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FEEDING MANAGEMENT AND THE PERFORMANCE OF SHEEP IN SOUTHERN SINAI:
2. REPRODUCTION AND PRODUCTION PERFORMANCE OF THE EWE.

Farid, M.F.A., H.S. Khamis, E.Y.A. Eid and A. Helal
Animal Nutrition Department, Desert Research Centre, Al-Matareya, Cairo, Egypt.

ABSTRACT

An experiment was carried out to characterize key reproduction and production traits of sheep in southern Sinai. A free choice cafeteria feeding system was adopted to study diet selection and voluntary food intake and to insure nutrition is not a limiting factor. Eighty-five ewes in four groups were used. The control group was fed according to NRC standards throughout. Ewes in the three experimental groups were offered ad lib one of three basal roughages; berseem hay, one-third hay plus rice straw and rice straw plus a molasses-urea mixture. Roughages were made available ad lib throughout the experiment and comprised the sole ration during the early pregnancy stage. Thereafter, and up to weaning of offspring they were offered free choice in separate feeders ground corn grains and cottonseed meal.

The hay-fed ewes appeared to select diets that satisfied their energy and protein requirements during the different stages of the production cycle and maintained optimum proportions of roughage and rumen degradable protein in their daily dry matter intake. The straw-fed ewes, on the other hand, failed to control their intake as per physical and physiological needs especially during early pregnancy and through lactation

At the start of the experiment the ewes were not in their optimum condition, weighing only about 75% of adult weight. After lambing, control and hay-fed ewes attained optimum weights whereas straw-fed ewes nearly maintained their weights before breeding irrespective of receiving free choice concentrates during the late pregnancy stage onward.

Hay-fed ewes performed similar or better than the controls throughout. Straw-fed ewes, even with free choice concentrates, had low fertility (lambing rates), high lamb and ewe mortality, low milk production, smaller birth weights of offspring. The ewe production index (kg lambs weaned per 100 ewes joined to ram) was 1765 and 1983 kg for the control and hay-fed ewes, and only 1197 and 672 kg for the hay-straw and straw-Mufeed groups.

However, these may not be the consequence of feeding straw per se. The control diets contained straw contributing about one-third of the roughage in the diet or about 15% of total dry matter intake. Rather, it is the art of balancing the rations in the light of recent advances in nutrition and the allied sciences that makes the difference.

Keywords: Feeding management, Diet selection, Reproduction, Production, Sheep.

INTRODUCTION

Profitable sheep production is dependant on the successful management of the flock throughout the whole production cycle of the ewe and the raising of replacements. In Egypt, there are no well-defined sheep production systems nor there is enough knowledge of the true inherent production potential of the local breeds or of their nutritional needs. Hence, feeding management is invariably based on arbitrary assumptions and the use of foreign feeding standards.

Two experiments (Abd El-Aziz, 1983; Mohammed, 1999) were carried out at the Desert Research Centre to evaluate a so-called "Biological Efficiency" of meat production from Barki sheep. Those experiments extended from before breeding up to the weaning of offspring, i.e. a full production cycle of the ewes. However, no attempt was made to optimize the management of feeding. Rather, the arbitrary feeding system as practiced on the experimental farm was adopted. That system was devised without sound knowledge of the true production potential of the breed nor of its nutritional requirements and the economics of production. Accordingly, it is believed that the realized productivity was below the potential of the breed.

The present experiment was carried out using a free-choice cafeteria feeding system in order that the animals are permitted to express their production potential under conditions where nutrition is presumed not a limiting factor. Moreover, different basal roughages were used as the authors were under the impression that the presently widely advocated notion of using low quality roughages and crop residues may not be commensurate with high productivity. The national shortage of feed resources and desired high productivity of farm animals are not to be allowed to compete unfairly.

Results of diet selection, voluntary feed intake and the overall ewe condition were reported earlier (Farid *et al.*, 2006). The present publication deals with the reproductive and productive performance of the ewes from before mating till the weaning of offspring.

MATERIALS AND METHODS

A total of 85 local ewes, 14 primiparous and 71 multiparous, at the southern Sinai experiment station at Ras-Sudr were randomly assigned, within age class, to four groups and the groups were randomly assigned to treatments. The ewes were of mixed origin, Ossimi and Baladi bought from the Nile delta markets and some Barki ewes brought from Maryot research station.

Ewes in the control group were fed according to American feeding standards (NRC, 1985). Diets were generated using the ARIES software of the University of California, Davis (UCD, 1997). The diets consisted of berseem hay, rice straw, yellow corn grains and un-decorticated cottonseed meal, plus additives of salt, TM-salt and calcium carbonate (Table 1).

The three experimental groups were allowed free-choice and *ad lib* intake throughout. They differed in the basal roughage offered to each group. Those were *ad lib* berseem hay, one-third berseem hay plus *ad lib* rice straw and *ad lib* rice straw with added a commercial molasses-urea mixture, Mufeed, composed of cane molasses with 4% urea and 2% TM-salt. It was added to straw at the rate of 10% w/w, as fed basis.

A flushing concentrate (4 parts ground corn grains and 1 part soybean meal) was offered at the rate of 200 g/day/ewe to all four groups. Because of the starting poor condition of the ewes flushing extended from two weeks before mating till the end of the breeding season that lasted 40 days. Mating was carried out using four fertile and tested rams that were rotated between groups every ten days. Rams were marked on the brisket with colored grease in order to facilitate the recording of mounted ewes. Checks were carried out once in the morning and rams were re-greased.

Table 1: Nutritive value of feed ingredients, DM basis[1].

	Egyptian Clover Hay	Rice Straw	Straw-Mufeedmix.[2]	Corn Grains	Wheat Bran	Cotton-seed meal
DM, %	89.00	90.00	88.50	89.00	89.00	90.00
ME, Mcal/kg	1.99	1.48	1.91	3.18	2.35	2.84
TDN, %	55.00	41.00	43.90	80.00	65.00	75.00
TP, %	16.00	3.20	4.55	9.2	17.10	25.60
DIP, %	11.52	1.85	3.28	2.76	12.10	19.06
CF, %	28.80	35.10	31.60	2.60	11.30	22.55

1. Data extracted from Kearl et al. (1979) and UCD (1997).
2. Mufeed is a commercial urea-molasses mix containing 4.0% urea and 1.0% trace-mineralized salt, and added to straw at the rate of 10% w/w, as fed basis.

