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EFFECT OF MODIFYNG ROUGHAGE /CONCENTRATE RATIO ON SEMEN QUALITY AND FERTILITY AS AFFECTED BY EXHAUSTIVE EJACULATION IN ZARAIBI BILLY GOATS

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ABSTRACT

The objective of this study was to determine the effect of a specific proportion of concentrate feed mixture (CFM) to berseem hay (BH) on semen quality, sperm abnormalities and fertility of Zaraibi billy goats during exhaustion test. Six adult billy goats were equally divided into control group (G-A) and treated group (G-B). Semen quality and sperm abnormalities were evaluated with exhaustion test of epididymis (ETE). Semen collected three times daily at one hour interval among ejaculates for three successive weeks. The feeding system for G-A was 700 gm CFM supplemented with 500 gm BH daily / buck, while 500 gm CFM plus 750 gm BH were afforded to G-B daily / head. The fertility test was carried out with 48 healthy and sexual mature Zaraibi nanny goats without any significant difference among them in body weight, age and oestrous period. Nanny goats were divided into two equal groups (n=24) which mated with billy bucks in G-A and G-B. The obtained results show lower semen quality in G-A compared to G-B ($P<0.05$). Semen-ejaculate volume and sperm concentration in the first ejaculates were significantly ($P<0.05$) higher than second and third ejaculates. On the contrary, the advanced sperm motility was higher ($P<0.05$) in second and third ejaculates than the first. Concerning ETE designing, G-A was recorded significantly ($P<0.05$) higher sperm morphological abnormalities than G-B. The fertility rate was defined significant ($P<0.05$) higher percentage of nanny goat kided in G-B than G-A. These results suggest that replacing 30% of concentrate with hay could maintain semen quality and fertility of Zaraibi goat bucks after intensity of semen collection by ETE.

Key words: *Goats, forage, concentrate, exhaustion, semen quality, fertility.*

INTRODUCTION

The availability of feed resources and their rational utilization by livestock might represents the most compelling task facing planners and animal scientists in the world. The situation is acute in Egypt where chronic annual feed deficits and increasing animal populations are common, thus making the problem a continuing saga. Goats play an important role in the livelihood of wide sector in Egypt. The populations of goats are raised mainly in three regions: the Nile Delta, Upper Egypt and in the desert rangelands, particularly in the north-west coastal zone.

Reproduction and performance of farm animals is largely dependent on their nutritional status. It is well documented that adequate nutritional management is crucial for successful mating in flocks (Smith and Akinbamijo, 2000 and Mellado et al., 2006). Carbohydrate, protein and nucleic acid metabolism and their deficiency may impair spermatogenesis, libido, fertility, embryonic development and survival (Alejandro et al., 2002). There are several studies concerning the relationship between nutrition and fertility. Lozano et al. (2003) reported that feed availability is a major environmental factor influence sperm quality, frequency of ejaculates needed for artificial insemination in goats and create a greater demand for semen from superior progeny tested sires. Mekasha et al. (2007) reported that regulation of testicular mass and sperm production in bucks depends on feed intake. In other hand, Jabbar and Anjum (2008) indicated that forage to concentrate ratio of

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25:75 is most appropriate for economical mutton production of Lohi lambs.

The present study was planned to determine the effect of ratio between forage and concentrate on some semen characteristics such as frequency of semen collection, abnormalities of spermatozoa and fertility in Zaraibi billy goats.

MATERIALS AND METHODS

The present study was carried out in El-Serw Experimental Station, located in the north eastern part of the Nile Delta, Domietta Governorate Egypt, belonging to Animal Production Research Institute, during the period from February to June, 2009.

Animals and management

Six healthy and mature Zaraibi goat bucks approximately 2.5-3 years old and weighed 50.82±0.40 live body weight. Bucks were divided into two equal groups (3 in each). The first and second groups were kept as the control (GA) and treated (GB), respectively. The experimental billy goats were clinically examined to detect any abnormalities of the external reproductive organs. In addition, bucks were vaccinated against ovine pasteurellosis and treated against endo- and ecto-parasites. The billy goats groups were housed and fed in individual pens and had free access to mineral mixture block and fresh water during the experimental period.

Nutritional treatments

Billy goats in first group (G-A) was fed 700gm / head / daily concentrate feed mixture (CFM) + 500gm / head /daily Berseem hay (BH), while in second group (G-B), replacement of 30% of berseem hay with concentrate feed mixture to be 500g CFM / bucks /daily supplemented plus 750 gm BH / buck / daily. The composition of CFM was cotton seed (17.50%), yellow maize (40%), wheat bran (25%), soybean meal (7%), molasses (6%), limestone (2.5%), common salt (1.5%) and minerals (0.5%). Chemical composition of the experimental feeds were analyzed according to A.O.A.C. (1995).

