**International Journal of Innovation Scientific Research and Review**
*Vol. 04, Issue, 07, pp.2996-3001, July 2022*
*Available online at http://www.journalijisr.com*
*SJIF Impact Factor 4.95*

IJISRR

**ISSN: 2582-6131**

# Research Article

## EFFECTS OF MANAGEMENT AND FEED SUPPLEMENTATION ON BODY MEASUREMENTS OF DESERT LAMBS RAISED UNDER RANGE CONDITIONS IN WEST KORDOFAN, SUDAN

**[1]Salah.Abdelgabar.Salah Bukhari, [2]Ibraheem Musa.Tibin, [1]Musa Ahmed Musa Tibin, [1]Adam Jumaa Hamid Hamdoun, [3,]*Jumaa.BarramJadalla**

[1]Department of Animal Production, Faculty of Natural Resource & Environmental Studies, Al Salam University, Sudan, P.O. Box 20, El Fulla, Sudan.
[2]Department of Meat Science, Faculty of Animal Production, University of Khartoum, Sudan.
[3]Department of Animal Production, Faculty of Natural Resource & Environmental Studies University of Kordofan.

**Received 03th May 2022; Accepted 05th June 2022; Published online 20th July 2022**

**ABSTRACT**

This study was conducted with the objective of studying the effects of pattern of husbandry and addition of concentrates on lambs' body measurements. Measurements were taken from lambs borne to different ewes groups. The first group (A) were borne to ewes left to graze the natural grazing from 6: pm to 7: am, stayed under shade from 8: am to 5: pm and watered once every 3 days, the second group (B) allowed grazing natural grazing from 6: pm to 7: am, stayed under shade from 8: am to 5: pm and drank daily, the third group (C) was kept on natural grazing from 6: pm to 7: am stayed in under shade from 8: am to 5: pm drank daily and offered concentrate at the rate of 250 g / head / day and the fourth group (D) was left on the natural grazing all the day watered once every five days as followed traditionally representing control. Body measurements (head length, neck length, ear length, height at wither, body length, heart girth, chest depth and tail length) was monthly recorded. All those data were recorded for the first years. The data on the parameters studied were analyzed via SAS/STATTM computer programme. Body measurements especially height at withers, heart girth, chest depth and body length indicated that they were higher for lambs of group C compared with the control. The study concluded that supplementary feeding of Desert lambs with concentrates could give best body measurements. It was recommended that husbandry pattern be changed to avoid heat stress and supplementary feeding be followed to improve lambs performance on the natural grazing.

***Keywords:*** Desert lambs, nutritional levels, water regimen, body measurements

## INTRODUCTION

Sheep and goats are important small ruminants species raised in different parts of the Sudan. There is especial role and relative advantages for sheep over cattle and camels when considered for meat production. Sheep reproduce quickly and annually and provide both the national and foreign markets with good quality meat. Animal wealth was estimated in 2005 to be 50.944, 42.987 million heads of sheep and goats, respectively (FAOSTAT 2009). North Kordofan is the home land of Hammari and Kabashi tribal Desert sheep. North Kordofan holds about 8.89 million heads of sheep that represent 41.9% of total animals in the State and 17.4% of national sheep herd (MARF 2006). Sheep flocks in North Kordofan are raised on rangelands under traditional agro-pastoral systems. One of the major constraints under rangelands conditions is the unavailability of nutritious grazing resources on a year-round basis, where animals face a prolonged dry season (February-June). This is reflected on seasonality of production and reproduction, high mortality rates in both young and mature animals and low reproductive performance (El-Hag *et al.,* 2001). The situation is further aggravated by the dominance of annuals (90% of the vegetation) and the disappearance of legumes and perennials (El Wakeel 2002). Normally farmers provide their animals with different supplements during critical times of feed shortage. Supplements used are mainly oilseed cakes and cereal grains. Cassrad*et al.,* (1956) studied environmental factors affecting body dimensions in yearling Hampshire Ewes and concluded that both body size and conformation are affectedto an important extent by age, sex, type of birth and nutritional status of the lamb.Live weight estimates are used for assessing health and growth monitoring and in ration computation (Maglad*et al.,* 1986). The relationship between physical measurements in sheep may help in providing means for predicting traits that are not easily measured under field conditions. Regressing measurements of ear length, heart girth, body length, chest depth and height at withers on the age of the animal showed a poor relationship between ear length and age of the animal (Sulieman*et al.,* 1990). However, there were highly significant regression coefficients between the other live measurements taken and age. Heart girth is the most variable live measurement since it reflects condition in the animal (Sulieman*et al.,* 1990).In Ethiopian "Menz" rams, the highest correlation was between body length and wither height. Among traits, the strongest relationship was obtained between body condition score and body length (Sulieman*et al.,* 1990). Body condition score did not differ significantly between age groups and differences between age groups were noticed for heart girth and body lengthy. Also, Maglad*et al.,* (1986) found that heart girth was the measurement correlated most with body weight in all ages of calves. Tolera (1998) found a strong positive correlation between body weight and heart girth measurement. He also reported that in the absence of a weighing scale, body weight of sheep could be predicted using the equation y = 0.734x-26.386 where x and y represent heart girth (cm) and body weight (kg), respectively. The specific objective was to study the effects of supplementation on body measurements (body length and heart girth) and body weight prediction.

