introduction**

Sudan owns large population of livestock species. This wealth contributes significantly in national and regional economy. It is the main source of family livelihoods in form of source of income and food such as milk and meat. Sheep contribute up to 21% in gross domestic product (GDP) of Sudan. The national population was estimated to be 37 million heads (1)

 The large national herd of sheep is raised under cheap production systems based on natural grazing. The herders also grow some crops that produce good quality residues that are often not properly used as supplements for their animals. Several studies have shown that natural grazing could hardly support sheep requirements during the dry season (2). For instance, the protein content of semi desert grasses decreased from 7.5% during rainy season in August to 4.4% at late maturity stage in March (2). As lambing takes place during the rainy season lambs face a problem of under nutrition at weaning age if they were to be fed on natural grazing only leading to weight loss.

To coup with this nutritional constraint, producers have developed traditional practices for synchronizing mating and parturition of their ewes to coincide lambing at times when natural grazing biomass is cable of providing lactating ewes with sufficient quantities of nutrient requirements (3,4). Therefore at the time when lambs reach to weaning age, the available natural grazing is of low quality. No studies had been done on effect of poor quality nutrient deficient pasture on the growth of the lambs in west Kordofan State. Also no studies had been done on effect of feed supplementation of lambs during these periods. It was against this background that a study was undertaken to study the effect of feed supplementation using groundnut seed cake and *Roselle* seeds. *Roselle* is grown as beverage and large amounts of seed are left after taking calyces.

 **Materials and methods**

A study was done in Abuzabad which lies within West Kordofan State (longitudes 280 45’ to 290 45’ and latitudes 120 20’ to 120 50’) and covers 4800 Km2  situated about 92 Km from Elfula, the headquarters of the State. This area is inhabited by agro-pastoralists with a little potential for crop production. This area is low rainfall savanna on sand (5) with average annual rainfall of 250 mm in the north and 400 mm in the south. The highest temperatures are recorded in April July (400 C) while lowest temperatures are recorded in December-January (140 C). The soil is predominantly stabilized sandy dunes with loamy sand along seasonal water courses and some clayey pockets in the south. The vegetation is diverse where thorny shrubs such as *Acacia senegal* *A. seyal* and *Ziziphus spinachristi* dominates. Tree species include *Balanites aegyptiaca Sclerocarya birrea. Tamarindus indica, Albizzia amara and Faiherbia albida.* Some trees and shrubs provide good browse biomass that is badly needed during dry seasons. Grasses and herbs are many though the density and abundance of species are dependent on the degree of grazing by different livestock species in the area. Mostly palatable species are over- grazed and their density is always seriously checked. *Aristida spp* *Eragrostic tremula*, *Panicum turgidum, andropogon gayanus* and *Cenchrus biflorus* are among grass species dominant in the area*.* *Blepharis linariifolia* and other palatable legumes have either disappeared or of very low density due to over grazing

Fifteen castrated four months old lambs of Sudan desert sheep of Hamari subtype were used in this study with weight ranging from15 Kg to 20 Kg. Lambs were grouped according to their body weight into three groups each with five animals and were then randomly allotted to three diets. Prior to experimentation lambs were ear-tagged for identification. The animals were also drenched with broad spectrum anthelmintics for internal and external parasites. Lambs were also vaccinated against diseases (sheep pox, HS and Anthrax) endemic in study area The experimental animals were individually penned and fed on their respective diets for 77 days after an adaptation period of two weeks during which they were fed on small amounts of the rations containing groundnut seed cake and/or Roselle seeds as well as the natural grazing (see Table 1). Feed and faecal samples were taken for chemical analysis according to procedures described by association of the official analytical chemists, AOAC (6). (At the end of each week's period the lambs were weighed.

After an overnight fast except from water, external body measurements and weight estimation was done as described by Owen and Norman (7). That included wither height, chest depth, shoulder width and trunk length. Feed intake, water consumption, nutrients digestibility coefficients were all determined as well as live body weight changes.

Feed sample were collected from each ration and dried for proximate analysis. Dry matter (DM) , organic matter (OM ), Ash , crude protein (CP), crude fibre (C F), Ether extract (EE) and Nitrogen free extract (NFE) were determined according to known analytical methods (6). Samples from each ration were analyzed for in vitro dry matter digestibility (IVDMD) according to (Tilly and Terrie method (8). Digestible energy (DE) was calculated using Retten–house *et al*., method (9).

