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Growth Rates of Sudanese Nubian Kids under Smallholder System

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Abstract: Seventy-three male and female Sudan Nubian goat kids were used in this experiment. The kids were born during the period between October 1998 to August 2000, to parent stock raised on traditional pastroralism. These kids were used in completely randomized design to investigate the effects of nutritional supplementation, sex, type of birth, parity order and season of kidding on growth rates of Nubian goat kids under smallholder system kept up to the age of 9 months. The result revealed that pre-weaning average daily weight gain of kids was significantly ($p<0.01$) affected by feeding supplementation, sex of the kid, litter size and season of kidding, while parity order did not significantly affected this trait. The pre-weaning growth rate of kids was significantly affected by feeding supplementation, parity order and season of kidding, while sex of kid and litter size exerted non-significant effect on this rate. The post-weaning average daily weight gain was significantly ($p<0.05$) affected by feeding supplement, while sex of the kid had a non-significant effect on this trait. The post-weaning growth rate was not significantly affected by feeding supplementation and the sex of the kid. The overall live weight gain and the overall growth rate were not significantly affected by feeding supplementation and the sex of the kid. There was a positive and a highly significant ($p<0.01$) correlation between birth weight and weaning weight of kids.

Key words: Nubian, goat, kids, growth, smallholder

INTRODUCTION

Information on goat kid growth rate is important for goat breeding and production and sustainability of any goat enterprise depends upon the successful raising of kids for replacement stock. Several studies, have shown that among the factors that affect goat kid growth rate are sex, type of birth, parity order, plane of nutrition and season of kidding (El Moula *et al*., 1999; Shetaewi *et al*., 2001; Santra *et al*., 2002; Berhane and Eik, 2006; Gbangboche *et al*., 2006).

Nutritional research to improve meat goat production lags behind that for cattle and sheep though the meat goat population has increased throughout the world (Pashaa and Saithanoob, 2000). Very little information is pertinent to the performance of Nubian goat's kids under natural range conditions is available. This study was therefore adopted to fill in this gap, with the objectives of evaluating of effects of concentrate supplementation of natural pasture, other factors as sex, type of birth, parity order and season of kidding on pre and post-weaning growth rate of Nubian goat kids were also studied.

MATERIALS AND METHODS

Seventy-three male and female Sudan Nubian goat kids were used in this experiment. The kids were born during the period between October 1998 to August 2000, to parent stock raised on

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Table 1: Some meteorological data of the region during the experimental period of the study

	Years								
	1998			1999			2000		
Month	RH (%)	Temp. (°C)	RF (mm)	RH (%)	Temp. (°C)	RF (mm)	RH (%)	Temp. (°C)	RF (mm)
January	26	20.8	-	28	23.7	-	36	22.9	-
February	21	23.0	-	24	28.4	-	33	24.1	-
Marsh	17	26.1	-	15	27.1	-	21	26.2	-
April	15	31.7	-	14	31.2	Trace	18	31.7	Trace
May	18	34.1	-	22	35.2	Trace	26	34.3	0.1
June	22	34.5	-	25	34.8	4.7	26	35.7	-
July	39	33.9	1.4	44	31.5	42.2	36	32.8	2.5
August	50	30.7	34.7	51	30.3	51.3	39	32.5	2.0
September	52	31.3	87.6	44	31.1	20.4	39	31.7	16.3
October	37	32.0	7.2	36	31.5	4.2	30	30.2	24.1
November	25	32.9	-	26	28.0	-	27	26.7	-
December	28	25.5	-	33	25.0	-	29	22.5	-

Table 2: Chemical composition of natural pastures in the study area

Botanical name	Local name	Type DM	CP	CF	EE	Ash
			(%)			
Acacia ehrenbergiana	Salam	Bark and branch	12.66	27.51	1.95	6.36
Acacia ehrenbergiana fruit	Salam fruit	Fruit	1.67	16.00	3.00	8.25
Acacia ehrenbergiana flower	Salam flower	Flower	0.71	16.50	1.00	9.75
Acacia mellifera	Kitir	Tree	16.30	30.30	1.80	8.70
Acacia tortilis sub-sp. Radiana	Seyal	Tree	12.14	28.55	2.12	4.14
Schoenefeldia gracilis	Dembelab	Grass	4.90	36.70	1.00	15.50
Aristid spp.	Gau	Grass	5.70	38.40	0.50	10.00
Urochloa trichopus	Taffa	Grass	8.30	34.30	0.90	13.90
Cymbopogon nervatus	Nal	Grass	6.40	31.90	1.40	8.40
Tribulus terrestris	Dirasa	Grass	26.17	33.00	4.00	24.00
Targus berteronianus	Shara	Grass	9.88	8.84	1.36	21.00
Ipomoea cordofana	Hantoot	Grass	18.38	17.50	1.50	22.00
Aristida adscension	Humra	Grass	2.98	43.00	2.22	8.75
Sorghum straw	Gasab feterita	Stem	1.58	24.50	0.50	7.00

