Returns and Economical Efficiency of Barki Sheep Fed on Salt Tolerant Plants in Sinai, Egypt

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Abstract: Forty Barki ewes (3.5 – 4.5) years, averaged (35 ± 3.5 kg) body weight, fed conventional feeding (berseem hay and concentrate feed mixtures) and non conventional feeding (halophytic silage and concentrate feed mixtures) cultivated in salt affected soil to evaluate biological and economical efficiency from flushing stage until weaning age in South Sinai. Ewes were randomly divided into 2 groups (20 each). Group 1 (G1) received berseem hay and concentrate feed mixture (control), while group 2 (G2) received halophytic silage and concentrate feed mixture. Biological efficiency was estimated as, the ratio of total weaned lambs to the total feed intake as dry matter (DM). The result showed that, lambing rate was estimated as 90%for G1 and 80% for G2. Average DMI per head was found (292.8 kg vs. 274.1 kg) for G1 and G2 throughout the experimental period (298 days). Type of feed had no significant effect ($P < 0.05$) on birth weight (3.41 and 3.32 kg), weaning weight (14.25 and 11.07 kg) and average daily gain of lambs (0.120 and 0.087 kg) for G1 and G2, respectively. The values of biological and economical efficiency were 24.2 and 30.97 kg and 50 and 68.9 for G1and G2, respectively. Both economical biological were comparable and have the same trend. The study concluded that, halophytic silage could be utlized in feeding Barki ewes without severe biological disorders.

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1. Introduction

Sheep play a considerable role in agriculture matrix particularly in desert and marginal areas. Under the arid conditions of South Sinai Peninsula in Egypt, where sheep are raised in predominantly extensive production systems, shortage of feedstuffs and scarcity of fresh water are the main limiting factors for sufficient animal production. The natural vegetations are characterized by the dominance of numerous less palatable and unpalatable shrubs. Sheep, goats and camels always over graze the palatable ones. The less and unpalatable plant species represent approximately 70% of the total green coverage. Under these challenging conditions, alternative feeding resources such as halophytes and other salt-tolerant plants may provide sensible alternatives in marginal areas (Squires and Ayoub, 1994).

Several attempts have been made to improve the palatability of such less and un-palatable halophytic plants through appropriate processing methods. Ensiling halophytic plants with other salt-tolerant plants appeared to be the most convenient processing method, to reduce dependence on limited fresh water forage resources under the prevailing conditions of aridity in Egypt (Abou El Nasr *et al*. 1996) and consequently increase forage availability required for animal production. The current study was carried out to investigate the possibility of using silage composed of the available halophytic plants in South Sinai Peninsula for feeding Barki sheep and evaluate its effect on biological and economical efficiency.

2. Materials and Methods

Study location

The present study was launched at Ras Sudr Research Station, located at South Sinai Peninsula, belonging to Desert Researcher Center, Ministry of Agriculture and Land Reclamation, as a part of Bilateral Project (ICBA-DRC) in Egypt. The project aimed at improving the sustainability of sheep production systems by increasing the availability of non-conventional forage resources through introduction of salt-tolerant plants.

The experimental silage

Silage used in this experiment was made of the leaves and stems of some halophytic plants grow naturally or cultivated in South Sinai. Four salt-tolerant plants were separately cultivated in the salt-affected soil of the Research Station Farm and irrigated with underground saline water. The experimental silage formulated of 50% *Atriplex nummularia* (saltbush), 15% Pearl millet, 25% (fodder beet root and *carthamus tinctorius* (safflower)) and 10% *Carthamus tinctorius* hay. The obtained silage was moist with pleasant aroma, golden yellow colour, acidic (3 – 4.5).

Experimental procedures

A total number of forty Barki ewes aging (3.5 – 4.5) years and averaging (35 ± 3.5 kg), live body weight were randomly distributed into two equal groups (20 ewes each) balanced for age and live body weight. Each group housed in separated shaded mating pen. The first group (G1) was fed berseem hay and concentrate feed mixture (CFM) and served as control group, while the second group (G2) was fed silage formulated from salt tolerant plants, as well as CFM. Experimental ewes were fed their nutrient requirements according to Kearl (1982). Table (1) shows the chemical composition of the experimental diets offered to ewes of G1 and G2.