A One-Way Analysis of Variance was used to analyze data of this study; a test used to examine the equality of three or more means at one time by using variances. The first step in this test is to compute the grand mean of a set of samples and this is the total of all the data values divided by the total sample size. This followed by calculating the total variation which is comprised the sum of the squares of the differences of each mean with the grand mean. If the sample means are close to each other (and therefore the Grand Mean) this will be small. The variation between group means is divided by their degrees of freedom (individual number minus number of groups). The steps are summarized below:

**Results**

The chemical composition of feed ingredients used in experiment rations were as shown in Table 1. The digestibility coefficients of feed rations used in the experiments were as shown in Table 2. The lambs' performance on natural grazing under GNSC and Roselle seed supplement were as shown in Table 3. The body measurements of lambs under natural grazing supplemented with ground nut seed cake and *Rosellle* seeds were as shown in Table. 4.

Table 1. Chemical composition of feed ingredients used in rations formulated

 for the experiment

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Feed | DM | OM | CP | CF | EE | ASH |
| Natural grazing (NG) | 96.9a | 91.7a | 4.2b | 43.5a | 1.40a | 5.2a |
| NG and groundnut seed cake | 96.4b | 89.76b | 10.34b | 36.32b | 5.4b | 6.64b |
| NG and Roselle seeds | 96.62c | 89.94c | 10.56b | 36.12b | 5.56b | 6.68b |
| SE+ | 0.1 | 0.3 | 0.15 | 0.13 | 0.11 | 0.12 |

Means with different superscripts on the same column are significantly different (P<0.01)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
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Table 2. Digestibility coefficients of the rations used in the study

Rations digestibility (%)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Nutrients | I | II | III | SE+ |
| Dry Matter | 46.0b | 63.5a | 64.9a | 2.484 |
| Organic Matter | 35.4b | 66.4a | 66.9a | 2.432 |
| Crude Protein | 22.1c | 84.8a | 68.1b | .557 |
| Crude Fiber | 47.9b | 41.1b | 53.1a | 3.103 |
| Ether Extract | 57.1c | 84.8b | 94.1a | 1.596 |
| Nitrogen Free Extract | 64.5b  | 77.1a | 76.6a | 1.843 |
| TDN | 51.0b | 56.9b | 61.5a | 2.134 |

Means with different superscripts on the same row are significantly different (P<0.01)

Table 3. Lambs performance on natural grazing as affected by type of supplement

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Roselle seed | +GNSC | Natural grazing | Parameters |
| - | 5 | 5 | 5 | No of lambs |
| - | 77 | 77 | 77 | Days on test |
| 1.899 | 605a | 572ab | 522b | Daily feed intake (g/d) |
| 1.146 | 19.7 | 19.8 | 20.4 | Initial body weight (kg) |
| 0.939 | 25.7a | 24.5a | 18.1b | Final body weight |
| 0.689 | 8.4a | 7.1a | -2.1c | Weight change (kg) |
| 19.78 | 109.4 | 91.7 | -27.53 | Weight gain g/d |
| 3.516 | 5.7a | 6.3a | - | Feed conversion ration |
| 0.411 | 9.3 | 9.4 | 9.6 | Initial weight W 0.75 |
| 0.318 | 11.4a | 10.9a | 9.5b | Final weight W 0.75 |

Means with different superscripts on the same row are significantly different (P<0.01)

Table 4. The body measurements of lambs under natural grazing supplemented with groundnut seed cake and Roselle seeds

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| SE+ | Roselle seed | +GNSC | Natural grazing | Parameters  |
| 1.028 | 35.0 | 34.7 | 38.6 | Initial body length (cm) |
| 1.643 | 44.9 | 44.3 | 43.0 | final body length (cm) |
| 0.748 | 28.3 | 28.3 | 27.28 | Initial body depth(cm) |
| 0.409 | 35.6a | 34.7b | 31.5c | final body depth (cm) |
| 0.548 | 61.5 | 61.4 | 62.0 | Initial body height (cm |
| 0.941 | 69.0a | 68.0a | 65.2b | final body height (cm) |
| 1.236 | 59.0 | 58.7 | 61.2 | Initial hearth girth (cm) |
| 0.873 | 66.5a | 64.7a | 59.9b | Final hearth girth (cm) |
| 0.717 | 1.48a | 1.43a | 1.13 b | Water consumption L/d |

 Means with different superscripts on the same row are significantly different P<0.01.01)

**Discussion**

In this study voluntary dry matter intake (VDMI) of the natural grazing (NG) was significantly (P<0.05) lower for the group of lambs that were kept on the NG only compared with the other two groups that were fed NG supplemented either with the groundnut seed cake (GNSC) or *Roselle* seeds. The findings of this study were similar to earlier studies done (3, 4, 11, 12, 13**)**. It had eelier been shown that sheep on fully mature GN consumed significantly lower amount of feed than those offered biomass harvested at early stages of growth (3**)**. The limited consumption of feed was attributed to low digestibility coefficients of nutrients of NG at that stage of maturity and to low crude protein content of herbage.