Exhaustion semen collection

Semen collection was commenced at day 60 after offering the treatment diet using a warm artificial vagina from both G-A and G-B using epididymal exhaustion test (ETE). The ETE was designed to collect daily three semen ejaculates at one hour interval between ejaculates up to three consecutive weeks.

Semen characteristics during ETE

Semen ejaculate (ml) was recorded immediately after collection by graduated collection tube. The percentage of sperm motility and sperm cells- concentration $x10^9$/ml were recorded according to Salisbury et al., (1978). Total sperm abnormalities were recorded as described by Blom (1972).

Fertility trial

The fertility test was conducted on 48 healthy and sexually mature nanny goats after end of ETE. Nanny does were divided into 2 groups (24 each). The average initial live body weight and age were nearly equal and without significant difference among them in oestrous cycle. The nanny goats of the first and second groups were mated with billy buck.

Mating protocol

A teaser billy buck was used twice a day at 6-9 am and 6-9 pm to detect oestrus nanny goats. The oestrus nanny goat was identified when stood to be mounted. Nanny goat which comes in heat in the morning offered to experimental fertile bucks in the evening. While, nanny goats showed oestrus in the evening were executed to mating in the next morning (6-9 am). Nanny goats passing two oestrous cycles without showing heat were considered pregnant.

The fertility traits and kid's rate were calculated as:

$$\text{Kidding rate after mating period (\%)} = \frac{\text{No. of pregnant nanny goats}}{\text{No. of mated nanny goats}} \times 100$$

Nanny goat kids **(**%) =

$$\frac{\text{No. of nanny goat kid}}{\text{No. of nanny goats pregnant}} \times 100$$

Statistical analysis

Data were analyzed using SAS (2004). The differences among means were evaluated by Duncan's Multiple Range test (Duncan, 1955).

RESULTS AND DISCUSSION

The feed analyses of both feed sources used in the study are presented in Table 1.

Data in Tables 2 and 3 summarize semen quality and morphological abnormalities with ETE, respectively. It is obvious that semen quality was significantly (P<0.05) higher and morphological abnormalities of spermatozoa was less in G-B compared to G-A. The preponderance of G-B in semen quality and lower morphological abnormalities during ETE may be related to zinc level which was greater in G-B (32 ppm) than G-A (22 ppm). EL-Sisy et al. (2008) reported that 10 ppm being a minimum requirement zinc level and 1000 ppm may be toxic and that it plays an essential role in testicular growth, seminiferous tubules development, spermatogenesis, testicular steriodogenesis and androgen metabolism. Also, Zafar et al. (2009) indicated that minerals are required for cellular survival, having roles in metabolism, maintenance growth and have specific roles in reproductive tissues. On the other hand, Handan et al. (2009), in rams, reported that zinc is associated with calcium to play major role in helping ejaculate more semen and very important in boosting fertility, sexual vigor and maximum semen output.

The data show significant (P<0.05) differences between consecutive ejaculates through ETE (Table 2). The first semen ejaculates had larger semen volume than second and third ejaculates in the first week. While, there were no significant difference between the first and second semen ejaculates in second and third weeks during partial depletion. The difference between ejaculates could be attributed to the sexual desire of bucks at the time of collection, preparation on bucks to semen collection and the period elapsed between the collections. The increasing semen volume in the first and second ejaculates may be due to more intensive of seminal fluid from accessory glands. These results confirm with Talebi et al. (2009) who found that seminal fluid represents 95-98% of total ejaculate volume; and that seminal vesicles secreted 40-80% in ejaculates and 15-30% of the remainder coming from the prostate gland. The highest sperm motility was recorded (P<0.05) in the second and third ejaculates as compared to the first ejaculates during ETE. Superiority of second and third ejaculated in sperm motility was related to hormonal stimulation through depletion of the epididymal. The sperm motility was depended on hormonal level especially testosterone and minerals such as zinc. Dissanayake et al. (2009) found that zinc deficiency in rats causes a reduction in the structural parameters of seminiferous tubules which influences serum levels of testosterone and prolactin. Sonoko et al. (2009) reported that zinc is an essential trace element for the maintenance of germ cells, the progressive spermatogenesis, and the regulation of sperm motility. Sperm-cell concentration in first semen ejaculates had higher sperm numbers than next ejaculates. These results are in agreement with those of Imwalle and Katz (2004) who found that sperm-cell concentration was significantly higher in the first ejaculates during first week compared with subsequent ejaculates or time.