Table 1. Chemical composition of the experimental diets fed to Barki sheep (%, as DM basis).

Items	Silage	Berseem hay	CFM
Dry matter	35.93	91.83	91.25
Organic matter	79.94	84.18	91.07
Crude protein	10.95	12.36	14.13
Crude fiber	20.16	23.55	7.01
Ether extract	1.43	2.20	2.01
Ash	20.06	15.83	8.93
Nitrogen free extract	47.40	46.06	67.88
Neutral detergent fiber	51.38	45.85	62.34
Acid detergent fiber	32.07	30.75	9.57
Hemicellulose	20.67	15.11	52.77
C.CHO	48.62	54.15	37.66
Sodium, %	3.975	16.36	0.150
Potassium, %	2.21	0.43	1.70

The experimental ewes were naturally mated once a year at autumn season on 15th of October and the breeding season lasted for 34 days (2 estrus cycles). Ewes in each group were assigned with a fertile breeding ram. Rams' briskets were colored with different colored grease fortnightly, and mating pens were checked daily for colored ewes. At the beginning of the study, ewes in each group were individually weighed before morning feeding (initial body weight) and monthly, thereafter. Changes of live body weight were recorded throughout the experimental period. After lambing, newborn lambs were weighed at birth and biweekly thereafter up to weaning (90 days).

Feed intake of ewes

Daily feed intake per ewe as dry matter (DM) was adjusted and estimated for each group according to their live body weight and physiological status, *i.e.* pregnancy and lactation. In this context, the experimental period lasted for 298 days and was divided into four stages; flushing (15 days), breeding until mid pregnancy (134 days), late pregnancy (59 days) and lactation stage (90 days). The amount of DM required for each ewe during the flushing stage till the end of pregnancy were estimated as 2.1% of average live body weight for the two studied groups. While, during lactation stage, the amount of DM required was representing about 3.2% of their live body weight. Rations offered (roughage : concentrate ratio) to the experimental ewes from flushing till mid pregnancy were formulated of 50% roughage and 50% concentrate feed mixture, while it was 40% roughage and 60% concentrate feed mixture during late pregnancy and lactation stages (as DM).

Biological efficiency

Number of kilograms weaned lambs per ewe joined (KWEJ) is considered as one of the most indicative parameters for measuring biological performance of production in the flock, since it combines into one index, ewe and ram fertility as well as mortality and growth rates of lambs. In this context, reproductive traits in terms of conception rate, lambing rate (expressed as the number of ewes lambed per ewe joined), lambing % (expressed as the number of lambs born per ewe joined), weaning % and mortality rate (from birth to weaning) were considered. In addition to, productive traits; birth weight, weaning weight and average daily gain were recorded. Biological efficiency was estimated as the ratio of total kilograms weaned lambs to the total feed consumed as dry matter intake (DMI).

Economical efficiency

Quantitative assessments of economic productivity are necessary to evaluate a certain managerial procedure under investigation. In the current study, variable costs considered feeds costs only, while revenues represented the monetary value generated from marketed weaned lambs to estimate revenues/ewe from each group. Economical efficiency of the current study was estimated as the costs of feeds consumed (as fed) to produce one kilogram of weaned lambs, as well as, benefit/cost ratio was calculated. Economic indicators derived were based on farm gate prices in Egyptian pound (LE) as follows; berseem hay (LE 1750/ton), CFM (LE 2000/ton), halophytic silage (LE 765/ton) and marketed weaned lambs (LE 45/kg) were considered.

Statistical analysis

Data were statistically analyzed using the General Linear Model (GLM) procedures described by SAS (2004) to derive estimates of the studied biological traits for the two experimental groups under investigation. The following model was assumed to underlay the least squares analysis of variance:

$Y_{ij} = \mu + d_i + e_{ij}$

Where:

Y_{ij} = the observations,

μ = the overall mean,

d_i = the effect due to i^{th} experimental diets, i = 1, 2,

e_{ij} = random error associated with the ij^{th} observation.

The significant differences between means of the two studied groups were tested according to Duncan's New Multiple Ranges Test (Duncan, 1955).