***Corresponding Author: Jumaa.BarramJadalla,**
3Department of Animal Production, Faculty of Natural Resource & Environmental Studies University of Kordofan.

## MATERIALS AND METHODS

### Study area

This study was conducted in Mahgour village, ELNuhoud, locality within latitudes 11° 5' - 13° 75' N and longitudes 27°-29° 5' E, about 900 km west of Khartoum. The rainy season extends from July to September with a peak in August. Average annual rainfall is 300 mm in the north and about 400 mm in the south parts. The highest annual temperatures (42°C) were recorded within a period extending from April to July, while the lowest values (14°C) were recorded during December and January (ELNuhoud Meteorological Station 2007). The soil is generally of smoothly undulating sandy plain dissected by patches of loamy sands in the southern parts (Ali 2002). Grasses are mostly annual including *Dactylcoteniumaegyptium*, *Cechrusbiflorus*, *Echinochloacolonum, Eragrostisasperaand Andropogongayanus* (Steven 1988).

### Experimental animals

The lambs borne to the different ewes groups were suckled for 4 months. After weaning the male lambs were castrated when their weight ranged between 15 to 20 kg and all lambs were vaccinated and treated against parasites. The measurements were carried out at birth and monthly till 6 months of age using a measuring tape.

### Experimental feed and lambs

The four experimental groups were left under the following management practices:

Group A: Grazing on natural pasture over night (from 6: pm to 7: am), stayed under shade from 8: am to 5: pm, provided water every 3 days.

Group B: Grazing on natural pasture over night (from 6: pm to 7: am), stayed under shade from 8: am to 5: pm, provided water daily.

Group C: Grazing on natural pasture over night (from 6: pm to 7: am), stayed under shade from 8: am to 5: pm, water provided daily and supplemented with concentrate at rate of 250 g / lambs / day after weaning.

Group D: Grazing on natural pasture from 7: am to 12: am and from 6: pm to 12: pm, stayed under trees from 12: am to 5: pm and water provided once every 5 days.

### Data collection

The measurements were carried out at birth and monthly using a measuring tape according to Owen *et al.,* (1976) and included:

A-Height at withers and was measured from the highest point on the dorsum of the animal to the ground surface at the level of the front feet.
B-Body length and that was measured from the tip of the scapular to the pin bone.
C-Heart girth was measured around the circumference of the chest just behind the four legs and along the xiphoit depression.
D-The length of the head was measured for the tip of nose to the atlas joint along the curvature of head.
E-Ear length was measured from the base of the ear at the skull along the dorsal surface to the tip of the ear.
F-The length of the neck was measured from the atlas joint to first thoracic spinal process.
G-The length of the tail measured from the base to the tip.
H-The depth of the chest was measured horizontally in a straight line from the highest point between the shoulders to the sternum.

### Chemical analysis

Feed samples of the concentrate in group C were taken for proximate analysis according to the procedures described by the Association of Official Analytical Chemists (AOAC, 1998). The composition and chemical analysis is presented in table 1.

