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Full Length Research Paper

Egyptian sheep ewes conception and lambing rates as affected by dietary supplementation with selenium in winter and vitamin A

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Conception rate was affected significantly (P < 0.05) by progesterone + PMSG treatment in summer and insignificantly by supplementation with each of dietary selenium in winter and dietary vitamin A in autumn. When expressing the results in percentages, the highest increase in conception rate was by treatment with progesterone + PMSG in summer (46.91), followed by selenium treatment in winter (7.17) and treatment with vitamin A in autumn (3.01). Meanwhile, lambing rate was insignificantly affected by the three treatments in the three seasons. The highest increase (in lambing rate) obtained was 13.02% in autumn by vitamin A dietary supplementation, followed by selenium dietary supplementation in winter (6.76%) and treatment with progesterone + BMSG in summer (3.83%) respectively. Effects of mating with rams' dietary supplemented with selenium during winter and summer and with vitamin A during autumn on the studied traits were not significant. The highest increase in conception rate (13.79%) was shown when mating with rams treated with selenium in summer, followed by those treated with vitamin A in autumn (3.63) and by selenium in winter, respectively. In lambing trait, the highest increase was obtained by mating with rams treated with selenium in winter (14.80%), followed by those treated with vitamin A in autumn (11.25%). Housing effects (the housing effect is the difference in perception of warmth or difference in Temperature-humidity index (THI) values between indoors and outdoors) on conception rate were significant (P<0.01 or 0.05) during winter and autumn and insignificantly during summer. In this respect, the conception rate was 32.29% higher in the south than in the north part of the farm in winter. In autumn and summer, the values were 15.38 and 14.02% respectively, higher in the north than in the south part of the same farm. Meanwhile, lambing rate was insignificantly affected by the same factor during the three seasons. Lambing rate was 9.52 and 9.31% higher in the south than in the north part of the farm in winter and autumn, respectively. There were no significant interactions between the factors studied on the traits studied. Therefore, the main factors are reported.

Key words: Ewes reproduction, treatment with selenium in winter, progesterone + BMSG in summer, vitamin A in autumn, housing effect.

INTRODUCTION

Most breeds of sheep and goats are sexually inactive during the spring and early summer. The same breeds normally begin cycling in the late summer or early autumn, as short-day breeders (Hafez, 1987).

Recently, it happened that the conception rate reached 19% in a flock of Egyptian Suffolk (1/16 Ossimi.15/16 U.K. Suffolk of which the crossbreeding programme was begun in the year 1957, then inter se mating was carried out) in a Statal farm (Aboul-Naga and Aboul-Ela, 1985). When discussing that problem, it was observed that the sheep which were kept in the sheds suffered from sele-

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nium deficiency more than once, although the animals were fed on NRC (1985) requirements. In addition, it was found that conception rate was lower significantly ($P < 0.05$) in Egyptian Suffolk sheep ewes mated in summer and insignificantly in autumn than in those mated in winter breeding season, while lambing rate was insignificantly affected by season variation (Marai et al., 2004). Further, the diet given to the animals was free of the green fodder.

In this respect, a project of study was planned to investigate the reproductive traits of ewes (Marai et al., 2004, 2006a, b, c) and rams as affected by such unfavourable conditions and the methods of its alleviation.

The objectives of the present investigation were to study the Egyptian sheep ewes conception and lambing rates as affected by dietary supplementation with selenium in winter and vitamin A in autumn and treatment with progesterone + BMSG in summer, under sub-tropical environment of Egypt. Effects of the mating rams dietary supplemented with selenium during winter and summer and with vitamin A during autumn, in addition to the effects of the housing stress (the housing effect is the difference in perception of warmth or difference in Temperature-humidity index (THI) values between indoors and outdoors) during summer on the same traits, were studied.

MATERIALS AND METHODS

The present study was conducted in the Department of Animal Production, Faculty of Agriculture, Zagazig University, Zagazig, Egypt. The experimental work was carried out at El -Gemmaiza Experimental Station located in mid Nile Delta (30.5°N) and the lab work was conducted in the Department of Sheep and Goat Research, belonging to Animal Production Research Institute, Ministry of Agriculture, Egypt.