From the end of breeding till the end of the early pregnancy stage, three months from day-15 of breeding, ewes in the three experimental groups received only the basal roughage. As of the start of the late pregnancy stage and up to the end of lactation and weaning of offspring at the age of 16 weeks the three experimental groups were offered *ad lib* in separate feeders ground corn grains and cottonseed meal to allow for free-choice intake. Mineral additives were added to both the grain and the meal at the rate of 1% limestone and 0.5% each of common and trace-mineralized salt. The experiment extended over a total of 42 weeks till the weaning of offspring.

Animals were group-housed in partly shaded pens with ample feeding space for the separate feeding of all roughage and concentrate ingredients. Feeds were offered twice daily at 8:00 AM and 4:00 PM. Refusals were collected the following morning, weighed and sampled, and daily intake was recorded. Fresh tap water was made available for free drinking once daily after the morning feeding. Standard reproductive parameters were recorded during breeding and up to lambing. Shrunk live body weight of ewes was recorded biweekly. Birth and weaning weights of lambs were also recorded. During lactation, daily milk yield was measured weekly using the standard hand-milking procedure after separation of lambs from their dams. Data were statistically analyzed using the GLM procedures of SAS (1990).

RESULTS

Food Intake

Results of diet selection, voluntary food intake and the characteristics of dietary intake of ewes in the different treatments and during the different stages of the production cycle were presented earlier (Farid *et al.*, 2006). In general, and within a stage of the production cycle, total dry matter intake was similar in the different treatment groups and was not different from the control (Figure 1). There were two exceptions, however. During early pregnancy where only roughages were offered dry matter intake was highest in the hay group and lowest in the straw-Mufeed group, the hay-straw group being intermediate, i.e. intake was positively related to the nutritive quality of the roughage. During late pregnancy the hay group consumed more dry matter than the other three groups and were able to maintain a dietary roughage proportion practically similar to, or slightly higher than that in the control group.

When concentrates were offered free-choice as of the late pregnancy period till the end of the experiment roughages represented a decreasing proportion of dry matter intake and, again, as the nutritive quality of the roughage decreased its proportion in total dry matter intake decreased (Figure 1). Hay was the least affected and was appreciably lower than the control only during the early lactation stage. In the straw-Mufeed group roughage proportion in total dry matter intake was un-physiologically low and was critical in the hay-straw group.

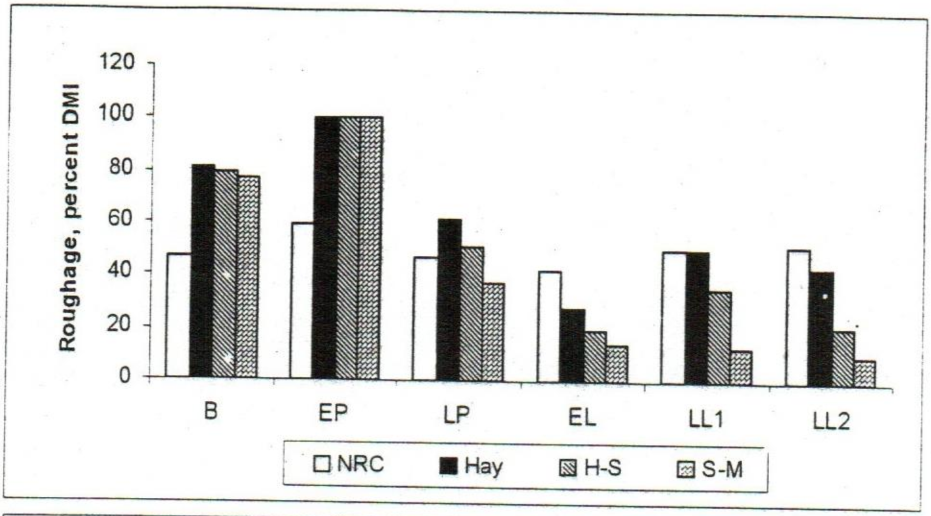
Energy intake followed a similar trend to that observed for total dry matter intake (Figure 2). Total protein intake, on the other hand. was appreciably less in the two straw-fed groups as compared to the hay-fed group.

Contrary to expected, dry matter, energy and protein intakes continued to increase during late lactation as compared to that during the early lactation stage, and the dietary roughage proportion decreased. This supports the contention discussed earlier (Farid *et al.*, 2006) that nursing lambs beyond the age of 6 to 8 weeks consume increasing amounts of concentrates (and hay), and if feed allowances are regulated as in the control group they might represent serious competition to their dams. Therefore, intake as recorded represents the sum of that of the dams and the offspring.

Body Condition of Ewes

The condition of the ewes at the start of the experiment was well below optimum. When the experiment started two weeks before breeding, the overall average live body weight was 33.75 kg. This is much less than the 45 kg considered optimum for Barki, one of the smaller Egyptian breeds.

Surprisingly, previous work on the biological efficiency of the Barki breed of sheep for meat production (Abd El-Aziz, 1983, Mohammed, 1999) reported similar observations indicating that the experimental farm flock management might not have been up to standard. Starting ewe weights in those two experiments were 35.1 and 33.5 kg, respectively. Corresponding weights at the end of lactation and weaning of offspring were 38.1 and 44.4 kg, respectively. In the first experiment (Abdel-Aziz, 1983) ewes were, in a sense, arbitrarily fed as per the experimental farm flock whereas in the second (Mohammed, 1999) ewes were fed according to the NRC (1985) feeding standards. This explains the optimum weight of 44.4 kg realized at the end of the second study.