**Table 1.** Ingredients and proximate analysis of the supplemented diet

| Ingredients (as fed) | |
|---|---|
| Sorghum grain | 33% |
| Groundnut cake | 20% |
| Groundnut hulls | 46% |
| Common salt | 1% |
| Proximate analysis (%) on dry matter basis | |
| Crude protein (CP) | 17.99 |
| Crude fiber (CF) | 16.75 |
| Ether extract (EE) | 05.60 |
| Nitrogen free extract (NFE) | 51.64 |
| Ash | 09.28 |
| ME(MJ/kg) calculated | 11.96 |
| ME MJ/kg DM=0.012 CP%+0.031 EE%+0.005 CF%+0.014 NFE (Ellis 1980). | |

### Statistical analysis

The statistical analysis was conducted using the GLM procedure of SAS (SAS 1994). Chi-square analysis was then used to evaluate reproductive parameters differences. Significant of differences between means was detected using Duncan's multiple range test (Duncan 1955).

## RESULTS

### Effects of management and level of nutrition on lambs'performance

The results of body measurements of lambs from birth till the age of 180 days as affected by system of grazing of their dams, watering frequency and supplementation during the autumn season is presented in table 2. Height at wither (HW) at birth (o days) was not significantly ($p > 0.05$) different among lambs of the four groups (41.375±0.800 cm). At the age of 30 days lambs in group A recorded the highest (HW) followed by group B, then C and finally D and their values were 55.3, 54.1., 52.0 and 40.6 cm respectively. Starting from the age of 60 till 180 days of age, the three groups A, B and C had similar (HW) but D had lower value. The differences were significant ($p> 0.05$).

**Table 2.** Effect of treatments on performance and body measurements of Hammari Desert lambs in North Kordofan Mean body measurements(cm) for period (days) Parameter Height at wither

| *Treatments* | 0days | 30days | 60 days | 90 days | 120 days | 150 days | 180 days | Total change |
|---|---|---|---|---|---|---|---|---|
| A | 41.9±.943 NS | 55.3±1.225 a | 61.8±1.145 a | 66.5±1.122 a | 71.4±1.211 a | 73.6±1.302a | 75.9±1.374 a | 33.9±1.699 b |
| B | 41.7±.894 NS | 54.1±1.162 a | 60.7±1.086 a | 65.4±1.065 a | 69.8±1.149 a | 72.3±1.235 a b | 76.3±1.304 a | 34.7±1.612 a |
| C | 41.9±.800 NS | 52.0±1.040 b | 59.3±.972 a | 66.1±.952 a | 72.6±1.027 a | 75.3±1.105 a | 77.1±1.166 a | 35.2±1.442 a |
| D | 40.0±1.033 NS | 40.6±1.342 c | 49.5±1.255 b | 55.4±1.229 b | 68.6±1.326 b | 69.5±1.426 b | 69.5±1.505 b | 29.5±1.861 b |

*abc :Means in the same column bearing different superscripts are significantly (P<0.05) different. NS: not significant at (P<0.05).*

The heart girth (HG) of lambs is presented in table 3. There were no significant (p> 0.05) differences among the four groups at birth (o days). Starting from the age of 30 till 180 days the three groups of lambs, A, B and C had similar (H G) with group D having lower value. The differences between the three groups from one hand and group three from the other hand was significant (p> 0.05)

**Table 3.** Effect of treatment on performance and body measurements of Hammari Desert lambs in North Kordofan Mean body measurements (cm) for period (days) Parameter Heart girth

| Treatment | 0days | 30days | 60 days | 90 days | 120 days | 150 days | 180 days | Total change |
|---|---|---|---|---|---|---|---|---|
| A | 37.9±.838 NS | 51.5±1.097 a | 58.5±1.229 a | 65.9±1.328 a | 70.3±1.900 a | 75.2±1.629 a | 77.3±1.706 a | 39.4±1.501 b |
| B | 38.7.838 NS | 52.7±1.066 a | 61.1±1.166 a | 65.7±1.366 a | 73.4±1.569 a | 76.2±1.629 a | 77.4±1.705 a | 38.7±1.424 b |
| C | 40.3±.918 NS | 51.9±.904 a | 59.6±1.043 a | 65.7±1.126 a | 72.3±1.654 a | 74.8±1.382 a | 80.6±1.448 a | 40.5±1.273 a |
| Control D | 39.3±.711 NS | 39.5±1.167 b | 52.3±1.347 b | 54.7±1.454 b | 67.4±1.191 b | 70.7±1.784 b | 71.1±1.869 b | 31.8±1.644 c |