Materials

The numbers of 215 ewes and 24 rams of Egyptian Suffolk sheep were used as a part of an experiment carried out on males and females, under 3 lambings/2 years system (December - February as winter season. May - July as summer season and August - October as autumn season). The ewes were of 1.5 - 4.0 years of age and 45 - 60 kg body weight and the rams were of 1.5 - 2.5 years of age and 60 - 70 kg body weight.

In each season, the ewes were divided according to their age and weight into eight groups (A, B, C, D, E, F, G and H) nearly similar in age and weight. The A, B, C and D groups were housed in the southern part of the farm, while; E, F, G and H were housed in the northern part of the farm. One ram was used to mate each group of ewes. The design of the study and numbers of animals were as shown in Table 1.

All the animals were healthy and clinically free of external and internal parasites.

Animals were offered their feed requirements according to NRC (1985). Additional ration for rams and flushing for ewes were offered 15 days before and after beginning of the breeding seasons (total 35 days). The daily ration was composed of 1.0 kg concentrates, 0.25 kg barely and *ad lib* rice straw for rams and 1.0 kg of concentrates and *ad lib* rice straw for ewes. The concentrates and roughages (Table 2) were analyzed according to A.O.A.C. (1980). The animals had access to water daily four times in summer at 9.00, 12.00, 15.00 and 18.00 h and three times in winter at 9.00, 13.00 and 18.00 h.

Ewes and rams were housed in soil floored semi-open sheds, during the experimental periods. Either the south or the north sheds of the farm were divided into four partitions, each of 3 x 8 m for rams and 4 x 12 m for ewes. Each two partitions were within a pen. In the north sheds, the south parts were roofed and the north parts were without roofs, while in the south sheds the contrary was the case. The height of the north wall of the south part and that of the south wall of the north part of the farm was 4 m with ½ x 3 m as an open window. The surface area of each shed pen was surrounded by brick walls of 2 m height. All the building was constructed by bricks and cement.

Methods

At the end of the pregnancy period, conception and lambing rates were calculated during the experimental periods for ewes as follows:

$$\text{Conception rate \%} = \frac{\text{Number of ewes lambed (Alive or dead offspring)}}{\text{Number of ewes exposed}} \times 100$$

$$\text{Lambingrate\%} = \frac{\text{Numberof offspringborn(A liveor dead)}}{\text{Numberof eweslambed(A liveor deadoffspring)}} X\,100$$

Temperature-humidity index

Ambient air temperature and relative humidity (RH %) were recorded at the times of carrying out the physiological and scrotal measurements and semen collection. Ambient air wase recorded using Mercury thermometer to the nearest 0.1°C. Maximum and minimum temperatures were recorded using thermometer. Relative humidity was recorded using hair-hygrometer to the nearest 1%.

Temperature-humidity index (THI) was estimated according to the following equation (Marai et al., 2000): THI = db°C - {(0.31 - 0.31 RH) (db°C - 14.4)}, where db°C = dry bulb temperature in Celsius and RH = RH % / 100. Then the obtained values of THI were classified as follows: <22.2 = absence of heat stress, 22.2 - < 23.3 = moderate heat stress, 23.3 - <25.6 = severe heat stress and 25.6 and more = very severe heat stress (Table 3).

Statistical analysis

The statistical analysis effects of treatment ram effect and housing and their interactions in ewes, was as follows:

$y_{ijkL} = \mu + t_i + h_j + r_k + th_{ij} + tr_{ik} + hr_{jk} + thr_{ijk} + e_{ijkl}$, where: μ = overall mean, t_i = fixed effect of i^{th} treatments (i = I and 2), h_j = effect due housing (j = 1 and 2), r_k effect of ram (k = 1 and 2), th_{ij} = interaction between treatment and housing, tr_{ik} = interaction between treatment and ram, hr_{jk} = interaction between housing and ram, thr_{ijk} = interaction between treatment, housing and rams and e_{ijkl} = residual effect. For ewes data was carried out by using the following model: The statistical analysis was computed using analysis of variance procedure. Significant differences between means were separated by Duncan's Multiple Range test procedure described in SAS (1995).