The current study provided clear evidence that G-A combined with significantly (P<0.05) higher morphological abnormalities of spermatozoa than G-B during consecutive weeks with ETE (Table3). The morphological abnormalities observed in the study were similar to those described by Khalifa et al., (2009) who found significant increase (P<0.05) in rams abnormal spermatozoa as frequency of ejaculation increased. The changes of morphological abnormalities were attributed to different levels of minerals (Zn and Ca) in CFM and BH . Rise frequency of ejaculation resulted in the rapid release of immature spermatozoa and fertility (Oyeyemi and Akusu, 1998). Zinc deficiency lead to decrease spermatogenesis,

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impaired male fertility, reduced sperm motility and morphological abnormalities (Wong et al., 2000). Also, Meseguer et al. (2004) reported that intracellular concentrations of Ca^{2+} and the proportion of cholesterol in the sperm membrane are important marks for the semen quality, sperm morphology and fertility potential. Moreover, zinc and calcium deficiency caused severe damage to the testes such as atrophy of the testicular tubules and the inhibition of spermatid differentiation (Morisawa and Yoshida, 2005). Moreover, Prasad (2008) suggested that testes may harbor a zinc incorporation system, exert protective effect against testicular injury and play an essential role in the maintenance of testicular functions. Sperm fertility depends on semen quality (normal spermatozoa), quantity (adequate number) and nutrition. Similarly, Oyeyemi et al. (2008) reported that low plane of nutrition has been identified to delay, slightly, the onset of puberty, increase sperm abnormalities and high quality semen should not have more than 10% of abnormal sperm cells.

Fertility trial

Results in Table 4 were explained fertility trial after using ETE. Data show significantly ($P<0.05$) higher nanny goats kided %. for G-B than G-A. The increasing nanny goat kided percentage in G-B was related to the elevate level of calcium in BH (1.71) compared to CFM (0.87) which known to have positive role in activating fertility. Gülay et al. (1997) suggested that extracellular calcium is required for successful fertilization by initiate the acrosomal reaction to attain release of enzymes necessary for sperm-egg interaction. The same authors reported evidence that this ion may involve in sperm motility. Zinc is also essential to provide protein and energy that may had essential role to preserve and helps embryos to complete uterus growth. Baltaci et al. (2004) found that zinc in rats has an important role in thyroid metabolism, participation in protein synthesis and it's involved in T_3 binding to its nuclear receptor. Moreover, increasing BH in diet provided fatty acids that play essential role in sperm fertility especially polyunsaturated fatty acids, a finding reported with Strzezek (2004) that reduction of polyunsaturated fatty acids decreased the sperm number, motility, and sperm fertilizing ability. Zinc appeared of very vital role in affecting various parameters of semen, it had an antibacterial function, protect the testis against the degenerative changes and it may play a regulatory role in the process of capacitation and acrosomal reaction (Hasan et al., 2007 and Mekasha et al., 2008). The low percentage of nanny goat kidedin G-A may be due to higher manganese (Mn^{2+}) level in CFM (73 ppm) than BH (45 ppm) that mightaffect fertility. Similarly, Elbetieha, et al. (2001) indicated that ingestion of Mn^{2+} to adult male rates caused some adverse effects on fertility, reproduction system and sexual behavior.

CONCULSION

The presented results explain that replacement of 30% of concentrate feed mixture with berseem hay improved semen quality during consecutive ejaculates, enhanced fertility and maintenance of reproductive performance in Zaraibi billy goats.

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Table 1: The chemical compositions of the experimental feed stuffs.

Ingredients (%)	Feed stuffs	
	CPM	BH
Dry matter	91.30	89.40
Organic matter	93.50	87.50
Crude fiber	15.50	28.20
Crude protein	16.30	13.80
Ether extract	02.97	02.31
Nitrogen free extract	58.73	42.94
Ash	06.50	12.75
Ca^{2+}%	00.87	01.71
P^{3-}%	00.98	00.36
Mn^{2+} ppm	73.00	45.00
ZN^{2+} ppm	22.00	32.00

CFM: Concentrate feed mixture
BH: Berseem hay

Table2: Semen quality as affected by duration of semen collection and frequency of ejaculates in billy goats.