*abc :Means in the same column bearing different superscripts are significantly (P<0.05) different. NS: not significant at (P<0.05).*

The length of head (L H) from birth to age of 180 days is presented in table 4. Lambs had similar head length at birth and to 30 days of age except for group D that had lower values. Thereafter and at the age 60 days group A and B were similar followed by group C and lastly D. From 120 – 180 C had the highest values followed by A, B and D.

**Table 4.** Effect of treatment on performance and body measurements of Hammari Desert lambs

| Treatment | 0days | 30days | 60 days | 90 days | 120 days | 150 days | 180 days | Total change |
|---|---|---|---|---|---|---|---|---|
| A | 15.1±.476 a | 22.9±.507 a | 26.3±.543 a | 27.9±.482 a | 28.8±.512 b | 30.4±.604 b | 31.9±.705 b | 16.8±.800 NS |
| B | 15.5±.476 a | 22.1±.507 a | 25.4±.543 a | 28.4±.482 a | 28.3±.512 b | 29.7±.604 b | 31.1±.705 b | 15.6±.800 NS |
| C | 16.1±.388 a | 21.8±.414 a | 24.6±.444 b | 27.5±.393 a | 30.7±.418 a | 31.8±.494 a | 32.3±.576 a | 16.2±.653 NS |
| Control D | 13.4±.521 b | 14.1±.556 b | 21.8±.595 c | 24.5±.528 b | 29.9±.561 b | 30.3±.662 b | 29.9±.772 b | 16.5±.876 NS |

lambsin North Kordofan Mean body measurements (cm) for period (days) Parameter Head length

*abc :Means in the same column bearing different superscripts are significantly (P<0.05) different. NS: not significant at (P<0.05).*

The lengths of ear (L E) of lambs from birth to 180 days of age are presented in table 5. The values were not significantly different (p> 0.05). While at the age of 30 days lambs of group D recorded lower values as compared with the other three groups. No significant differences (p> 0.05) were observed among the four groups in ear length at birth, 60, 90, and 150 days, while in period 30 days , 120 days, 180 days and overall period significant differences (p> 0.05) were observed among the three groups and the control in body measurements.

**Table 5.** Effect of treatment on performance and body measurements of Hammari Desert lambs in North Kordofan Mean body measurements (cm) for period (days) Parameter Ear length.

| Treatments | 0days | 30days | 60 days | 90 days | 120 days | 150 days | 180 days | Total change |
|---|---|---|---|---|---|---|---|---|
| A | 10.8±.299 NS | 15.6±.359 a | 15.7±.192 NS | 16.4±.158 NS | 17.1±.282 b | 18.7±.296 NS | 19.4±.304 b | 8.6±.456 a |
| B | 11.3±.299 NS | 16.3±.359 a | 16.2±.192 NS | 16.7±.158 NS | 17.2±.286 b | 18.8±.296 NS | 19.7±.304 a | 8.4±.456 a |
| C | 10.9±.244 NS | 15.8±.293 a | 16.2±.156 NS | 16.6±.129 NS | 18.9±.233 a | 19.7±.242 NS | 20.3±.248 a | 9.3±.372 a |
| D control | 10.8±.328 NS | 12.6±.394 b | 15.5±.210 NS | 16.0±.173 NS | 17.8±.313 b | 18.5±.324 NS | 18.2±.333 b | 7.4±.499 b |

*abc :Means in the same column bearing different superscripts are significantly (P<0.05) different. NS: not significant at (P<0.05).*