Table 1. Experimental design and numbers of ewes during winter, summer and autumn breeding seasons.

Items	South of farm				North of farm			
	Winter season							
Groups	A	B	C	D	E	F	G	H
No. of ewes	9	8	8	8	8	10	11	9
Treatments:								
Ewes	0	+S	0	+S	0	+S	0	+S
Ram	0 (Control)	0	+S	+S	0	0	+S	+S
Summer season								
Groups	A	B	C	D	E	F	G	H
No. of ewes	9	6	11	6	13	7	10	6
Treatments:								
Ewes	0	+P	0	+P	0	+P	0	+P
Ram	0 (Control)	0	+S	+S	0	0	+S	+S
Autumn season								
Groups	A	B	C	D	E	F	G	H
No. of ewes	9	9	9	9	10	10	10	10
Treatments:								
Ewes	0	+V.A	0	+V.A	0	+VA	0	+ V.A
Ram	0 (Control)	0	+VA	+ V.A	0	0	+V.A	+V.A

0 = without treatment (Control); S = Selenium (0.1 mg/kg dry matter of ration as Sodium salenite, orally); V. = Vitamin (100 IU/kg body weight, orally) and P = Progesterone used in synchronization of oestrus of ewes by a progesterone - impregnated vaginal pessary (60 mg progesterone) before mating with 12 days, accompanied with an injection of 500 IU PMSG at removal of the pessary (Spong).

Table 2. Chemical analyses of the diets used in the experimental trails.

Items	Dm (%)	CP (%)	CF (%)	EE (%)	NFE (%)	OM (%)	Ash (%)	Sel. (%)	Car. (%)
Concentrates	90.46	18.50	13.46	4.85	53.69	90.50	9.50	0.095	1.46
Barely	90.00	7.78	10.00	2.23	76.56	96.57	5.34	0.097	2.00
Rice straw	92.30	3.47	35.10	1.41	39.65	79.63	20.37	0.084	2.00

Sel. = Selenium and Car. = Carotene.

RESULTS

Only the main factors are reported, since no important interactions between season and parity were detected for any of the traits studied.

Treatment with selenium in winter, progesterone + BMSG in summer and vitamin A in autumn

Tables 4 - 6 illustrates conception and lambing rates as affected by treatment with selenium in winter, progesterone + BMSG in summer and vitamin A in autumn in Egyptian sheep ewes, mating with rams dietary supplemented with selenium housing side of the farm; under sub-tropical environment of Egypt.

Conception rate was affected significantly ($P < 0.05$) by progesterone + PMSG treatment in summer and insignificantly by supplementation with each of dietary selenium in winter and dietary vitamin A in autumn. When expressing the results in percentages, the highest increase in conception rate was by treatment with progesterone + PMSG in summer (46.91), followed by selenium treatment in winter (7.17) and treatment with vitamin A in autumn (3.01). Meanwhile, lambing rate was insignificantly affected by the three treatments in the three seasons. The highest increase obtained was 13.02% in autumn by vitamin A dietary supplementation, followed by selenium dietary supplementation in winter (6.76%) and treatment with progesterone + BMSG in summer (3.83%)

Table 3. Microclimatic data during the whole experimental periods.

Items	South of the farm				North of the farm				Day-light
	Air temperature		RH	THI	Air temperature		RH	THI	length
	Min* (°C)	Max** (°C)	(%)	Max**	Min* (°C)	Max** (°C)	(%)	Max**	(h@)
December - February (Winter)	10.0	20.1	78.4	19.7	9.2	18.8	80.5	18.85	10.47
May-July (Summer)	21.7	36.0	60.50	33.35	21.0	34.0	62.3	31.65	14.05
August - October (Autumn)	19.8	33.0	65.0	30.95	19.0	31.6	66.2	29.71	12.20

* = Minimum, ** = Maximum; RH = Relative Humidity %; THI= Temperature Humidity Index and @ = Hours.