3. Results and Discussion

Ewes Live body weight

Least squares means and standard errors of live body weight changes of ewes throughout the experimental period are presented in Table (2). Changes in live body weight, within the same group, scored + 8.0 kg for G1 and + 5.3 kg for G2. Results demonstrated that, ewes were in a good condition at mating and no significant differences were reported in average live body weight changes from the beginning of experiment until mid pregnancy stage. However, at the end of pregnancy period ewes of G1 recorded a higher live body weight (46.7 kg) than ewes of G2 (42.4 kg), and the difference was significant ($p < 0.05$).

Table 2. Least squares means and standard errors of live body weight (kg) of ewes during the experimental period

Experimental period	G1	G2
Flushing (initial)	38.7 ± 1.37	37.1 ± 1.22
Start of pregnancy	41.7 ± 1.37	40.9 ± 0.97
Mid of pregnancy	43.7 ± 1.37	41.1 ± 1.22
End of pregnancy	46.7^a ± 1.46	42.4^b ± 1.28
Weight changes (initial - end of pregnancy)	+ 8.0	+ 5.3
End of lactation period	43 ± 1.41	40.3 ± 1.22

G1; ewes fed berseem hay + CFM, G2; ewes fed halophytic silage + CFM. [a,b] Means followed by different superscript letters within the same raw are significantly different (P 0.05).

The reported changes in ewe's body weight are considered acceptable, since previous studies stated that pregnant ewes lose weight at lambing, which is equivalent to the birth weight of lambs plus 60% of that weight as fluid and placenta. The observed results of the present study revealed that, combing halophytic silage in the diet of Barki ewes did not affect negatively live body weight of ewes and weight of fetus throughout the pregnancy stage. These results are in disagreement with Eid (2003) who found that, ewes fed on halophytic silage achieved more weight at the end of pregnancy than ewes fed on hay (8.52 kg vs. 7.32 kg) and attributed that due to the increase in extracelluler fluid as reported by El – Shaer (1996).

On the other hand, at the end of lactation stage, results indicated that, type of feeding did not affect significantly live body weights of ewes. In contrary, the obtained results are in disagreement with El-Shaer (1981) and Kandil (1980), for Barki ewes under similar environmental and nutritional conditions, and authors reported that, there was a significant effect of type of diet on live body weight of ewes throughout the lactation period.

Reproductive performance

The current results indicated that all ewes came into heat and were mated by their assigned Barki rams during the first oestrus cycle. Estimate of average gestation period was 143.7 days for both studied groups. Results of reproductive traits of the current study are shown in Table (3). The obtained results revealed that, G2 was lower in conception rate of (80%) than G1, of (90%), but the differences were not significant. These results are disagreed with those reported by Eid (2003) for the same breed. In this context, the current results showed that, lambing rate were 90% and 80% for G1 and G2, respectively. Ewes of G2 fed on halophytic silage did not show negative effects on reproductive performance. These results are in agreement with results obtained by Eid (2003). No mortality were recorded from birth to weaning except one case of still birth in G1 group.

Table 3. Reproductive performance of ewes for the two studied groups.

Trait	G1	G2
No. of ewes joined	20	20
No. of ewes conceived	18	16
No. of ewes lambed	18	16
No. of lambs born alive	17	16
No. of lambs weaned	17	16
Conception rate, (%)	90	80
Lambing rate, (%)	90	80
Lambing percentage, (%)	85	80
Lambs weaned, (%)	99	100
Mortality rate (Birth- weaning), (%)	0	0
Kg of weaned lambs/ewe joined	12.11	8.65

G1; ewes fed on berseem hay + CFM, G2; ewes fed on halophytic silage + CFM.

Growth performance of lambs

The least squares means and standard errors of birth weight, weaning weight and average daily gain, as affected by experimental diets, are presented in Table (4). The findings of the present study showed that no significant differences on birth weight, weaning weight, and average daily gain between the two groups. The obtained results revealed that, overall means of birth weight (3.32 kg), weaning weight (12.7 kg), average daily gain (104 g/day) are lower than that reported by Mohammady (1999) of (3.75 kg, -16.47 kg, and 140 g/d), respectively, for the same breed.