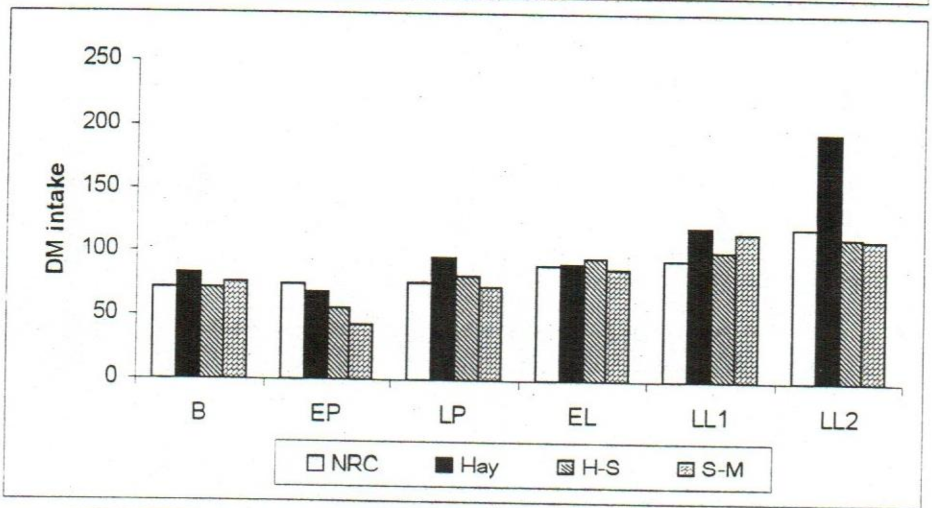


Figure 1. Average daily dry matter intake (g/day/kg$^{0.75}$) and dietary roughage content (% DMI).

Nutritionally, the production cycle in this experiment may be divided into three periods. The first would be breeding and early pregnancy where only roughages were available in addition to the limited amount of concentrates used for flushing the ewes in all four groups. The second period comprised late pregnancy and early lactation where concentrate ingredients were made available free-choice and *ad libitum*. The third period represented late lactation where concentrate ingredients were also made available free-choice and *ad libitum*, but this period was also characterized by increasing competition for concentrates (and possibly hay) by the fast growing lambs beyond the age of eight weeks. Because of this evident competition, feed allowances to the control group were not reduced during late lactation.

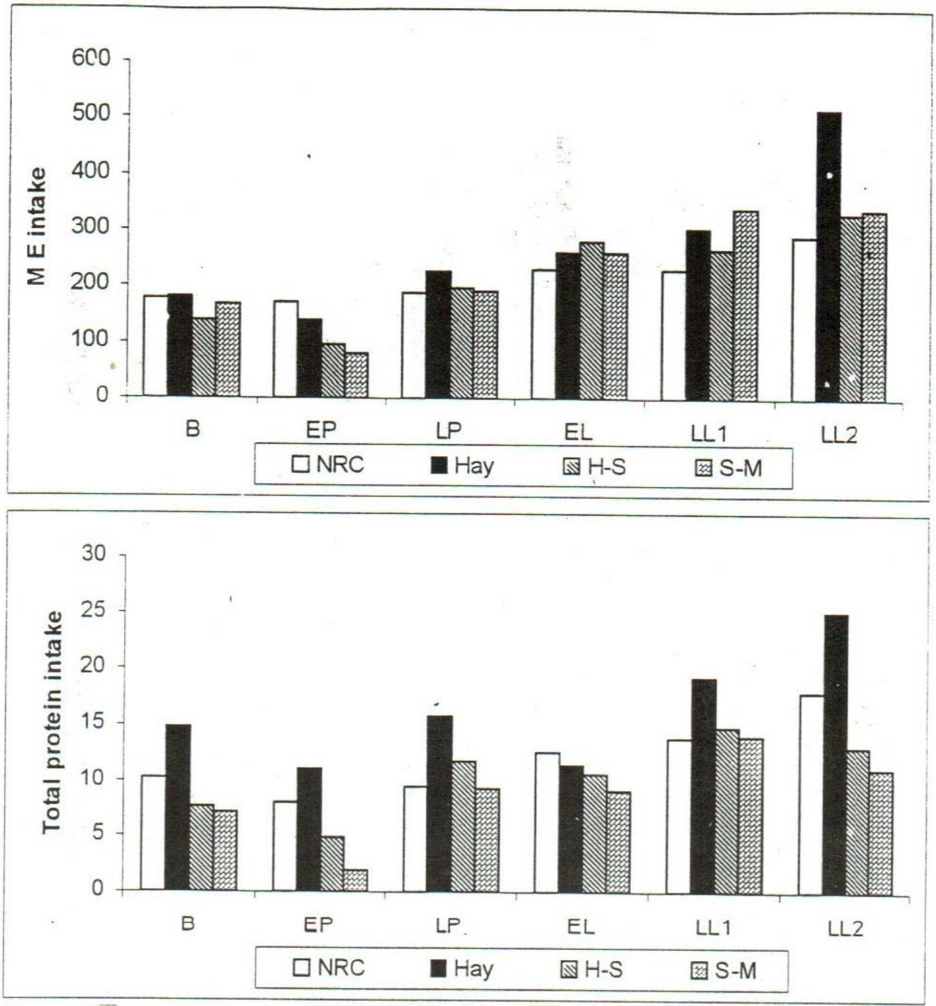


Figure 2. Average daily ME calculated intake (kcal ME/day/kg$^{0.75}$) and total protein intake (g TP/day/kg$^{0.75}$).

Least square means of live body weights and weight changes during the production cycle of the ewes in the four treatment groups are summarized in Table 2. Data from barren ewes were not included. Pregnancy and lactation intervals were calculated to the nearest week from the actual lambing date of each ewe.

During early pregnancy the control ewes gained appreciably and were able to compensate for the results of pre-experiment inferior management. In 90 days they had gained 10.6 kg and reached a live body weight of 43.34 kg. The roughage fed groups, and where no concentrates were fed during this stage, differed in their response, a reflection of the forage quality offered to each group. Ewes in the hay-fed group gained 8.88 kg whereas those fed the straw-Mufeed gained only 2.65 kg, and ewes in the hay-straw group were intermediate at 5.62 kg.