Table 4. Least square means (± S.E) of conception and lambing rates in Egyptian Suffolk ewes as affected by treatment (Selenium), mating with rams dietary supplemented with selenium (Ram) and housing side (South or North part of the farm), during winter breeding season.

Variable	Conception rate (Ewes born/ewes joined (%)	Change (%)	Lambing rate (Lambs born/ewes lambed (%)	Change (%)
Treatment (T):				
Without selenium	72.90 ± 7.16		107.14 ± 6.76	
With selenium	78.13 ±7.37	7.17	114.38 ± 6.92	6.1
Significance	NS		NS	
Ram (R):				
Without selenium	75.35 ± 7.26		103.13 ± 6.92	
With selenium	75.69 ± 7.26	0.45	118.39 ± 6.76	14.80
Significance	NS		NS	
Housing (H):				
South part of the farm	91.67^{a} ± 7.16		116.52 ± 5.96	
North part of the farm	59.38^{b} ± 7.36		105.00 ± 7.63	
Significance	**		NS	

Means bearing different letters within the same classification differ significantly (P < 0.01). ** P < 0.01 and NS = Not significant.

respectively.

Mating with rams dietary supplemented with selenium during winter and summer and with vitamin A during autumn

Effects of mating with rams dietary supplemented with selenium during winter and summer and with vitamin A during autumn on the studied traits were not significant. The highest increase in conception rate (13.79%) was shown when mating with rams treated with selenium in summer, followed by those treated with vitamin A in autumn (3.63) and by selenium in winter, respectively. In lambing trait, the highest increase was obtained by mating with rams treated with selenium in winter (14.80%), followed by those treated with vitamin A in autumn (11.25%).

Housing effects

The calculated maximum Temperature-Humidity Index (THI) values were 19.7 and 18.85 during winter, 33.35 and 31.65 in summer and 30.95 and 29.71 during autumn in the southern and northern parts of the farm, respectively, indicating absence of heat stress during winter and exposure of the animals to very severe heat stress during summer and autumn, but with higher values (more housing stress) in the south than in the north parts of the farm.

Housing effects (the housing effect is the difference in perception of warmth or difference in Temperature-humidity index (THI) values between indoors and outdoors) on conception rate were significant (P < 0.01 or 0.05) during winter and autumn and insignificantly during summer. In this respect, the conception rate was 32.29% higher in the south than in the North part of the farm in

Table 5. Least square means (±S.E) of conception and lambing rates in Ossimi x Suffolk ewes as affected by treatment (Progesterone plus BMSG), mating with rams dietary supplemented with selenium (Ram) and housing side (South or north part of the farm), during summer breeding season.

Variable	Conception rate (Ewes born / ewes joined %)	Change (%)	Lambing rate (Lambs born / ewes lambed %)	Change (%)
Treatment (T):				
Without progesterone	57.13^{b} ±7.19		101.13 ± 4.53	
With progesterone	83.93^{a} ± 9.36	46.91	105.00 ± 4.6	3.83
Significance	*		NS	
Ram (R):				
Without selenium	65.98 ± 8.23		100.00 ± 4.35	
With selenium	75.08 ± 8.45	13.79	108.13 ± 4.77	8.13
Significance	NS		NS	
Housing (H):				
South part of the farm	65.91 ± 8.54		105.00 ± 4.91	
North part of the farm	75.15 ± 8.14	14.02	103.13 ± 4.18	-0.18
Significance	NS		NS	

Means bearing different letter within the same classification, differ significantly (P < 0.05), * P < 0 05 and NS = Not significant.

winter. In autumn and summer, the values were 15.38 and 14.02%, respectively, higher in the north than in the south part of the same farm. Meanwhile, lambing rate was insignificantly affected by the same factor during the three seasons. Lambing rate was 9.52 and 9.31% higher in the south than in the north part of the farm in winter and autumn, respectively.