Date of collection between end of September and beginning of November (1998). Stage of collection: Late bloom stage, dried aerial part for grasses and fresh twigs for trees

traditional pastroralism. The grazing zone of these animals was in the southern Butana plains of Sudan near Abu Deleig, 100 km north east of Khartoum. The metrological conditions of the grazing pasture and pasture composition are given in Table 1 and 2, respectively. The year was divided into three seasons, summer (from March to June), autumn (from July to October) and winter (from November to February). The parent stock was divided into three groups (A, B and C) of equal number and weight, during winter and summer goats were allowed day grazing and in the evening they were kept indoors in enclosures made of mud, to allow giving supplement. Group A was given sorghum grains at night, at a rate of 500 g/head/day for 30 days before parturition and throughout the lactation period. For the remaining time of their physiological cycle this group was given sorghum at a rate of 170 g/head/day. Group B was also given sorghum grains at night at a rate of 170 g/head/day throughout their physiological cycle to simulate the traditional management in the area. Group C was given *ad libitum* a molasses based diet throughout it's physiological cycle (Table 3). All groups were offered sorghum stalks at a rate of 500 g/head/day and allowed access to fresh pore-hole water twice a day in dry summer and once in winter.

In autumn the goats and their kids were taken outside Abu Deleig area to its surrounding plains, where night grazing was also practiced in addition to day grazing. No dietary supplementation was offered during this period. Watering was once a day from running surface water (Khors) during the early wet season and from excavated ponds at the end of the season.

Table 3: Ingredients and proximate analysis of experimental diet (As fed basis)

Components (%)	Ration A	Ration B	Ration C	Sorghum stalks
Molasses	-	-	50.00	-
Sorghum grains	100.00	100.00	-	-
Wheat bran	-	-	41.00	-
Groundnut cake	-	-	8.00	-
Salt	-	-	1.00	-
Total	100.00	100.00	100.00	
Proximate analysis (%)				
Dry matter	94.50	94.50	91.80	93.00
Crude protein	12.75	12.75	12.15	4.14
Crude fibre	2.87	2.87	6.10	24.50
Ether extract	2.46	2.46	2.71	0.50
NFE	74.34	74.34	51.08	47.83
Ash	2.08	2.08	9.09	7.68
ME (MJ kg^{-1})	12.84	12.84	9.51	6.22

Kids born to these goats were allowed to freely suckle colostrum for the first three days after parturition, thereafter they were separated from their dams during the day. In the evening half of their dam milk was milked before kids were released to spend the night with their dams. Kids were weaned at three month of age. Consequently and to the sexual maturity (9 month age) kids were divided into two groups (A and B). In winter and summer group (A) was given sorghum grains at a rate of 250 g/head/day, while group (B) was given sorghum grains at a rate of 100 g/head/day, to simulate the traditional practice in the area. During this period all kids received sorghum stalk at a rate of 250 g/head/day. In autumn kids depended solely on grazing.

The birth weight was taken immediately after birth and when kids were dry. All kids were then weighed at 2 weeks intervals up to sexual maturity at the 9th month of age.

The pre-weaning average daily weight gain (PADWG) was calculated as follows:

$$\text{PADWG} = \frac{\text{Weaning weight} - \text{Birth weight}}{90(\text{weaning age in days})}$$

The pre-weaning growth rate (PGR) was calculated as follows:

$$\text{PGR} = \frac{\text{Weaning weight} - \text{Birth weight}}{\text{Birth weight}}$$

The post-weaning average daily weight gain (PWADWG) was calculated as follows:

$$\text{PWADWG} = \frac{\text{Weight at 9 month} - \text{Weaning weight}}{180\ (\text{days})}$$

The post-weaning growth rate (PWGR) was calculated as follows:

$$\text{PWGR} = \frac{\text{Weight at 9 month} - \text{Weaning weight}}{\text{Weaning weight}}$$

The overall average daily weight gain (OADWG) was calculated as follows:

$$\text{OADWG} = \frac{\text{Weight at 9 month} - \text{Birth weight}}{270\ (\text{sexual maturity age in days})}$$

The overall growth rate (OGR) was calculated as follows:

$$OGR = \frac{\text{Weight at 9 month} - \text{Birth weight}}{\text{Birth weight}}$$

Meteorological Data

Meteorological information on temperature, relative humidity and rainfall at the time of investigation were collected from the nearest meteorological station (Shambat) (Table 1).