It was earlier reported that voluntary dry matter of sheep varied from 30-85g /kg (W75)/day according to CP of biomass offered (11). An increase of 37.5% increase in total VDMI has been reported (12**)**. This was attributed to improvements and optimization of rumen ecosystem to support higher microbial growth rates and consequently higher digestibility coefficients. The voluntary dry matter intake of roughage by ruminants has been found to be affected by the rate of digestion and disappearance of nutrients from the digestive tract (13). Because natural grass was of low digestibility, the lambs VDMI would increase through supplementation. The group of lambs supplemented with *Roselle* seeds consumed 605 g/day of NG compared with 572g/d and 522 g/d for the group supplemented with GNSC and on entire NG respectively. This finding was in agreement with earlier studies (14, 15, 16, 17). These earlier studies found that mixtures of concentrates and roughage were utilized more efficiently and VDMI significantly increased among different experimental animal groups when they were supplemented rather than being fed on mature natural grass solely. On the other hand, this study found that the VDMI for the experimental animal group on the natural grazing and supplemented with either *Roselle* seeds or GNSC were not significantly different from each other. Contrary to this, earlier study (4**)** reported that supplementation of sheep with high energy, low protein concentrate such as sorghum grains decreased NG intake. The declined NG intake were attributed to the effect of the volatile fatty acids produced upon feeding ruminants high starch concentrates and its effects on rumen *p*H. Similarly, another study (18) reported that supplementation of the dry season grazing with cereal grains depressed fiber digestibility due to the drop in *p*H and that in turn depressed the cellulytic microbes activity, hence digestibility of fiber. Supplementation of roughage diets with energy sources in the form of lipids reduces CF digestibility as a result of the fiber being protected from attack of the microbes of lipids being toxic to rumen microbes. Both effects reduce fiber digestibility (19, 20, and 21). It has been reported that fiber digestibility decreased from 65 to 45 % when dry timothy grass hay was supplemented with soya bean oil instead of its soaps (21**)**.

In this study dry matter digestibility (DMD) increased with supplementation from 46% when the NG alone was offered to 63.5% and 64.9% when NG was supplemented with GNSC and *Roselle* seeds respectively. The results obtained in the present study were comparable to findings of earlier study (22) in which DMD increased from 44 to 66 % when the low quality roughage was supplemented with non-protein nitrogen, NPN, and legume hay. In another study (23), DMD increased from 40 to 48 % when supplemented with rape seed meal. Elsewhere DMD increased from 44 to 50 and 51.6 % when the dry season grazing was supplemented with 500g/d molasses plus 60 g/d urea (24**)**. In this study, no differences in DMD were observed and that could be attributed to type of supplement.

In this study it was shown that organic matter digestibility (OMD) increased with supplementation from 35.4 to 66.4 and 66.1% when the NG was supplemented with GNSC and *Roselle* seeds respectively. This finding agrees with earlier studies (25, 26). It was observed that OMD increased from 56 to 60 % when low quality roughage was fed supplemented with legume hay (25**)**. Also there was an increased OMD of low quality roughage from 38 to 45 and 59 % upon supplementation with cereal grains and legume hay respectively (26**)**. In this study no differences in OMD could be attributed to type of supplement. Similarly crude protein digestibility, CPD, increased from -22.10 to 58.5 and 68.9% upon supplementation of the NG with GNSC and *Roselle* seeds respectively. The negative crude protein digestibility coefficient value observed in this study for the group that consumed the NG alone may be attributed to the low dietary protein content of the low quality roughage (4.20%). These findings are in agreement with an earlier study (24) in which CPD decreased with the decrease of dietary CP in roughage. A negative CPD was reported when dietary CP content was 3.6% or less. Other studies have reported increased CPD upon supplementation (27, 28**)**. This was attributed to the increased digestibility of the high protein diets.

In this study it was found that Ether extracts digestibility, EED, and NFED coefficients increased upon supplementation of the NG with GNSC or *Roselle* seeds. The observed increase in coefficients of these nutrients may be due to higher contents of the components of these nutrients in diets when supplemented rather than giving a natural grazing diet. The increased efficiency may be due to increased growth of rumen microbes.

 In this study it has been shown that the improved nutrients digestibility coefficients resulted in increment of the total digestible nutrients (TDN) of the supplemented diets than the NG fed alone. Those values increased from 51.0kg TDN/100Kg DM for the NG when given as sole diet to 56.9 and 61.5 kg TDN/100 kg DM upon supplementation with GNSC and *Roselle* seeds respectively. Some workers (29)observed that a tendency of high protein treatment group to have a higher TDN values. The values of TDN obtained in this study were lower than those earlier reported (30**)**where the effects of high energy rations for fattening lambs, fed on different concentrates-roughage rations resulted in TDN ranging from 63.8-72.7 Kg TDN/ 100Kg DM.

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