DISCUSSION

Treatment with selenium in winter, progesterone + BMSG in summer and vitamin A in autumn

In the present study, the highest increase in conception rate was by treatment with progesterone + PMSG in summer (46.91) is due to the effectiveness of the use of Progestogen plus PMSG for synchronization of oestrus, in sheep. Such results were expected, since conception rate without treatment in the present study was 57.13 Table 4). In addition, Marai et al. (2004) reported that conception rate was significantly lower (P < 0.05) in summer breeding season than in the other seasons in the same flock due to exposure to high ambient temperature during summer (THI = 31.65, with daylight length 14.05 h).

In the respect, Abdel-Rahman et al. (1994) reported that percentage of synchronous estrus was greatly higher (70%) in Rahmani ewes treated with Progesterone plus PMSG as compared to the control ewes (20%), Ovulation and oestrus occur in ewes synchronized with progesterone-impregnated vaginal passaries (40 mg fluorogestone acetate) 14 days plus injection of PMSG (600 IU) before 24 h of removal of the passary (Larsson et al., 1991). Takarkhed et al. (1997) added that synchronization rate values were estimated as 100, 86, 100 and 71% in four groups of ewes with a sponge impregnated with 80 mg progesterone inserted into the vagina for 14 days, followed by injection of 1000 IU PMSG at sponge removal in the 1^{St} group, 375 mg progesterone implanted subcutaneous for 14 days plus 1000 IU PMSG injected on day 12 of the oestrus cycle in the 2^{nd} group and 1000 IU PMSG on day 12 and 15 mg PGF2$\propto$ on day 14 in the 3^{rd} group, and the untreated control, respectively. Induction of ovulation through the use of hormones is based on the use of progestogene to mimic a normal luteal phase.

The results of the present study showing that selenium supplementation during winter insignificantly affected conception rate of the Egyptian Suffolk ewes, were similar to those of Panter et al. (1995) who claimed that oestrous cycle was not affected by selenium treatment in ewes and Avci et al. (2000) who found no significant difference in reproductive performance with a low dose under maintenance requirements in ewes. However, contrary results were reported by other authors, in other animals. In cattle, Harrison et al. (1984) reported that effective reduction of incidence of metritis and cystic ovaries may be reached by pre-partum selenium injecttions during the post-partum period, in dry cows. It is known that selenium is required by ewes, since it is accumulated preferentially by the placentome, ovary, pituitary and adrenal glands. Generally, is an essential nutrient for animal. Most field cases of low fertility of nutritional origin may be due to selenium deficiency. Diseases due to its inadequacy in livestock are of aworldwide distribution (Sanders, 1984). Biochemically selenium acts as a component of the enzyme glutathione peroxidase activity, an enzyme that catalyzes the degradation of organic hydroperoxdase. Absence of selenium correlates with a loss of glutathion peroxidase activity and is associated

Table 6. Least square means (±S.E) of conception and lambing rates in Ossimi x Suffolk ewes as affected by treatment (Dietary supplementation with vitamin A), mating with rams dietary supplemented with vitamin A (Ram) and housing (South or north part of the farm, during autumn Breeding season.

Variable	Conception rate (Ewes born / ewes joined %)	Lambing rate (Lambs born / ewes lambed %)
Treatment (T):		
Without Vitamin A	91.95 ± 6.98	116.63 ± 7.32
With Vitamin A	94.72 ± 6.58	131.81 ± 7.08
Significance	NS	NS
Ram (R):		
Without Vitamin A	91.67 ± 6.79	117.60 ± 7.43
With Vitamin A	95.00 ± 6.79	130.83 ± 6.97
Significance	NS	NS
Housing (H):		
South part of the farm	86.67^{b} ± 6.79	130.28 ± 6.88
North part of the farm	100.00^{a} ± 6.79	118.15 ± 7.51
Significance	*	NS

Means bearing different letters, within the same classification, differ significantly (P < 0.05), * P < 0.05 and NS = Not significant.

with damage to cell membranes due to accumulation of free radicals. Cardiac muscle is the most susceptive tissue to selenium deficiency with cell membrane damage, in human. Normal cells are replaced with fibroblasts. This condition is known as a cardiomyopathy and is characterized by an enlarged heart composed predominantly of nonfunctioning fibrotic tissue (Burtis and Ashwood, 1996). In ewes, deficiency of selenium may lead to reproductive dysfunctions such as retained placenta and reduced fertility (Buck et al., 1981).