Statistical Analysis

Means, standard deviations and correlation coefficients of the different traits were computed. Analysis of variance was performed in accordance to general linear method. Duncan's multiple range test was used with factors that had significant effect on the traits studied. All techniques of the statistical analysis were conducted using computer program statistical package for social science (SPSS, 1998).

RESULTS

Pre-Weaning Kid Growth

Pre-Weaning Average Daily Weight Gain

As seen in Table 4 pre-weaning average daily weight gain was significantly higher ($p<0.01$) in group (A) than in group (B) and (C), while there was no significant difference between groups (B) and (C) in average daily weight gain. The overall average pre-weaning daily weight gain for the kids was 63.3±3.9 g.

Irrespective of supplement feeding parity order resulted in anon-significant increase in pre-weaning average daily weight gain of Nubian goat kids, recorded values of pre-weaning average daily weight gain for 1st, 2nd and 3rd parities were 65.2±3.46, 65.6±3.85 and 72.9±4.67 g, respectively (Table 4).

Sex also exerted no-significant effect on the average pre-weaning daily weight gain, although males were heavier than females.

Table 4: Pre weaning live weight gain

	Factors						
	Feeding regime				Parity order		
Weight gain	A	B	C	Average	1	2	3
PADWG (g) SE±	75.3±2.82^{a}	60.0±3.55^{b}	54.5±5.25^{b}	63.3±3.9	65.2±3.46^{a}	65.6±3.85^{a}	72.9±4.67^{a}
n	38	24	11	73	31	25	17
PGR SE±	2.80±0.15^{a}	2.38±0.19^{ab}	2.15±0.28^{b}	2.44±0.21	2.57±0.16^{ab}	2.26±0.18^{b}	3.00±0.22^{a}
n	38	24	11	73	31	25	17
	Factors						
	Sex		Litter size		Season of kidding		
Weight gain	Male	Female	Single	Twin	Winter	Summer	Autumn
PADWG (g) SE±	67.9±3.10^{a}	66.2±3.32^{a}	69.5±3.35^{a}	53.6±5.58^{b}	62.1±2.86^{b}	72.00±4.14^{ab}	77.30±5.59^{a}
n	39	34	62	11	42	20	11
PGR SE±	2.52±0.15^{a}	2.60±0.16^{a}	2.56±0.12^{a}	2.55±0.29^{a}	2.32±0.14^{b}	3.00±0.20^{a}	2.69±0.27^{ab}
n	39	34	62	11	42	20	11

^{a,b}: Means in the same column have the same superscripts are not significantly different ($p>0.05$), PADWG = Pre-weaning average daily weight gain, PGR = Pre-weaning growth rate

As seen in Table 4 pre-weaning average daily weight gain of single born kids (69.5±3.35 g) was significantly higher ($p<0.01$) than that of twin born kids (53.6±5.58 g).

As regard to season of the year, kids born in autumn had a significantly ($p<0.05$) high pre-weaning average daily weight gain than those born in summer or winter, while there was no significant difference in pre-weaning average daily weight gain between kid born in summer and winter.

Pre-Weaning Growth Rate

Table 4 gives effect of supplementary feeding, parity order, sex, litter size and season of the year in pre-weaning kid growth rate. Pre-weaning growth rate of kids in group (A) (2.80±0.15) was significantly higher ($p<0.01$) than the pre-weaning growth rate of kids in group (C) (2.15±0.28), while there was no significant difference between the pre-weaning growth rate of kids in group (A) and (B) and group(B) and (C). The over all average of the pre-weaning growth rate of the kids was 2.44±0.21.

As seen in Table 4 pre-weaning growth rate of kids of parity three was significantly higher ($p<0.05$) than the pre-weaning growth rate of kids of parity one and two, while there was non significant difference between the pre-weaning growth rate of kids of parity one and two.

The sex of the kid and litter size exerted non significant effect on pre-weaning growth rate yet, males had higher pre-weaning growth rate than females and also singles were heavier than twins. Season of kidding affected significantly the pre-weaning growth rate, where kids born in summer had significantly higher ($p<0.05$) pre-weaning growth rate than kids born in winter, while there was non significant differences between the pre-weaning growth rate of kids born in autumn and those born in winter and also between kids born in summer and autumn.