Measurements for length of necks groups (L N) of lamb from birth to 180 days of age are presented in table 6. Length of neck of group D was significantly (p> 0.05) higher at birth till 30 days of age than the three other groups and the lengths were similar thereafter till the age of 90 and from 120 till 180 days of age group C recorded significantly (P<0.05) higher values compared with A, B and D. Values of chest of depth (C D) of lamb groups are presented in table 7. No significant differences (p> 0.05) were observed at birth and at the age of 120 days. At the age of 30, 60, 90, 150 and 180 days of age group C was significantly superior (P<0.05) to the other groups. Values for the length of tail (L T) of lambs from birth to 180 days of age are presented in table 8. No significant (p> 0.05) differences were observed among the four groups of lambs in (LT) at birth, at 30 group C had longer tails, at 60 B and C were similar and had higher values than A and D which were also similar. From 120 to 180 days of age group C exceeded the other three groups and overall values showed significantly (p> 0.05) higher L T values among group supplemented and the other three groups.

**Table 6.** Effect of treatment on performance and body measurements of Hammari Desert lambs in North Kordofan Mean body measurements (cm) for period (days) Parameter Neck length.

| Treatments | 0days | 30days | 60 days | 90 days | 120 days | 150 days | 180 days | Total change |
|---|---|---|---|---|---|---|---|---|
| A | 11.6±.424 b | 16.9±.518 b | 21.9±.627 NS | 23.5±.424 NS | 22.9±.403 b | 24.3±.493 b | 25.0±.490 b | 13.4±.616 b |
| B | 11.1±.402 b | 17.4±.492 b | 21.4±.594 NS | 24.6±.402 NS | 23.9±.383 b | 24.9±.468 b | 25.9±.465 a b | 13.9±.548 a b |
| C | 11.8±.360 b | 16.9±.440 b | 22.0±.532 NS | 23.8±.360 NS | 24.8±.342 a | 26.3±.419 a | 26.8±.416 a | 15.0±.523 a |
| Control D | 14.8±.464 a | 14.9±.568 a | 21.2±.686 NS | 23.7±.465 NS | 23.9±.442 b | 25.1±.541 a | 24.4±.537 b | 9.5±.657 b |

*abc :Means in the same column bearing different superscripts are significantly (P<0.05) different. NS: not significant at (P<0.05).*

**Table 7.** Effect of treatment on performance and body measurements of Hammari Desert lambs in North Kordofan Mean body measurements (cm) for period (days) Parameter Chest Depth

| Treatments | 0days | 30days | 60 days | 90 days | 120 days | 150 days | 180 days | Total change |
|---|---|---|---|---|---|---|---|---|
| A | 18.7±1.004 NS | 26.5±.571 a | 31.3±.861 b | 34.8±1.087 a | 36.9±.673 NS | 38.5±.742 a | 40.8±.800 a | 22.1±5.022 a |
| B | 19.6±1.747 NS | 27.4±.542 a | 32.5±.817 a | 34.1±1.031 a | 37.2.638 NS | 39.3±.704 a | 41.1±.759 a | 21.5±4.764 a |
| C | 19.3±1.246 NS | 25.3±.485 a | 30.8±.731 b | 33.3±.922 a | 37.9±.571 NS | 40.1±.630 a | 41.5±.679 a | 22.2±4.261 a |
| Control D | 19.5±1.481 NS | 22.1±.626 b | 29.9±.943 b | 28.5±1.191 b | 36.8±.737 NS | 37.9±.813 b | 37.5±.876 b | 18.0±5.501 b |

*abc :Means in the same column bearing different superscripts are significantly (P<0.05) different. NS: not significant at (P<0.05).*

The measurements for body length (B L) of lamb groups from birth to 180 days of age are presented in table 9. The BL was significantly (p> 0.05) highest in lambs born for ewes in group C where their dams were fed natural grazing supplemented with concentrate (28.5 cm) and the lowest values were recorded for lambs in ewes of group A that were fed natural grazing and watered once every three days (23.0cm). Body length (B L) of lamb groups was not significantly different(p> 0.05) at the age of 30, 90 and 180 days. At 60 and 120 group D had lower values than the other three groups while at the age of 150 days group C had the highest value compared with the other three groups.

