Nutritional and Physiological Studies on The Metabolism of Ram and Goat Spermatozoa: II. Metabolism of Goat Buck Spermatozoa.

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Abstract: Six Zaraibi goat bucks aged ten months with an average live body weight 31.17±1.78 kg were used. The animals were divided into two equal groups, A and B. Group A was fed 100 % *ad lib* and group B was fed 80 % *ad lib* of the concentrate mixture. The roughage ammoniated rice straw was fed *ad lib* for the two groups. Two successive semen ejaculates were collected from each buck weekly after ten weeks of starting feeding of two planes to group A and B. A total of 178 semen ejaculates were obtained through the period of this experiment. Results showed that semen ejaculate collected from bucks of group A were of slightly better physical semen characteristics than that collected from bucks of group B. Methylene blue reduction time test (MBRT) of group B was 91.00 ±4.89 sec. while it was 97.81±7.01 sec. for semen ejaculates of bucks of group A which gave semen ejaculates of lower sperm concentration as compared to that obtained from group B. the differences between the two groups in the physical semen characteristics were statistically insignificant except for sperm concentration. First semen ejaculates of the bucks of the two groups showed also slightly better physical characteristics than second ones. Methylene blue reduction time test showed the same trend and it was 81.58±4.75sec. and 94.70±5.55 sec. for the first and the second semen ejaculates, respectively. Fructolysis index of raw semen of bucks of group A was of higher value (1.53±0.09 mg / 10^9motile sperm) than that of bucks of group B (1.38±0.11 mg / 10^9 motile sperm). Fructolysis index after freezing and thawing showed the same trend of the previous studies on rams spermatozoa. Fructolysis index for bucks of group A and B after freezing and thawing was 1.85±0.39 mg /10^9 motile sperm and 1.48±0.16 mg/10^9motile sperm, respectively. The difference between the two groups was statistically insignificant. It could be concluded that restriction of feeding Zaraibi bucks by 20 % of *ad lib* of the concentrate mixture had not affected significantly the semen characteristics and sperm metabolism of goat buck sperm cells.

Keywords: Metabolism, Goat, Semen, Buck sperm, Motility.

INTRODUCTION

Goat, in general, is one of the most important agricultural animals in the tropics. The total population of goats in Egypt was 3,988,000 heads (A.O.A.D., 2007). In Egypt, increasing demands of animal protein necessitate increasing the intensive production of goats especially for its least expense in rearing and maintenance compared to cattle and buffaloes.

Goats appear to have a superior adaptation to the arid tropics because of their ability to conserve water, travel well, graze selectively and take willingly a wide variety of the vegetation (Maloity and Taylor, 1971). Indigenous goats also tend to be resistant to many of the diseases which plaques other livestock species in these areas (El-Sisy, 1997).

The success of Artificial insemination (AI) in goats is based on the ability to efficiently collect and cryopreserve spermatozoa from high quality bucks for use on does over generations. Using a few selected superior male spermatozoa resources and conducting an efficient AI system rapidly improves the selection differential of goat population in well managed goat farms (Amoah and Gelaye, 1990).

Concerning the level of feed intake of goat bucks and its effect on growth and reproductive performance, research seems to be lacking, so that the main purpose of this work was to evaluate:

a). The effects of two feeding planes on the physical and biochemical (as methylene blue reduction time test and fructolysis index) characteristics of semen of Zaraibi goat bucks.

b). The effect of the two feeding planes of Zaraibi bucks on semen preservation and metabolism of their spermatozoa by using fructolysis index before freezing and after thawing, respectively.

MATERIALS AND METHODS

This study was carried out at the Experimental Animal Production Farm, Faculty of Agriculture, Suez Canal University, Ismailia, Egypt, during the period from April, 2007 till October, 2008.

Six Zaraibi goat bucks aged ten months with an average live body weight 31.17±1.78 kg were used. The animals were divided into two equal groups A and B. Group A was fed 100 % *ad lib* and group B was fed 80% *ad lib* of the concentrate mixture. The roughage ammoniated rice straw was fed *ad lib* for the two groups.