Table 2: Average live body weight and weight changes of ewes during the production cycle in the four experimental groups with different basal roughages and free-choice *ad lib* concentrates.[1]

Stage	NRC control	Hay group	Hay-Straw	Straw-Mufeed
Live body weights, kg:				
Start of breeding	(18) 32.47+1.220^{a}	(17) 36.05+1.369^{a}	(14) 33.13+1.675^{a}	(9) 36.53+1.819^{a}
Pregnant + 30 days	(18) 35.38+1.387^{a}	(17) 38.98+1.556^{a}	(14) 34.26+1.905^{a}	(9) 37.41+2.068^{a}
Pregnant + 60 days	(18) 39.52+1.497^{a}	(17) 41.83+1.679^{a}	(14) 35.93+2.055^{a}	(9) 38.34+2.231^{a}
Pregnant + 90 days	(18) 43.34+1.503^{ab}	(17) 45.05+1.687^{a}	(14) 38.75+2.064^{b}	(9) 39.18+2.240^{b}
Pregnant +120 days	(18) 48.11+1.498^{a}	(17) 49.35+1.681^{a}	(14) 41.76+2.057^{b}	(9) 41.42+2.233^{b}
Before lambing[2]	(18) 53.31+1.592^{a}	(17) 54.57+1.786^{a}	(14) 44.84+2.186^{b}	(9) 45.82+2.373^{b}
After lambing[2]	(18) 44.04+1.499^{a}	(17) 45.80+1.682^{a}	(14) 37.49+2.058^{b}	(9) 35.71+2.234^{b}
Lactating + 28 days	(18) 43.13+1.467^{ab}	(16) 46.78+1.678^{a}	(14) 38.69+2.027^{b}	(7) 39.68+2.603^{b}
Lactating + 56 days	(18) 40.08+1.451^{b}	(16) 47.27+1.650^{a}	(13) 39.04+2.013^{b}	(7) 40.68+2.559^{b}
Lactating + 84 days	(18) 39.53+1.457^{b}	(14) 48.90+1.817^{a}	(13) 40.99+2.022^{b}	(7) 42.14+2.570^{b}
Lactating +112 days	(17) 40.61+1.538^{b}	(13) 51.90+2.083^{a}	(12) 43.31+2.709^{b}	(7) 44.45+2.647^{b}
Weight changes, kg/stage:				
Early pregnancy (90 days)	(18) 10.60+0.586a	(16) 8.88+0.714a	(14) 5.62+0.805b	(9) 2.65+0.874c
Late pregnancy (60 days)	(18) 9.98+0.474a	(16) 9.54+0.577a	(14) 6.09+0.651b	(9) 6.63+0.707b
Weight loss at parturition	(18) –9.27+0.406b	(16) –8.90+0.494b	(14) –7.35+0.558a	(9)-10.11+0.605b
Early lactation (56 days)	(18) –3.97+0.591c	(15) 1.03+0.728b	(13) 1.28+0.820b	(7) 3.86+1.043a
Late lactation (56 days)	(17) –0.14+0.451b	(12) 2.57+0.719a	(12) 4.12+0.619a	(7) 3.76+0.777a

1. Least squares means ± SEM, numbers in parenthesis are numbers of animals; data from barren ewes were not included.
2. Weights recorded during the last week of pregnancy and during the first day after lambing.

a-c Means in a row not sharing a superscript were significantly ($P<0.05$) different according to Duncan's multiple range test.

During the late pregnancy stage, where concentrates were fed free-choice and the increase in live body weight was accounted for by both body gain and fetal growth, the control and hay-fed groups were superior to the hay-straw and straw-Mufeed groups. The former groups gained 9.98 and 9.54 kg, respectively, and the latter ones gained 6.09 and 6.63 kg, respectively.

Live body weights recorded on the first day after lambing were optimum for the control and hay groups being 44.04 and 45.80 kg, respectively. For the other two groups, live body weights were only 37.49 kg for the hay-straw group and 35.71 kg for the straw-Mufeed group. That is feeding free-choice concentrates was not sufficient to offset the negative effects of the lower quality roughages.

The control ewes during early lactation, and with the regulated diets offered as per the NRC standards, lost on average 3.97 kg in eight weeks. The other three groups fed free-choice roughages and concentrates gained weight. The hay group gained the least (1.03 kg) whereas the straw-Mufeed group gained the most (3.86 kg). The hay-straw group was intermediate and gained 1.28 kg in eight weeks. Increased weight gains with decreasing nutritional quality of the roughage offered was probably a reflection of excessive concentrate (corn grains and cottonseed meal) intake as presented earlier which might have resulted in decreased milk production and shunting energy to body stores because of a possible shift in rumen fermentation pattern towards a lower acetate-propionate ratio (Ørskov, 1986). During the second half of lactation a similar trend was observed. Noteworthy, total intake was abnormally high and reflecting food intake by the ewes and their offspring.

Milk Production

The milk production potential of the Egyptian breeds of sheep is low and it was particularly so in the present experiment. Lactation curves of the four groups are illustrated in Figure 3. In all, peak lactation was observed during the second week after lambing. Total milk production was higher in the control and hay groups, 24.07 and 20.02 litres, respectively (Table 3). In the hay-straw and straw-Mufeed groups it was only 16.99 and 13.59 litres. The hay-fed group showed better persistency throughout as compared to the control and the straw-fed groups. Lactation was presumed to last 16 weeks. It was 109 days in the control group and only 86 days in the straw-Mufeed group. In general, both total milk production and the length of lactation decreased progressively as the nutritional quality of the roughage offered decreased, irrespective of the liberal free-choice feeding of concentrates.