**Table 8.** Effect of treatment on performance and body measurements of Hammari Desert lambs in North Kordofan Mean body measurements (cm) for period (days) Parameter Tail length

| Treatments | 0days | 30days | 60 days | 90 days | 120 days | 150 days | 180 days | Total change |
|---|---|---|---|---|---|---|---|---|
| A | 30.2±.830 NS | 41.6±1.530 a | 45.3±1.370 b | 50.2±1.295 b | 54.1±1.676 b | 55.7±1.621 b | 58.3±1.605 b | 28.1±1.800 b |
| B | 30.6±.830 NS | 38.3±1.530 a | 49.5±1.370 a | 54.0±1.295 a | 54.9±1.672 b | 56.9±1.621 b | 59.1±1.605 b | 28.5±1.800 b |
| C | 30.3±.677 NS | 40.4±1.249 a | 48.1±1.119 a | 52.3±1.057 b | 59.7±1.366 a | 62.2±1.324 a | 63.4±1.311 a | 33.1±1.470 a |
| Control D | 29.5±.909 NS | 36.1±1.676 b | 45.8±1.501 a | 47.0±1.419 c | 55.3±1.832 b | 56.6±1.776 b | 56.5±1.758 b | 26.9±1.972 c |

*abc :Means in the same column bearing different superscripts are significantly (P<0.05) different. NS: not significant at (P<0.05).*

**Table 9.**Effect of treatment on performance and body measurements of Hammari Desert lambs in North Kordofan \Mean body measurements (cm) for period (days) Parameter Body length

| Treatments | 0days | 30days | 60 days | 90 days | 120 days | 150 days | 180 days | Total change |
|---|---|---|---|---|---|---|---|---|
| A | 23.0±.775 c | 34.6±1.142 NS | 40.5±.965 a | 44.4±1.208 NS | 49.0±1.848 a | 50.5±1.879 b | 52.4±1.891 NS | 29.4±1.977 b |
| B | 24.4±.775 c | 36.5±1.110 NS | 40.1±.819 a | 44.0±1.243 NS | 50.0±1.902 a | 51.4±1.879 b | 52.5±1.891 NS | 28.9±1.875 b |
| C | 28.5±.849 a | 33.9±.942 NS | 42.9±1.057 a | 44.5±1.025 NS | 53.0±1.568 a | 56.0±1.594 a | 56.9±1.606 NS | 31.6±1.677 a |
| D control | 25.0±.657 b | 33.9±1.216 NS | 38.9±.916 b | 41.5±1.324 NS | 51.0±1.025 b | 53.3±2.058 b | 52.3±2.071 NS | 23.7±2.165 c |

*abc :Means in the same column bearing different superscripts are significantly (P<0.05) different. NS: not significant at (P<0.05).*

# DISCUSSION

### The effects of dams' nutritional level and grazing pattern on lamb body measurements

Lambs body measurements under four different husbandry patterns in this study have indicted positive effects of supplementary feeding and four patterns of management and grazing on lambs' body measurements. Lambs born to mothers that received supplements recorded better body measurements than the control. Height at wither in supplemented group of lamb were 77.1cm compared with 69.5cm in farmers' practice. Heart girth in the supplemented group of lambs was 80.0 cm compared with 71.1cm in control practice. Chest depth in lamb supplemented group were 41.5 cm compared with 71.1cm in farmer practice. Body length in the supplemented group of lambs was 56.9cm compared with 52.3cm in lambs reared through the farmer practice. The superiority of body condition and better measurement values in lambs fed supplements and kept under shade is attributed their better nutritional status and better management practice than control.In table 9. Sudan desert lambs recorded highest body length at birth than other Sudanese sheep breedsThose results are similar to the findings of Mansour *et al.,* (1992) who indicated that, the body length at birth were 25.95, 25.60 and 23.50 cm for Shugor, Dubasi and Watish respectively. The heart girth for Watish at birth was lowest than Shugor and Dubasi. Sudan desert lambs at birth had longest height than Dubasi and Shugor. Similarly Cassrad*et al.,*(1956) studied environmental factors affecting body dimensions in yearling Hampshire Ewes and concluded that both body size and conformation are affectedto an important extent by age, sex, type of birth and nutritional status of the lamb.Suleiman *et al.,* (1990) reported that the estimation of the relationship between body measurements in sheep may help to provide means for predicting traits which are not normally easily measured under field conditions. Babiker and Mohammed (1990) found that desert sheep were significantly (P< 0.01) higher at wither (84 vs.71 cm) than other breeds and had significantly (P< 0.05) deeper chest (36 vs. 34 cm) than the Australian Merino sheep. While Mansour *et al.,* (1992) indicated that Shugor lambs significantly (P< 0.05) exceeded the Dubasi and Watish in body lengths and heart girth, while Dubasi lambs were significantly (P< 0.001) superior than Shugor and Watish lambs in height at wither and chest depths.They concluded that heart girth is the most variable live measurement since it reflects condition in the animal. Sedentary system. Hibret*et al.,* (2001) studies of physical measurements in mature Ethiopian "Menz" rams showed that among linear measurements, body condition score, heart girth, body length and wither height, the highest correlation was between body lengths and wither height. Among those traits, the strongest relationship was obtained between body condition score and body length. Also Tolera (1998) found a strong positive correlation between