The feed ingredients which were used in this study were 47% ground yellow corn, 40% wheat bran, 10% soybean meal, 2% limestone and 1% common salt. The concentrate mixture and ammoniated rice straw consisted (on dry matter basis) of 15.59 and 8.32% crude protein and 75.71% and 46.70% total digestible nutrients, respectively.

A total of 178 semen ejaculates were obtained from the six Zaraibi bucks through the whole period of the experiment. By using an artificial vagina, two successive semen ejaculates were collected from each buck weekly on the same day and after a period of ten weeks of starting feeding the two planes to group A and group B.

The physical and biochemical semen characteristics which tested in each semen sample were reaction time (RT), semen ejaculate volume (SEV), initial motility (IM), sperm cell concentration (SCCx10^9), total sperm

number per ejaculate (TSN/EJ), total motile sperm per ejaculate (TMS/EJ), methylene blue reduction time test (MBRT), initial fructose and after 30 and 60 minutes, fructose utilization and fructolysis index (mg fructose utelized/10^9 motile sperm) according to Beck and Salisbury (1943); Mann (1948); El-Alamy (1982), Salamon, and Maxwell (1995) and Kafi *et al.* (2004)

Two sperm metabolic indices were tested in each semen sample 1). Methylene blue reduction time (MBRT) and 2). Fructolysis index (FI). MBRT was estimated by the methods adopted by Herman and Madden (1953). Fructose concentration (mg fructose/ml semen) was determined according to Mann (1948) in the collected semen samples. Fructose content was calculated per 10^9 motile sperm after sixty minutes incubation at 37°C, the utilized fructose /10^9 motile sperm was calculated.

Some semen ejaculates of the bucks of the two groups were extended by the rate of 1:4 with Tris Egg yolk extender (Table 1) according to El-Alamy (1982), Awad (1998) and Salamon and Maxwell (2000). These extended semen samples were frozen in pellets according to El-Keraby *et al.* (1990) and Awad, (1998). These samples were thawed and used to determine fructolysis index after freezing and thawing of buck frozen semen.

Data were analyzed using General Linear Model (GLM) procedure of SAS (1996) and means were compared using Duncan's Multiple Range test according to Steel and Torrie (1984).

Table (1): Composition of Tris-egg yolk extender.

	Ingredients	PART (A)	PART (B)
1.	**Tris (Hydroxy methyl) amino methane**	2.42	2.42
2.	**Citric Acid (gm)**	1.34	1.34
3.	**Fructose (gm)**	0.50	0.50
4.	**Egg yolk (ml)**	20.00	20.00
5.	**Antibiotics* (ml)**	1.00	1.00
6.	**Glycerol (ml)**	12.00	-
7.	**Distilled Water**	Up to 100	Up to 100

*Each one milliliter of antibiotic contained 50,000 IU Penicillin and 50,000 µ gm Streptomycin based as sulfate.

RESULTS AND DISCUTHON

Semen ejaculates which were collected from Zaraibi goat bucks of group A had slightly better physical semen characteristics than that collected from bucks of group B (Table 2). The differences between the two groups in the physical semen characteristics were statistically insignificant except for sperm cell conc. /10^9/ml semen. Therefore, methylene blue reduction time test of group B was 91.00±4.89 sec. while it was in group A 97.81±7.01 sec. due to the lower conc. X 10^9/ ml of semen ejaculates of group A as compared to that obtained from group B (Table 2).

The sexual desire of the bucks of the two groups was nearly the same and the animals showed less than one minute as reaction time at semen collection and ejaculation. This reaction time of the first semen ejaculates was shorter than the second ones although the first ejaculates of the bucks of the two groups were significantly of better quality than that of the second ones (Table 3). Methylene blue reduction time test showed the same trend and it was 81.58±4.75 sec. for the first ejaculates and was 109.57±7.65 sec. for the second ones. This finding is in agreement with that reported by Khalifa (2005) who worked on young, adult and old Zaraibi buck semen ejaculations, first, second and third successive ejaculates and the first ejaculates showed weekly better physical semen characteristics.