Reproductive Performance

The ewes used in the present experiment were 16.5% primiparous and 83.5% multiparous, and their condition was less than optimum as explained earlier. Nevertheless, breeding season activities were not affected except in straw-Mufeed group where only 81.0% of the ewes run with the ram were marked. As noted before for the effects of treatments on body condition of the ewes and their milk production, lambing rate (percent of joined to rams) was not different between control and hay-fed ewes at 90.5% for both (Table

Table 3: Length of lactation and average lactation yield.[1]

	NRC control	Hay group	Hay-Straw	Straw-Mufeed
Length of lactation, days: [2]	(18) 108.85 ± 5.558^{a}	(16) 97.75 ± 6.321^{ab}	(13) 95.55 ± 7.714^{ab}	(7) 85.65 ± 9.805^{b}
Lactation yield, litres/4 weeks:				
1- 4 weeks	(18) 11.59 ± 1.100^{a}	(15) 9.97 ± 1.354^{a}	(13) 8.90 ± 1.527^{a}	(8) 7.16 ± 1.894^{b}
5- 8 weeks	(18) 5.77 ± 0.457^{a}	(15) 5.27 ± 0.563^{ab}	(12) 4.14 ± 0.642^{ab}	(7) 3.46 ± 0.806^{b}
9-12 weeks	(17) 3.32 ± 0.375^{ab}	(14) 4.01 ± 0.585^{a}	(12) 2.62 ± 0.514^{ab}	(6) 2.19 ± 0.668^{b}
13-16 weeks	(17) 3.92 ± 0.481^{ab}	(12) 5.75 ± 0.660^{a}	(11) 2.21 ± 0.774^{b}	(4) 2.67 ± 1.144^{b}
Total, 16 weeks	(18) 24.07 ± 2.154^{a}	(16) 20.02 ± 2.652^{a}	(13) 16.99 ± 2.990^{ab}	(8) 13.59 ± 3.709^{b}

1. **Least squares means ± SEM, numbers in parenthesis are numbers of animals.**
2. **Ewes still lactating after the lapse of 16 weeks after lambing, 112±3 days, were dried up.**

4). It decreased progressively as the nutritional quality of the roughage offered decreased, being 68.2% in the hay-straw group and only 47.6% in the straw-Mufeed group. Compared to the control group, these values represent 25 and 47 percent losses in lambing rate, respectively.

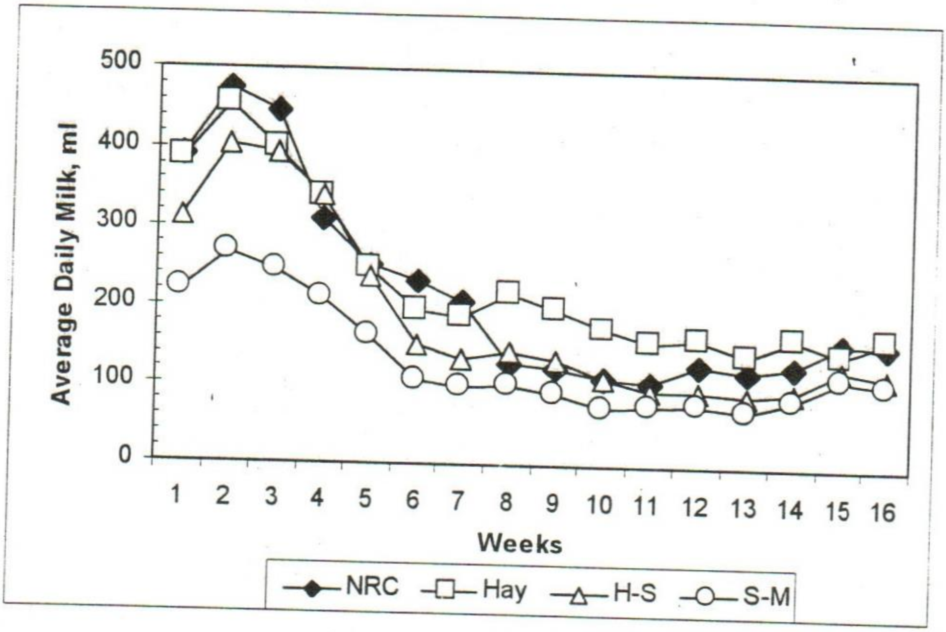


Figure 3. Lactation curves of control ewes and groups offered different basal roughages *ad lib* and free-choice concentrates.

Differences in numbers of cases of twinning, abortions and stillbirths were not conclusive of differences between treatments. However, early embryonic mortality, defined as the number of ewes mated but did not lamb nor aborted and including undetected conception failure, were recorded only in the hay-straw and straw-Mufeed groups, 4 and 3 cases respectively, representing 18.2% and 14.3% of ewes joined. During early pregnancy where this was expected to happen the ewes in those two groups were apparently under-nourished.

Consequently, total lambs born alive were 18 from both control and the hay-fed groups (85.7% of ewes joined) and only 14 and 8, respectively from hay-straw and straw-Mufeed groups (63.6% and 38.1% of ewes joined). Lamb mortality from birth to weaning was within expected range (up to 5%) only in the control group. In the other three groups it increased to 16.7% in the hay group, 14.3% in the hay-straw group, and a high of 25.0% in the straw-Mufeed group. On the other hand, ewe mortality during the 42-week experimental period was high only in the straw-Mufeed group (19.0% of ewes joined), three quarters of which was during pregnancy and the remaining quarter during lactation.

Table 4. Reproductive performance of ewes.

	NRC group	Hay group	Hay-Straw	Straw-Mufeed
Ewes joined to rams:				
Primiparous	2	4	4	4
Multiparous	19	17	18	17
Total	**21**	**21**	**22**	**21**
Ewes mated:				
Number	21	19	21	17
% of joined	**100.0**	**90.5**	**95.5**	**81.0**
Ewes lambing:				
Number	19	19	15	10
% of joined	**90.5**	**90.5**	**68.2**	**47.6**
Twinning, cases	0	1	0	0
Abortions, cases	2	0	1	0
Early embryonic mortality, cases[1]	**0**	**0**	**4**	**3**
Lambs born:				
Total	19	20	15	10
Stillbirths	1	2	1	2
Live lambs:				
Males	10	12	3	2
Females	8	6	11	6
Total live lambs	**18**	**18**	**14**	**8**
Ewe mortality:				
During pregnancy	0	0	1	3
After lambing	1	0	0	1
Total	1	0	1	4
% of joined	**4.8**	**0.0**	**4.5**	**19.0**
Lamb mortality:				
Males	1	0	0	1
Females	0	3	2	1
Total	1	3	2	2
% of born alive	**5.9**	**16.7**	**14.3**	**25.0**

1. early embryonic mortality = number of ewes mated but did not lamb nor aborted, and including undetected conception failure.