The results of the present study showing that vitamin A supplementation during autumn insignificantly affected conception rate of the Egyptian Suffolk ewes were similar to those of Avci et al. (2000) who indicated that dietary supplementation of 15 IU vitamin A/kg body weights to ewes showed no significant effect on their reproductive performance. However, Vitamin A has specific effects on the female reproductive organs (promoting of formation of estradiol-17β) in tertiary follicles and progesterone in corpora lutea, maturation and function of oviducts, uterus and placenta (Kolb and Seehawer, 1998). In addition, Vitamin A has a favourable effect on overall cellular growth and plays an important role in regulating stability and structure of the body fluids (Abdel-Hamid et al., 1993 and El-Husseiny et al., 1997). At the same time, it is essential for normal functioning mammalian males and females (Rao and Raja, 1977 a, b and Rabie, 1992) and its activities have relation to cell receptors, promotion of the function of gonads and immune system and have specific effects on male reproductive organs and testosterone synthesis (Kolb and Seehawer, 1998). Further, higher animals are unable to synthesize vitamin A. Beta-carotene main function is acting as pro-vitamin A. and as an antioxidant and free-radical scavenger serving to stabilize membranes.

Mating with rams dietary supplemented with selenium during winter and summer and with vitamin A during autumn

The insignificant effects of mating with rams dietary supplemented with selenium during winter and summer and with vitamin A during autumn on the studied traits, may suggest carrying out further studies with bigger numbers of animals, in the different parts of the country.

Housing effects

Housing in the sub-tropics should help the animals to withstand the climatic heat stress. Therefore, animals are normally housed in open sheds with east- west long axis. This phenomenon minimizes exposure of the building to direct sun light, and allows cooling the animals with the north-south flowing winds. However, most often building of these sheds is carried out by bricks and cement, in addition to that some of the animals are kept in the north side and the remaining animals are kept in the south part of the farm.

Housing effect (the housing effect is the difference in perception of warmth or difference in Temperature-humidity index (THI) values between indoors and outdoors) on conception rate was significant (P < 0.01 or 0.05) during winter and autumn.

In winter, conception rate was higher significantly (P < 0.01) in ewes kept in the south part of the farm (THI = 19.7) than in the North (THI = 18.85) part. This may be

due to the suitable effect of ambient temperature in southern than in the northern part of the farm, in winter breeding season.

In autumn, ewes kept in north of the farm (THI = 29.71) showed significantly ($P < 0.05$) higher conception rate than in the South part of the farm (THI = 30.95). This may be due to the increase in ambient temperature resulting from increase of solar radiation in Southern than in Northern part of the farm. The present results were in agreement with those reported by Curtis (1983) and Casu et al. (1991). High environmental temperature or the rapid and sudden fluctuations of temperature that often occur in many parts of the sub-tropics, cause unfavourable effects on reproduction function. Particularly, the high ambient temperature reduces the length of oestrous cycle or suppress oestrus and adversely affects ovulation (Casu et al., 1991). Failure of ova to be fertilized and early embryonic mortality may be also due to mating of ewes during hot weather, since a large number of ova produced are abnormal and a small number of ova are fertilized, during heat stress. The latter phenomenon may be probably due to that the nucleic acid metabolism is upset in ova subjected to a high temperature at a certain stage of development (for instance, the zygote).

The critical period of heat stress effect on fertility is from a few days before to a few days after mating (Curtis, 1983). High ambient temperature has direct effect on uterine environment and reduces blood supply (Sulong, 1987) and indirect effect on imbalance of hormones such as progesterone, thyroid and glucocorticoid hormones (Curtis, 1983) . Lublin et al. (1984) reported that, during hyperthermia, there was significant reduction in blood flow in the ovaries (-23%) and in the undifferentiated uterine wall of non-pregnant or early-pregnant animals. Such results verify that the low reproductive performance during periods of the thermal stress is due to functional problems in females (as well as males).

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