body weight and heart girth measurement.This assumption was supported by the fact that, the husbandry system has some effects on the production characteristics of the Sudan Desert sheep El-Hag *et al.,*(2001) who found significant differences between sedentary and nomadic flock in some parameters studied. Ewes lambed under nomadic system had higher lambs birth weights than ewes lambed in semi intensive system.

**Prediction equations and coefficient determination**

The assessment of the relationships between lamb weight and body measurements are shown in table 10. The correlation coefficients obtained were positive and significant. In general, the analysis of R2 at different age groups in lambs revealed that a comparatively higher relationship between body measurement and body height was observed. This is mainly due to the fact that the height is due to growth of bones, whose function of increase in weight is probably not proportionate to increase in general body weight. The results are supported by other research (Ulaganathan*et al.,* 1992). Since in both sexes the lowest R2 was obtained at birth, this suggests that weight at birth could not be estimated more accurately by combination of two or more measurements .This may be the bones and muscles of lamb not completed in this stage of life.The relationships between ewe weight and body measurements were shown in table 11. These tables showed the general models for the estimation of body weight in each lamb age groups. Most of the correlation coefficients obtained were positive and significant. These findings are in general agreement with Mohammed and Amin (1996) who reported that, a positive correlation would help in estimating body weight of Sahel goats in the field. Similar results were obtained by Thiruvenkadan (2005). Similar results are in line with Atta and El-khidir (2004).The higher association of body weight with heart girth was possibly due to relatively larger contribution in body weight by heart girth (consisting of bones, muscles and viscera). It is similar with findings of Mayaka*et al.,* (1995); Mohammed and Amin (1996). Who reported that, the higher association of body weight with chest girth was possibly due to relatively larger contribution in body weight by chest girth. This study implies that, the correlation coefficients between body weights and body measurements at different ages were positive and strongly correlated. Similar results were obtained by Thiruvenkadan (2005).Atta and El-Khidir (2004) concluded that, heart girth could be used with great accuracy to estimate live weight of Nilotic sheep. The correlations between body weights and heart girth pooled were lower than those at different age groups. This might be due to more or less similar environmental influence at different age groups. Since body heart girth had high correlation with body weight, this may be used as selection criteria. Thiruvenkadan (2005) also reported that selection based on body measurements should improve meat production in goats. Mohammed and Amin (1996) found a good correlation ($R^2$ = 0.98) between body weight and heart girth. They concluded that, the body weight of Sahel goats can be estimated in the field using morphometric measurements taken with a tape.

## CONCLUSIONS

The study concluded that farmers' husbandry pattern should be changed to avoid heat stress and supplementary feeding be followed to improve lambs performance and achieve best body measurements on the natural grazing.

**Acknowledgements**

The authors wish to thanks extend to rich the Ministry of High Education and Scientific Research for funding this study, also deep appreciation to the German Academic Exchange Service (DAAD) for partially funding of this valuable work.

## REFERENCES

**Ali M A 2002** Body measurements, performance and meat characteristics of the Hammari and Kabashi subtype of the desert sheep in the Sudan. Ph.D. Thesis (Animal production), University of Gezira.