Table (2): Means (± SE) of semen characteristics and methylene blue reduction time test of the two buck groups fed two different planes of feeding.

Items	GROUP		Mean	DATA NO.
	(A)	(B)		(A ; B)
Reaction Time (Sec)	52.97 ± 9.30	47.50 ± 13.60	50.63± 7.82	32 ; 24
Semen Ejac. Volume (ml)	1.08 ^{a}± 0.07	0.83 ^{b}± 0.05	0.98 ± 0.05	35 ; 25
Initial Motility (%)	82.43 ± 0.72	80.60 ± 0.78	81.67± 0.54	35 ; 25
Sperm Cell Conc./ ml (X 10^9)	1.79 ^{a} ± 0.11	2.14 ^{b} ± 0.14	1.94 ± 0.09	35 ; 25
Total Sperm No./Ejac. (X 10^9)	2.00 ± 0.22	1.85 ± 0.22	1.91 ± 0.16	35 ; 25
Total Mot. Sperm/Ejac.(X 10^9)	1.67 ± 0.20	1.48 ± 0.17	1.57 ± 0.13	35 ; 25
Total Mot. Sperm/ ml (X 10^9)	1.48 ^{a} ± 0.10	1.72 ^{b} ± 0.12	1.58 ± 0.08	35 ; 25
MBRT (Sec)	97.81 ± 7.01	91.00 ± 4.89	95.20± 4.72	31 ; 19

(A): group A; fed *ad lib.*
(B): group B; fed 80 % *ad lib*
Means with different letters differed significantly at P≤0.05

Fructolysis index of raw semen of Zaraibi goat bucks of group A was of higher value (1.53±0.09 mg /10^9 motile sperm) than that of bucks of group B (1.38±0.11 mg/10^9 motile sperm). This difference was mainly due to that initial fructose content of the semen ejaculates of bucks of group A was higher than that of group B and it may be due to the difference in the feeding planes of concentrate mixture of the two groups. This difference of the fructolysis index was statistically insignificant (Table 4).

Fructolysis index of semen samples of Zaraibi goat bucks after freezing and thawing was also of higher value which was 1.85±0.39 mg /10^9 motile sperm for bucks of group A and it was 1.48±0.16 mg /10^9 motile sperm for semen samples of bucks of group B (Table 5). This finding is in agreement with that reported on the studies of ram semen by Awad (1998), Zaghloul (2005). The difference between the values of the fructolysis index was statistically insignificant. Results of this work showed that restriction of feeding Zaraibi goat bucks by 20% of *ad lib* of concentrate mixture had not significantly affected the semen characteristics and the sperm metabolism as indicated by methylene blue reduction time test and fructolysis index.

Table (3): Means ± SE of semen characteristics and methylene blue reduction time test of the first and the second ejaculates collected from male goats.

Items	Ejaculate No.		DATA NO.
	1st Ejac.	2nd Ejac.	(1st ; 2nd)
Reaction Time (Sec)	39.57 ± 7.64	58.28 ± 13.70	30 ; 25
Semen Ejac. Volume (ml)	1.04 ± 0.08	0.92 ± 0.05	30 ; 29
Initial Motility (%)	81.50 ± 0.73	81.72 ± 0.83	30 ; 29
Sperm Cell Conc./ ml (X 10^9)	2.37^a ± 0.08	1.51^b ± 0.12	30 ; 29
Total Sperm No./Ejac. (X 10^9)	2.47 ± 0.23	1.43 ± 0.17	30 ; 29
Total Mot. Sperm/Ejac.(X 10^9)	2.04 ± 0.20	1.17 ± 0.14	30 ; 29
Total Mot. Sperm/ ml (X 10^9)	1.93 ± 0.07	1.24 ± 0.10	30 ; 29
MBRT (Sec)	81.58 ± 4.75	109.57 ± 7.65	26 ; 23

Means with different letters differed significantly at P≤0.05

Table (4): Semen characteristics, initial fructose, and fructose utilization of raw semen collected from two Zaraibi buck groups fed two different levels of feeding.