The Ewe Production Index

Ewe production index was calculated for the four groups (Table 5) as kilograms born and weaned per 100 ewes joined to rams. The data used included number of lambs born alive and the number weaned in addition to birth and weaning weights. Results were not corrected for differences of numbers of male and female lambs in each group but weighted group means of both birth and weaning weights were used. Details of lamb growth pre- and post-weaning will be presented in a succeeding publication.

The results (Table 5) plainly indicate that 100 ewes joined to rams and fed according to NRC (1985) weaned 1765 kg. Ewes fed *ad lib* hay throughout and free-choice concentrates (corn grains and cottonseed meal) from the start of late pregnancy till the weaning of offspring, weaned 1983 kg of lambs per 100 ewes joined. However, if lamb mortality in this group were only 5% as in the control, it would have weaned in excess of 2200 kg of lambs. As the nutritional quality of the roughage decreased, kilograms weaned per 100 ewes joined decreased to 1197 kg in the hay-straw group and to only 672 kg in the straw-Mufeed group. These represent only 68 and 38 percent, respectively, of what the control ewes produced, a considerable loss of productivity.

Table 5. Lamb production and the ewe production index. [1]

	NRC group	Hay group	Hay-Straw	Straw-Mufeed
Live lambs born / 100 ewes joined	85.7	85.7	63.6	38.1
Lambs weaned / 100 ewes joined	**81.0**	**71.4**	**54.5**	**28.6**
Lamb mortality, % born live	5.9	16.7	14.3	25.0
Birth weight of lambs:				
Males	3.86	3.75	3.23	3.45
Females	3.83	3.63	3.21	2.95
Average [2]	3.85	3.72	3.22	3.12
Weaning weight of lambs:				
Males	21.72	27.75	19.50	26.50
Females	21.88	27.83	22.78	22.90
Average [2]	21.79	27.77	21.96	23.50
Ewe production index:				
Kg born / 100 ewes joined	329.9	318.8	204.8	118.9
Kg weaned / 100 ewes joined	**1765.0**	**1982.8**	**1196.8**	**672.1**
Weaned weight index, %	100.0	112.3	67.8	38.1

1. **Details of lamb weights and pre- and post-weaning growth will be presented in a succeeding publication**
2. **Weighted means, not corrected for different numbers of sexes between treatments.**

In general, the results considered collectively emphasize the fact that decreasing the nutritional quality of the roughage offered, even with free-choice feeding of concentrates, all reproductive and productive parameters of ewes were adversely affected as can be seen in the hay-straw group and more so in the straw-Mufeed group. Diet selection and the nutritional wisdom of sheep will be discussed below.

DISCUSSION

Nutrition-Reproduction Interaction

The most important factor determining profitability of a sheep enterprise is "production rate" which is an expression of "reproductive efficiency". The relationship between nutrition and reproduction has long been a topic of concern among researchers and livestock producers as well. Medvei (1982), writing about the history of endocrinology, indicated that Aristotole (384-322 BC) had stated that nutrition is the most important environmental factor controlling conception. Presently, we know that nutrition controls many physiological functions related to reproductive efficiency, directly or mediated by the effect of nutrition on several endocrine mechanisms. Most important are the hypothalamus and the pituitary gland as well as the pancreas, thyroid and adrenal cortex glands (Butler, 2000, as well as the pancreas, thyroid and adrenal cortex glands (Butler, 2000, Lucy, 2000, 2001, Silke *et al.*, 2002). Also, the newly discovered "Leptin", secreted mainly from the adipose tissue and responsible for the long-term regulation of food intake and energy balance (Williams *et al.*, 2002), mediates the complex relationships between energy balance, hypothalamic and pituitary functions and reproductive efficiency.

Sheep producers are well aware that the next lamb crop is determined by the status of the ewe before and during the breeding season, and the condition of the offspring and their performance pre- and post weaning are determined by the status of the ewe at lambing (Neary, 2005).

Under-nutrition before and during breeding interferes with ovarian functions through its effects on the hypothalamus and pituitary gland. Ovarian cycling is then irregular, mature follicles and the formed corpus luteum are smaller and ovarian estrogen and progesterone secretion might decrease (Butler, 2000, Lucy, 2000). Conception failure and early embryonic mortality (0-28 days) increase and pregnancy and lambing rates decrease.

These authors and Silke *et al.* (2002) also indicated that under-nutrition during early/mid pregnancy affects placental development (30-90 days). That would limit the transfer of nutrients to the foetus and decrease steroid secretions responsible for the maintenance of pregnancy. These would be manifested in decreased lambing rate (increased early embryonic mortality and abortions) and smaller size offspring. Most important, these effects cannot be offset by better nutrition during late pregnancy.

Nutrition of ewes during the transition period, i.e. 2-3 weeks before and after lambing, is also critical. The common problems resulting from under-nutrition during this period are ketosis (pregnancy toxemia) and high mortality rates of ewes, and viability and performance of nursing offspring especially during the first six to eight weeks. Improper feeding of the ewe after lambing leads to rumen and metabolic acidosis and low milk production and fat content.

These findings concerning the nutrition-reproduction interactions explain the results obtained from the present experiment. Feeding the control ewes according to NRC recommended allowances had resulted in seemingly optimum performance. The hay-fed ewes, even though they did not receive concentrates during early pregnancy performed similarly well or better. Although flushing was applied for a relatively long period because of the starting poor condition of the ewes, it did not help much those in the two straw-fed groups and they performed poorly especially those in the straw-Mufeed group when receiving only the roughage during early pregnancy. Hence, the observed low lambing rate, increased early embryonic mortality, less number of lambs born alive, smaller birth weight of offspring and high mortality rates of both ewes and offspring. Feeding concentrates during late pregnancy did not offset the negative effects of under-nutrition during early pregnancy.