**AOAC Association of the official analytical Chemists 1998** Official Method of analysis. 15th end, AOAC, Washington D.C.

**Atta M and El-khidir O A 2004** Use of heart girth, wither height and scapuloischial length for prediction of live weight of Nilotic sheep. Small Ruminant Research 55: 233–237.

**Babiker S A and Mohamed S A 1990** Live- animal measurement and carcass characteristics of Sudan Desert sheep and Australian Merino sheep. Sudan. Journal Animal Production Vol. 32, part 1, 9-15.

**Cassard D W, Gregory P W, Weir W C and Wilson J F 1956** Environmental factors affecting body dimensions in yearling Hampshire Ewes Journal Animal Science -15:922-929

**El Wakeel A S and Abu-Sabah M A 1993** Relevance of mobility to rangeland utilization: the Baggara transhumant of southern Kordofan. Nomadic Peoples 32: 33-38.

**El-Hag F M, Fadlalla B and Mukhta H K 2001**Some production characteristics of Sudan Desert sheep under range condition in North Kordofan. Sudan Tropical Anim. Health and Production 33:229-239.

**Ellis N 1980**The nutrient composition of Sudanese animal feeds. Bul. I. Northern and Central Sudan.Animal Nutrition Research Laboratory, Kuku, Khartoum North. Appendix 1, p. 19.

**ElNuhoud Metrological Station 2007** Report .Annual Report. North Kordofan State, Sudan.

**FAO 2009** Quarterly Bulletin of Statistics, Food and Agriculture Organization,Rome.Italy.www.fao.org/docrep/012/i0680e/i0680e.pdf

**Hibret A, Toe F, Mukasa-Mugerwa E Kassa T and Markos T 2001** Genital disorder,linear and testicular characteristics in Menz rams. Tropical Animal Health and Production 33 (33):219-227.

**Maglad M A, Ahmed M K A and Lutfi A A 1986** Effect of ration, ambient temperature and relative humidity on dry matter and water intake of sheep. Sudan, Journal veterinary Science. Animal Husbandry 25:12-15.

**Mansour M E, Sulieman A H and Ali I E 1992** A note on growth of some different types of Sudan lambs from birth to weaning.Sudan Journal Animal Production 5:87-91.

**Mayaka T D, Tchoumboue J, Manjeli Y and Teguia A 1995** Estimation of live weight in West African Dwarf goats from heart girth measurement. Tropical Animal Health and Production. 28:126-128.

**Mehta S C Vij P K, Joshi B K, Sahai R and Nivsarkar A E 1995** Characterization and conservation of the Malpura sheep breed. Animal Genetics Resouce Information. 16: 83-91.

**MAWF Ministry of Animal Wealth and Fishers 2006** Report. Khartoum, Sudan 2-3.

**Mohammed I D and Amin J D 1996** Estimating body weight from morphometric measurements of Sahel (Borno White) goat. Small Ruminant Research 24: 1–5.

**Owen J E and Norman G A 1976** Studies in the meat production characteristics of Botswana Goat and sheep. Part 1: Tropical products institute, 56-62 Grays Inn road.

**Steven P 1988**The classification of floristic areas and floristic elements. Office of Arid Lands Studies, University of Arizona, Tucson AZ 85721, USA.

**Sulieman A H, Sayers A R and Wilson T R 1990** Evaluation of Shugor, Dubasi and Watch subtype of Sudan Desert Sheep at El Huda National Sheep Research Station, province, Sudan, (ILCA) research Report No18,ILCA,AddisAbaba,Ethiopia).1-30.

**Thiruvenkadan A K 2005** Determination of best-fitted regression model for estimation of body weight in KanniAdu kids under farmer's management system. Livestock Research for Rural Development 17:7.

**Tolera A 1998** Production situation and some productively and physical characters of traditionally managed sheep and goats of koshered District, Southern Ethiopia. Journal Animal Resource 13:49-59.

**Ulaganathan V, Krishnappa K and Shanmugasundaram S 1992**Prediction of body weight from linear body measurements in local goats. Indian Journal of Animal Genetics and Breeding 14, 2:31-32.

*********