Post-Weaning Live Weight Gain

Post-Weaning Average Daily Weight Gain

Table 5 indicates that post-weaning average daily weight gain increased non-significantly in group (A) feeding supplement (33.00±4.94 g) when compared with group (B) feeding supplement (23.7±4.71 g), while sex of the kid had a non-significant effect on post-weaning average daily weight gain though males had greater gain. The overall post-weaning daily weight gain was 28.35±4.60 g.

Post-Weaning Growth Rate

The results in Table 5 shows that the post weaning growth rate was not significantly affected by feeding supplement and the sex of the kid although males had greater post-weaning growth rate. The overall post-weaning growth rate was 0.76±0.11.

Overall Live Weight Gain

Overall Average Daily Weight Gain

As seen in Table 6 the overall average daily weight gain was not affected significantly by feeding supplement however, kids of group A which received 250 g of sorghum grains per day were heavier

Table 5: Post weaning live weight gain

	Rate			
Factors	PWADWG (g)	n	PWGR	n
Feeding regime				
A	33.00±4.49[a]	10	0.69±0.11[a]	10
B	23.70±4.71[a]	11	0.82±0.10[a]	11
Average	28.35±4.60	21	0.76±0.11	21
Sex				
Male	39.00±4.54[a]	10	0.90±0.11[a]	10
Female	27.30±4.32[a]	11	0.63±0.10[a]	11

[a, b]: Means in the same column have the same superscripts are not significantly different ($p>0.05$), PWADWG = Post-weaning average weight gain, PWGR = Post-weaning growth gain

Table 6: The overall live weight gain

	Rate			
Factors	OADWG (g)	n	OGR	n
Feeding regime				
A	49.00±3.88[a]	10	5.68±0.79[a]	10
B	23.70±3.70[a]	11	5.22±0.75[a]	11
Average	36.35±3.79	21	5.45±0.77	21
Sex				
Male	46.00±4.19[a]	10	6.01±0.77[a]	10
Female	40.90±3.99[a]	11	4.92±0.74	11

[a, b]: Means in the same column having the same superscripts are not significantly different (p>0.05), OADWG = Overall average daily weight gain, OGR = Overall growth rate

Table 7: Correlations coefficient of body weights at different ages and growth rate

Age specific and growth rate	PAD WG	PW GR	Weaning weight	Mature weight
Birth weight	0.132	-0.581[xx]	0.402**	-0.068
n	73	44	67	21
Weaning weight	0.919**	0.447**	-	0.584**
n	67	44		21
Mature weight	-	-	-	-
n				
Postweaning average daily gain	-	-	-	-
n				
Post weaning growth rate	-	-	-	-
n				
Overall average daily gain	-	-	-	-
n				
Pre-weaning average daily gain	-	0.743**	-	-
n		44		

Age specific and growth rate	Post-weaning average daily weight gain	Post-weaning growth rate	Overall average daily weight gain	Overall growth rate
Birth weight	-0.053	-0.162	-0.264	-0.738**
n	21	21	21	10
Weaning weight	0.665**	-0.534**	0.542**	0.447
n	21	21	21	10
Mature weight	0.995**	0.363	0.980**	0.767**
n	21	21	21	10
Postweaning average daily gain	-	0.263	0.972**	0.772**
n		21	21	10
Post weaning growth rate	-	-	0.383	0.505
n			21	10
Overall average daily gain	-	-	-	0.843**
n				10
Pre-weaning average daily gain	-	-	-	-
n				

*p<0.05 significant, **p<0.01 highly significant

by 106.8% than those of group B which received grain level simulating the traditional practice of the area. Irrespective of supplement level. Sex had a non significant increase in over all average daily gain. The overall average daily weight gain was 36.35±3.79 g.

Overall Growth Rate

The results in Table 6 indicated that the overall growth rate of kids was not affected by supplement level and that sex did not significantly affect overall growth rate of kids, though male had heavier growth rate than females.

Correlations Between Body Weight at Different Ages and Growth Rate

The results obtained in Table 7 showed that there was a positive and highly significant (p<0.01) correlation between weaning weight and pre-weaning average daily weight gain, pre-weaning growth rate, mature weight post-weaning average daily weight gain and overall average daily weight gain. The

result also indicated that there was a positive low non-significant correlation between birth weight and pre-weaning average daily weight gain, appositive medium correlation between the former trait and weaning weight and a negative highly significant ($p<0.01$) correlation between birth weight and pre-weaning growth rate. The correlations between birth weight and mature body weight, post-weaning average daily weight gain, post-weaning growth rate and the overall average daily weight gain were negative and non-significant. The correlation between birth weight and the overall average growth rate was negative and highly significant ($p<0.01$).