It is therefore appropriate to conclude that the ewe status before breeding and its nutrition during breeding and early pregnancy were the most significant factors controlling reproductive efficiency and affecting the overall production rate expressed above as kilograms born and weaned per 100 ewes joined to rams. Better feeding during late pregnancy and lactation seemed to improve ewe condition more than that of the offspring and the production rate. It would improve the production rate only if the ewes were in optimum condition before breeding and were well nourished during breeding and the first 90 days of pregnancy.

The nutritional wisdom of ewes in selecting their diets during the different stages of the production cycle was dealt with in an earlier publication (Farid *et al.*, 2006). Only when the good quality roughage, berseem hay, was fed that the ewes were able to select diets that satisfy their energy needs for maintenance and production and in the same time maintaining appropriate proportions of roughage and rumen digested intake protein (DIP) in the selected diets. When the lower quality straw was fed with limited hay or with Mufeed, satisfying energy needs was the primary concern, and concentrates intake increased . Maintaining optimum roughage and DIP proportions in the total diet was sacrificed, and performance was adversely affected.

Present results and the above discussion are compelling to advance the question: is it appropriate to feed straw and in the same time target high production performance? The obvious answer would be a simple no, but it will not be correct. In the control diets straw represented approximately one-third of the total roughage and about 15% of the total diet, DM basis. Those diets were generated using a computer software that can optimize diets not only for energy (ME) and protein (TP) but also for roughage and/or fibre content and fractions, DIP and the critical mineral elements. Therefore, it appears that appropriate evaluation of feed ingredients and formulation of diets suitable for the different stages of the production cycle, along with sound overall nutritional and flock management, are the key to profitable sheep production. Continuous monitoring of the ewe status is essential. Therefore, the use of body condition scoring, first developed for dairy cattle and now applied to the different classes of livestock, has become a common practice. The fat-tailed sheep is a special case as it stores fat mostly in the fat tail area. Hossamo et al. (1986) developed a scoring system for the fat-tailed Awassi sheep in Syria. This can be used or modified for use with the Egyptian breeds of sheep. From the managerial point of view, body condition scoring (BCS) would be more practical than repeated weighing and might be more meaningful. Some even believe that changes in body condition (i.e. BCS) are a more reliable guide for evaluating the nutritional status of the animal (Herd and Sprott, 1996).

Production Performance of Local Sheep

Native breeds of sheep, along with their unknown true inherent production potential, are invariably and unjustly evaluated in comparison with European breeds. Hence, they are considered low producers and non-economic. The present experiment was carried out under conditions where nutrition was not limiting, health status was monitored and flock management was acceptable but not as desired. Therefore, comparing our results with that in the literature for Barki and Ossimi sheep was appealing. Table 6 presents values of selected reproductive parameters and offspring weights and growth rates of those two breeds and some factors affecting it.

The cardinal observation was that our animals in the control and hay-fed groups performed better than anticipated from reviewing the literature. Secondly, the poor condition (live body weight) of ewes at the onset of breeding in all reports, similar to the condition of the ewes in the present experiment. Also, the wide variation observed between results from different sources. Only in one experiment (Mokhtar et al., 1984) lambing rates and lambs born alive were high, similar to what is reported in the present communication (Tables 4 and 5), and those were associated with the better levels of ewe nutrition used in that study. Genetic variation might have existed between flocks of ewes used in the different experiments. Nevertheless, inferior flock and feeding management are believed the most significant, otherwise ewes would have been in a better condition at the start of breeding.

IMPLICATIONS

Competent feeding management of the reproducing ewe flock is the key to the success and economic viability of sheep production enterprises. Most critical is the ewe condition before breeding and its feeding management through the different stages of the production cycle, especially during the first 90 days of pregnancy and the transition stage, 2-3 weeks before and after parturition. Our knowledge of the true inherent production potential of our native breeds of sheep is lacking. Our scientific knowledge and research methodology lagged behind worldwide advances for decades. And our vision while planning for the future is obscure. The requirements to offset that must include advancing our research philosophy, objectives and methodology.

The present results indicate that our native breeds of sheep can produce well, quantitatively and economically, if given a fair chance. A fair chance means recognizing their inherent production potential where health, nutrition and other environmental factors are not limiting, and providing requirements needed to realize that potential. Future research in sheep nutrition should engage itself with devising up-to-date feeding management systems. These ought to be suitable for our producers and their interests and resources, and utilize rationally recent advances in nutrition and the allied sciences.

On the animal side, this include not only the classical energy, protein, minerals and vitamins requirements but also, and more important, novel topics such as the animal's food intake capacity and its limitations, the complex nutrition-endocrine interactions and their interaction with the different physiological functions of the animal, the needed synchrony of fermentation and digestion of the different feed components in the rumen and along the gastro-intestinal tract and factors affecting it, the metabolic requirements within the animal for its different physiological functions, and may others. On the food side, it is the adoption of up-to-date methodology that would yield information on the physical, chemical and digestive characteristics needed to formulate diets that satisfy the animal's physical, chemical, digestive and metabolic requirements which vary considerably during the different stages of its production cycle.

Table 6: Literature summary of selected reproductive parameters of Barki and Ossimi ewes.