Group	RT (Sec)	SEV (ml)	IM (%)	SCC (10^9/ml)	TMS (10^9/ml)	Incubation Time	Fruc. Concentration (mg/ ml Semen)	Fruc. Utilization		
									mg/ 10^9 sperm	mg/10^9 motile
(A)	29.19 ± 3.42	0.96 ± 0.06	83.33 ± 0.40	2. 93 ± 0.11	2.44 ± 0.08	Initial	5.26 ± 0.22	1st 30 min.	0.83 ± 0.07	0.98 ± 0.08
						30 min. incub.	2.85 ± 0.16	2nd 30 min.	0.46 [a] ± 0.04	0.55 ± 0.05
						60 min. incub.	1.52 ± 0.10	All 60 min.	1.29 ± 0.08	1.53 ± 0.09
Data	36	36	36	36	36		23		23	23
(B)	26.20 ± 2.65	0.89 ± 0.05	83.17 ± 0.45	3.12 ± 0.08	2.59 ± 0.07	Initial	4.93 ± 0.21	1st 30 min.	0.82 ± 0.07	0.99 ± 0.09
						30 min. incub.	2.54 ± 0.27	2nd 30 min.	0.32 [b] ± 0.05	0.39 ± 0.06
						60 min. incub.	1.65 ± 0.22	All 60 min.	1.14 ± 0.09	1.38 ± 0.11
Data	30	30	30	28	28		22		22	22
Mean	27.70 ± 2.21	0.93 ± 0.04	83.25 ± 0.30	3.03 ± 0.07	2.52 ± 0.06	Initial	5.10 ± 0.20	1st 30 min.	0.83 ± 0.05	0.99 ± 0.06
						30 min. incub.	2.70 ± 0.17	2nd 30 min.	0.40 ± 0.04	0.47 ± 0.05
						60 min. incub.	1.59 ± 0.11	All 60 min.	1.23 ± 0.07	1.46 ± 0.08
Data	66	66	66	64	64		45		45	45

Group A fed *ad lib* and group B fed 80 % *ad lib* concentrate mixture

Table (5): Semen characteristics and fructose utilization of frozen semen collected from two buck groups fed two [1] different levels of feeding.

Group	RT (Sec)	SEV (ml)	IM (%)	SCC 10^9/ml	TMS 10^9/ml	Post-thaw TMS (10^9/ml)	Incubation Time	Fruc. Concentration (mg/ml)		Fruc. Utilization mg/10^9 sperm	Fruc. Utilization mg/10^9 motile
(A)	25.57 ± 4.30	1.00 ± 0.07	82.14 ± 0.70	2.45 ± 0.12	1.99 ± 0.08	1.66 ± 0.09	Initial	3.76 ± 0.08	1st 30 min.	0.84 ± 0.10	1.25 ± 0.14
							30 min. incub.	3.31 ± 0.08	2nd 30 min.	0.41 ± 0.07	0.60 ± 0.11
							60 min. incub.	3.12 ± 0.11	All 60 min.	1.25 [a] ± 0.13	1.85 ± 0.19
Data	28	28	28	28	28	24		18		18	18
(B)	24.83 ± 4.32	0.98 ± 0.05	81.67 ± 0.78	2.50 ± 0.04	2.04 ± 0.04	1.61 ± 0.05	Initial	3.56 ± 0.07	1st 30 min.	0.67 ± 0.09	1.07 ± 0.17
							30 min. incub.	3.23 ± 0.05	2nd 30 min.	0.26 ± 0.03	0.41 ± 0.05
							60 min. incub.	3.11 ± 0.05	All 60 min.	0.93 [b] ± 0.09	1.48 ± 0.16
Data	24	24	24	24	24	24		17		17	17
Mean	25.23 ± 3.03	0.99 ± 0.04	81.92 ± 0.52	2.47± 0.07	2.02 ± 0.05	1.63 ± 0.05	Initial	3.66 ± 0.06	1st 30 min.	0.76 ± 0.07	1.16 ± 0.11
							30 min. incub.	3.27 ± 0.06	2nd 30 min.	0.33 ± 0.04	0.51 ± 0.06
							60 min. incub.	3.11 ± 0.06	All 60 min.	1.09 ± 0.08	1.67 ± 0.13
Data	52	52	52	52	52	48		35		35	35