The result in Table 7 also indicated that mature body weight had positive and highly significant ($p<0.01$) correlation with the post-weaning average daily weight gain, overall average daily weight gain and the overall growth rate, while it had positive but non-significant correlation with the post-weaning growth weight.

As seen in Table 7 also, the correlation between post-weaning average daily gain and post-weaning growth rate was low but it was very high and significant ($p<0.01$) with overall average daily weight gain and overall growth rate. Post-weaning growth rate had low correlation with overall average daily weight gain and medium with overall growth rate ($r = 0.051$) Pre-weaning average daily weight gain had high and significant ($p<0.01$) correlation with pre-weaning growth rate and overall growth rate.

DISCUSSION

The average pre-weaning daily weight gain of the experimental goat's kids was 63.3±3.9 g was higher than that reported by Berhane and Eik (2006) for Ethiopian Abergelle goat's kids, on the other hand, this rate was lower than that given by El Khidir *et al.* (1998) and Guney *et al.* (2006) for Sudanese desert and Damascus goat's kids respectively.

The present result showed that kids born to group (A) supplement grew faster than kids born to group (B) and group (C) supplement. This could be due to amount of energy and protein furnished by each diet and to diet digestibility as the amount of supplement (sorghum grain) given to dams of group A was greater than that given to group B and molasses based given to dams of group C could have resulted in depression of digestibility. The superior nourishment of dams of group A might have affected dam's milk production capacity and consequently pre-weaning average daily weight gain and pre-weaning kid growth rate as kids in their early days depend solely on their dams milk yield. These finding agreed with Santra *et al.* (2002), Sheridan *et al.* (2003) and Chicago *et al.* (2006).

As seen in the result kids born in autumn had the highest average pre-weaning daily weight gain, while kids born in winter had the least average pre-weaning weight gain. Kids born in summer had the highest pre-weaning growth rate, These results agreed favorably with Wenzhong *et al.* (2005), Gbangboche *et al.* (2006) and Benyi *et al.* (2006).

The average pre-weaning daily weight gain of male kids was higher than that of female. These results agreed favorably with El Moula *et al.* (1999), Pal *et al.* (2004) and Vargas *et al.* (2007), who reported that male kids were grew faster than female kids.

Type of birth was also found to influence the kid pre-weaning growth (Table 4) hence single born kids had higher average pre-weaning daily weight gain than twin born ones. These finding agreed with the findings of Wenzhong *et al.* (2005) and Gbangboche *et al.* (2006), who reported that kids born as twin had slower early growth rate than those born as single.

Parity order was also influenced kid pre-weaning growth (Table 4) kid from does of 2nd and third parity had higher pre-weaning average daily weight than kids of parity two, these finding agreed with finding of Wenzhong *et al.* (2005) and Gbangboche *et al.* (2006), who reported that dam's age influence early growth rate.

This study indicated that the post-weaning growth performance of kids was inferior (Table 6) than pre-weaning growth performance and here sex drive effect could be implicated as kids during this

period are sexually mature. These results were favorably comparable with the findings of Berhane and Eik (2006) for Ethiopian Begait and Abergelle local goats. A non-significant effect of grazing supplementation and sex on post-weaning growth of kids reported in this study (Table 5) agreed with finding of Gbangboche *et al.* (2006), who reported that effect of non-genetic factors tended to cancel out for average daily gain by 120 days.

Correlation table indicated that the kid's birth weight was highly positively correlated with the pre-weaning period average daily weight gain and weaning weight. The correlation between birth weight and weaning weight found to be 0.40. The correlations calculated between birth weight and the subsequent post weaning weights were negative. This indicated a lower maternal effect on the post weaning period. Highly significant correlations were found between weaning weight and the subsequent post weaning weights. Thus it might be concluded that birth weight could not totally be reliable in predicting future body weights after weaning.

CONCLUSIONS

Concentrate supplementation of natural pasture improved goat kid growth rate to weaning. Sorghum grains supplement of group A (500 g/head/day) resulted in significantly greater pre-weaning average daily weight gain and pre-weaning growth rate than the two other types of supplements. Parity order resulted in a significant increase pre-weaning growth rate in the third parity. Litter size only affects significantly pre-weaning average daily weight gain. Pre-weaning growth rate was found to be significantly greater in kids born in summer than those born in winter and greater but not significantly so than those born in autumn.

Post-weaning growth rate of kids was found to be greater in kids of group A supplement with sorghum grain at a level of 250 g/head/day than those in group B supplement with sorghum grain level at 100 g/head/day.

RECOMMENDATION

Natural pasture should be supplemented with sorghum grains to improve pre-weaning and post-weaning growth rates of kids. Sorghum grain summer supplementation of natural pasture need to be practiced.

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