Breed	BARKI						OSSIMI							
Reference no.	(1)		(2)	(3)			(4)			(5)	(6)			(7)
Treatments	Exp farm	com farm		Ewe feeding level H	M	L	Lambing season W	S	Sp		Ewe feeding level 1.0M	1.8M	2.3M	
Ewe weight, kg:														
Before breeding	35.1	41.8	39.4								37.2	37.6	38.1	
Before lambing	43.0	42.2	45.7								41.0	46.5	48.8	
At weaning	38.1	39.3	44.4											
Per 100 ewes joined:														
Conceived ewes	82.8	66.9	82.9	97.8	91.3	76.1								76
Lambed ewes	81.5	66.9	82.4	91.3	91.3	76.1	100	86.7	93.3	72	81.2	86.7	80.8	74
Lambs born alive	79.5	68.9	85.8	97.8	95.7	76.1				81				93
Lambs weaned	71.2	61.4	76.3							80				87
Lamb mortality	10.3	10.8	11.1				0.0	13.3	17.6					14.1
Lamb weights, kg:														
Birth	3.51	3.33	3.78				3.75	2.65	2.55		3.48	4.14	4.19	2.89
Weaning (4 mon)	21.6	18.2	16.5				19.8	18.9	20.5					18.9
Daily gain, g/day	150	124	140				134	135	150					133

1- Abdel-Aziz (1983) and Younis *et al.* (1984), 2- Mohammed (1999), 3- Mokhtar *et al.* (1984),
4- Labban and Ghali (1969), 5- Aboul-Naga (1978), 6- Abdel-Hafiz *et al.* (1979),
7- Aboul-Naga and Afifi (1980).

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تأثير الرعاية الغذائية على إنتاج الأغنام فى جنوب سيناء : ٢ - التناسل والأداء الإنتاجى فى النعاج .

محمد فريد عبدالخالق فريد ، حجازى سالم خميس ، إيهاب يحيى أحمد عيد ، أحمد هلال
قسم تغذية الحيوان ، مركز بحوث الصحراء ، المطرية ، القاهرة .

أجريت الدراسة للتعرف على القدرات الإنتاجية والتناسلية للنعاج فى جنوب سيناء تحت ظروف لاتكون التغذية فيها هى العامل المحدد للإنتاج ، ولاتحد من قدرة الحيوان على إختيار الغذاء ، لذلك استخدمت فيها نظام التغذية الحرة .

أستخدمت فى الدراسة ٨٥ نعجة موزعة عشوائيا على أربع مجموعات . فى ثلاث مجموعات أعطيت النعاج أعلاف خشنة تختلف فى قيمتها الغذائية : دريس البرسيم المصرى ، ثلث الدريس وقش أرز ، قش أرز مضافا إليه مخلوط المولاس واليوريا المعروف بإسم "المفيد" . أعطيت الحيونات العليقة الخشنة فقط خلال المرحلة الاولى من الحمل ، بعد ذلك قدمت لها فى معالف منفصلة حبوب الذرة المجروشة وكسب القطن من أول المرحلة الثانية من الحمل وحتى فطام المواليد فى عمر ١٦ أسبوع . المجموعة الرابعة أستخدمت كمجموعة المقارنة ، وقد غذيت خلال المراحل الإنتاجية المختلفة حسب المقننات الأمريكية . بالإضافة إلى ذلك أعطيت النعاج فى المجموعات الأربع مخلوط مركز للدفع الغذائى قبل التلقيح بأسبوعين وحتى نهاية موسم التلقيح الذى إستمر ٤٠ يوما .

النعاج التى غذيت على الدريس كعلف خشن أمكنها أن تختار علائق توفر لها احتياجاتها من الطاقه ، ومن نسبة العلف الخشن والألياف والبروتين قابل الهضم فى الكرش ، بما يحقق المواصفات القياسية للعلائق المتزنة خلال كل مراحل دورة الإنتاج ، وفى المقابل فإن النعاج التى غذيت على قش الأرز لم تنجح فى ذلك ، وبصفه خاصة فى المرحلة الأولى من الحمل وخلال موسم الحليب .

فى بداية التجربة كان وزن النعاج كلها دون المتوسط المتعارف عليه للأنواع المصرية حيث بلغ متوسط الوزن فيها ٧٥% أو أقل من المتوسط النمطى لوزن النعاج البالغة . الأوزان بعد الولادة مباشرة أوضحت أن النعاج فى مجموعتى المقارنة والدريس أمكنها أن تصل إلى الوزن النمطى ، بينما مثيلاتها فى مجموعتى قش الأرز لم تتمكن من ذلك ، وذلك على الرغم من التغذية الحرة على مواد العلف المركزة خلال الفترة الثانية من الحمل وحتى الولادة .

الأداء التناسلى والإنتاجى للنعاج التى غذيت على الدريس كانت مثل أو أفضل مما تحقق فى مجموعة المقارنة ، أما تلك التى تغذت على قش الأرز فكان أداؤها متدنيا بصفة عامة فى كل الصفات المدروسة ، وبضمن ذلك الإنتاج التناسلى ومعدل الولادات ، إرتفاع نسبة النفوق فى الحملان والأمهات ، تدنى إنتاج الحليب ، وأوزان الميلاد والفطام فى الحملان . وقد تم حساب الدليل الإنتاجى للنعاج (= كيلو جرام وزن مفطوم لكل ١٠٠ نعجة دخلت موسم التلقيح) وكان ١٧٦٥ كيلوجرام لمجموعة المقارنة ، بينما كان ١٩٨٣ كيلوجرام لمجموعة النعاج التى تم تغذيتها على الدريس . فى المقابل كان الدليل الإنتاجى للنعاج التى غذيت على قش الأرز مع الدريس أو مع المفيد ١١٩٧ و ٦٧٢ كيلوجرام ، على التوالى .

تدنى التناسل والإنتاج قد لا يعود كله إلى أن العلف الخشن كان قش الأرز بل قد يعود إلى عوامل أخرى تتعلق بعدم إتزان العليقة لنقص العلف الخشن بها وزيادة المركزات ، وبالتالى نقص الألياف الخام ، وذلك لأن عليقة المقارنة كان يدخل فى تكوينها قش الأرز بنسبة تصل إلى ثلث العلف الخشن أو ١٥% تقريبا من إجمالى المادة الجافة فى العليقة اليومية ، ولكنها كانت محسوبة بما يوفر إحتياجات الحيوان ويحقق التوازن المطلوب حسب المواصفات القياسية المعروفة للعلائق المتزنة .