(1) Group A fed *ad lib* and group B fed 80 % *ad lib*

REFFERENCES

Amoah, E. A., and S. Gelaye (1990). Control of reproduction in the goat. Proc. Goat Production Symp. p 51. Fort Valley, GA.

A.O.A.D., (2007). Arab Organization for Agriculture Development. Arab agricultural Statistics Yearbook, Volume 23.

Awad, M. M. (1998). Comparitive studies of some treatments on the survival and fertilizing ability of sheep and goat spermatozoa. Ph.D. Thesis, Fac. Agric., Suez Canal Univ. Ismailia, Egypt.

Beck G. H. and G. W. Salisbury (1943). Rapid methods for estimating the quality of bull semen. J Dairy Sci, 26:483.

El-Alamy, M. A. (1982). SMAG-1 and GAWGY-Y1: two new efficient extenders for freezing ram semen. Indian J. Anim. Sci. 52: 299.

El-Keraby, F., R. M. Khalifa, M. A. El-Alamy and M. M. Awad (1990). Freezing ram semen: 1. A new method for freezing ram semen in pelleted form in liquid nitrogen vapour. Alex. Agric. Res. 35: 1.

El-Sisy, G. A. (1997). Effect of season and contact with females on semen characteristics and testosterone hormone level in goats. M.V.Sc. Thesis, Fac. of Vet. Med., Cairo Univ., Egypt.

Herman, H. A. and F. W. Madden (1953). The artificial insemination of dairy cattle. Lucas Bros. Pub.Co., Columbia, Missouri.

Kafi, M., M. Safdarian and M. Hashemi (2004). Seasonal variation in semen characteristics, scrotal circumference and libido of Persian Karakul rams. Small Rum. Res. 53: 133.

Khalifa, E. I. (2005). Effect of some processes of cryopreservation on post-thaw characteristics and freezing ability of goat spermatozoa. Ph.D. Thesis, Fac. Agric., Suez Canal Univ. Ismailia, Egypt.

Maloity, G. M. O., and C. R. Taylor (1971). Water requirements of African goats and haired-sheep. J. Agr. Sci. Cambridge 77:203.

Mann, T. (1948). Semen metabolism, antigenicity storage and artificial insemination. In Greep Ro, Koblinsky MA (eds), Frontiers in Reproduction and Fertility Control MIT Press, Cambridge, UK.

Salamon S. and W. M. C. Maxwell (2000). Storage of ram semen. Anim. Reprod. Sci. 62: 71.

SAS, (1996): SAS/STAT Software: Changes and Enhancement through Release 6.12. SAS Institute Inc., Cary, NC.

Salamon, S., W. M. C. Maxwell (1995). Frozen storage of ram semen I. Processing, freezing, thawing and fertility after cervical insemination. Anim. Reprod. Sci. 37:185.

Steel, R. G. D. and J. H. Torrie (1984). Principles and procedures of statistics with special reference to the biological sciences. McGraw-Hill Book Co. New York.

Zaghloul, M. M. (2005). Some studies in the metabolism of ram spermatozoa. Ph.D. Thesis. Fac. Agric., Suez Canal Univ., Ismailia, Egypt.

دراسات غذائية وفسيولوجية على التمثيل الغذائي للحيوانات المنوية في ذكور الأغنام والماعز
٢. التمثيل الغذائي للحيوانات المنوية في ذكور الماعز.