Semen characteristics	Duration of collection	Frequency of ejaculates	Control (G-A)	Treatment (G-B)	Overall means
Ejaculate-Semen volume (ml)	First week	First	1.21±0.09	1.63±0.08	1.42±0.14[a]
		Second	0.91±0.08	1.15±0.07	1.03±0.08[b]
		Third	0.48±0.06	0.61±0.04	0.55±0.44[c]
	Overall means		0.87±0.18[b]	1.13±0.23[a]	
	Second week	First	0.85±0.04	1.23±0.06	1.04±0.12[a]
		Second	0.58±0.03	0.93±0.05	0.76±0.11[a]
		Third	0.34±0.06	0.61±0.07	0.48±0.06[b]
	Overall means		0.59±0.14[b]	0.92±0.16[a]	
	Third week	First	0.51±0.03	0.99±0.05	0.75±0.18[a]
		Second	0.33±0.02	0.78±0.06	0.56±0.14[a]
		Third	0.24±0.01	0.49±0.03	0.37±0.06[b]
	Overall means		0.36±0.07[b]	0.75±0.11[a]	
Sperm motility (%)	First week	First	75.18±0.94	83.69±0.57	79.44±3.02[b]
		Second	81.33±0.52	85.71±0.87	83.52±1.54[a]
		Third	83.43±1.39	87.76±0.89	85.60±1.52[a]
	Overall means		79.98±2.03[b]	85.72±0.97[a]	
	Second week	First	73.88±1.51	81.55±0.91	77.72±2.32[b]
		Second	79.16±2.16	85.88±0.92	82.52±2.39[a]
		Third	83.32±1.32	88.63±0.86	85.98±1.87[a]
	Overall means		78.78±2.21[b]	85.35±1.67[a]	
	Third week	First	73.22±1.95	79.23±1.36	76.23±2.10[b]
		Second	78.16±1.65	83.80±1.34	80.98±1.99[a]
		Third	81.75±1.44	85.66±0.95	83.71±1.37[a]
	Overall means		77.71±2.02[b]	82.89±1.56[a]	
Sperm- cells concentration (x 10^9/ml)	First week	First	3.95±0.19	4.98±0.16	4.47±0.35[a]
		Second	2.59±0.16	3.87±0.23	3.23±0.43[b]
		Third	1.67±0.08	2.58±0.22	2.13±0.31[c]
	Overall means		2.74±0.55[b]	3.81±0.56[a]	
	Second week	First	2.51±0.08	3.34±0.07	2.93±0.27[a]
		Second	1.87±0.11	2.25±1.00	2.06±0.12[b]
		Third	1.23±0.06	1.81±0.013	1.52±0.21[c]
	Overall means		1.87±0.31[b]	2.47±0.38[a]	
	Third week	First	1.82±0.12	2.53±0.32	2.18±0.24[a]
		Second	1.37±0.15	1.78±0.11	1.58±0.13[b]
		Third	0.88±0.09	1.24±0.23	1.06±0.11[c]
	Overall means		1.36±0.21[b]	1.85±0.31[a]	

a, b, c values with different letters within a column or raw significantly different (P<0.05).

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Table3: Sperm abnormalities as affected by duration of semen collection and frequency of ejaculates in billy goats.

Duration of week collection	Classification of abnormalities	Control (GA)	Treatment (GB)
First week	Twin head	3	1
	Dag deffect	2	2
	Abnormal head	3	2
	Proximal cytoplasmic droplet	1	-
	Distal cytoplasmic droplet	3	2
	Tail coiled around head	24	19
	Tail coiled around mid piece	17	8
	Tail coiled below head	10	5
	Detached head	25	15
	Simple bent tail	38	25
Means of morphological abnormalities		12.60±3.84[a]	7.90±2.63[b]
Second week	Twin head	5	3
	Dag deffect	4	3
	Abnormal head	6	5
	Proximal cytoplasmic droplet	3	1
	Distal cytoplasmic droplet	6	5
	Tail coiled around head	56	34
	Tail coiled around mid piece	42	35
	Tail coiled below head	22	18
	Detached head	45	31
	Simple bent tail	74	57
Means of morphological abnormalities		26.30±7.81[a]	19.20±5.75[b]
Third week	Twin head	10	8
	Dag deffect	9	5
	Abnormal head	12	8
	Proximal cytoplasmic droplet	5	4
	Distal cytoplasmic droplet	16	15
	Tail coiled around head	110	98
	Tail coiled around mid piece	68	53
	Tail coiled below head	58	49
	Detached head	65	56
	Simple bent tail	86	74
Means of morphological abnormalities		43.90±10.00[a]	37.00±10.07[b]

a, b values with different letters within raw significantly different (P<0.05).

Table 4: Kidding rate and nanny goats kids as affected by duration of semen collection and frequency of ejaculates in billy goats.

Items	Control (GA)	Treatment (GB)
No. of nanny goats mated	24	24
No. of pregnant nanny goats	19	20
Kidding rate (%)	79.17[a]	83.33[a]
No. of nanny goat kids	14	17
Nanny goats kids (%)	77.78 [b]	89.47[a]

a, b, values with different letters within raw significantly different (P<0.05).