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أجريت هذه الدراسة على ستة من ذكور الماعز الزرايبي متوسط عمرها عشرة أشهر وبمتوسط وزن ٣١,١٧ كجم، وتم تقسيم الحيوانات لمجموعتين متساويتين في العدد (أ و ب). المجموعة (أ) تم تغذيتها حتى الشبع بينما المجموعة (ب) كانت تعطى ٨٠ ٪ من المجموعة (أ) وذلك من مخلوط العلف المركز، بينما قش الأرز المعامل بالأمونيا (المادة المالئة) وضع بصورة حرة أمام جميع الحيوانات. تم جمع قذفتين منويتين من كل ذكور المجموعتين أسبوعياً بعد انقضاء فترة تدريب على جمع السائل المنوي من هذه الحيوانات لمدة ١٠ أسابيع. وتم الحصول على عدد ١٧٨ قذفة منوية من ذكور المجموعتين خلال فترة هذه الدراسة. وتم تقييم هذه االقذفات المنوية لكل حيوان أسبوعياً للصفات الطبيعية وقياس الوقت اللازم لاختزال الميثيلين الأزرق وكذلك دراسة دليل استهلاك الفركتوز.

بينت الدراسة أن القذفات المنوية التي تم الحصول عليها من ذكور المجموعة (أ) كانت ذات صفات طبيعية أفضل قليلاً من التي جمعت من ذكور المجموعة (ب) على الرغم من أن ذكور المجموعة (أ) أعطت عدد أقل من تركيز الحيوانات المنوية لكل ١ سم٣ ولذلك كان دليل الميثيلين الأزرق لصالح المجموعة (ب) حيث كان بمتوسط ٩١,٠٠ ±٤,٨٩ ثانية وكان ٩٧,٨١±٧,٠١ ثانية في عينات السائل المنوي للمجموعة (أ). ولم تكن الفروق في الصفات الطبيعية لعينات السائل المنوي في المجموعتين معنوية ما عدا عدد وتركيز الحيوانات المنوية للسائل المنوي.

بينت الدراسة أيضاً أن صفات القذفات المنوية الأولى التي جمعت من ذكور الماعز الزرايبي كانت أفضل نسبياً في صفاتها الطبيعية عن القذفات المنوية الثانية التي جمعت من نفس الذكور في نفس اليوم وبين إختبار أزرق الميثلين في هذه العينات نفس الإتجاه حيث كان ٨١,٥٨±٤,٧٥ ثانية في القذفات المنوية الأولي وكان ٩٤,٧٠±٥,٥٥ ثانية في القذفات المنوية الثانية.

بينت نتائج دراسة دليل الفركتوز لعينات السائل المنوي لذكور المجموعة (أ) إرتفاعاً في القيمة حيث كانت ١,٥٣±٠,٠٩ ملجم/ $١٠^{٩}$ حيوان منوي متحرك في حين كانت ١,٣٨±٠,١١ ملجم فركتوز / $١٠^{٩}$ حيوان منوي متحرك في عينات السائل المنوي لذكور المجموعة (ب) – وكان دليل الفركتوز لعينات السائل المنوي لهذه الحيوانات بعد تجميده وإذابته أعلى منه في عينات السائل المنوي حديث الجمع وتشبه في ذلك الحال ما في عينات السائل المنوي لذكور الأغنام – حيث كان دليل الفركتوز للسائل المنوي بعد تجميده وإذابته ١,٨٥±٠,٣٩ ملجم / $١٠^{٩}$ حيوان منوي متحرك لذكور المجموعة (أ) وكان ١,٤٨±٠,١٦ ملجم /$١٠^{٩}$ حيوان منوي متحرك لذكور المجموعة (ب). ولم تكن الفروق بين المجموعتين في هذه الصفة معنوية. ويمكن الاستنتاج بأن تخفيض العلف المركز في العليقة عن حد الشبع في ذكور الماعز الزرايبي بنسبة ٢٠٪ لم يكن له تأثير واضح على التمثيل الغذائي للحيوانات المنوية لهذه الذكور.