On the other hand, the recent results indicated that, there are slight differences in estimates of birth weight, weaning weight and average daily gain between the control group (G1) and the other group (G2). Lambs of control group (G1) tended to grow faster and performed higher weaning weight as compared to group (G2), it could be due to the higher metabolic energy and protein content of G1 in comparison with G2. These may due to that, average daily protein and fat production , higher milk yield and consequently total fat and protein yields of ewes fed on hay (conventional diets) than ewes fed on silage of halophytic plants mixture, (Eid, 2003, EL–Shaer, 1981, and Ibrahim, 2002) which reflects on the ewe condition and her milk supply.

Table 4. Least squares means ± SE for birth weight, weaning weight and average daily gain (kg) of lambs under the experimental diets

Traits	Overall mean	G1	G2
		X SE	X SE
Birth weight	3.32 ± 0.09	3.41 ± 0.115	3.32 ± 0.162
Weaningweight	12.71 ± 0.86	14.25 ± 1.09	11.07 ± 1.24
Average daily gain	0.104 ± 0.009	0.120 ± 0.012	0.087 ± 0.013

G1; ewes fed on berseem hay + CFM, G2; ewes fed on halophytic silage + CFM.

Feed intake and biological efficiency

Dry matter intake (DMI) per ewe throughout the experimental period (298 days) and biological efficiency are presented in Table (5). Results revealed that, there are slight differences in DMI per ewe between the two groups. These may due to the variations of average live body weight of ewes at the beginning of each stage. In this context, ewes fed berseem hay (G1) consumed more total DMI (5856.8 kg) than ewes fed halophytic silage (G2), of (5482 kg) and followed the same pattern throughout the different stages over the experimental period. On the other hand, both values of DMI and KWEJ are considered as the main access to estimate the biological efficiency. The estimated biological efficiency for G1 and G2 were 24.2 kg and 30.97 kg, respectively, which indicated that G1 is more efficient than G2, since it consumed about 28% more DM than G1 to produce one kg of weaned lambs. This may be due to higher daily gain recorded for lambs of G1 which lead to heavier weaning weight and increased total kg weaned (242.25 kg) compared to total kg weaned of G2 (177.12 kg), which is lower than G1 by approximately 73%.

Table 5. Dry matter intake and biological efficiency (kg) per ewe of the two studied groups during the experimental period

Experimental stage	G1	G2
Flushing (15 days):		
DMI/day	0.800	0.780
DMI/stage	12.0	11.7
Breeding to mid pregnancy (134 days):		
DMI/day	0.860	0.830
DMI/stage	115.24	111.22
Late pregnancy (59 days):		
DMI/day	0.900	0.860
DMI/stage	53.10	50.74
Lactation (90 days):		
DMI/day	1.300	1.200
DMI/stage	117	108
Total dry matter intake/group/period	5856	5482
Total dry matter intake/ewe/period	292.8	274.1
Biological efficiency	24.2	3o.97

G1; ewes fed on berseem hay + CFM, G2; ewes fed on halophytic silage + CFM. DMI, dry matter intake.

Economical efficiency

The results of economic efficiency are summarized in Table (6). It is of interest to observe that G1 and G2 almost had the same feed costs per ewe during the whole experimental period (LE 605 vs. LE 596.3), nevertheless, G1 achieved lower feed costs to produce one kg of weaned lambs and estimated as LE 50.0, while G2 was higher and estimated as LE 68.9. In the same time, benefit/cost ratio was less than 1 for both G1 and G2, and accounted for 0.9 and 0.68, respectively, which means that costs exceeded revenues per ewe in the two groups.

Bioeconomic assessment

The current study confirmed that, there is a positive relation between biological and economical efficiency. Figure (1) displays the comparisons of biological to economical efficiency. The results of the economical efficiency tended to be in harmony with the result of biological efficiency. For both economical and biological efficiency, the higher revenues of G1 were offset by a higher biological performance. Since, total kg weaned lambs of G2 were approximately 26.9% less than G1. Corresponding values for economical efficiency, G2 was estimated as 37.8% less than G1 at weaning stage. It is of interest to confirm that, differences in revenues contributed more to variations in biological performance than in expenses.

Table 6. Economic efficiency of Barki ewes under the two studied groups

Item	G1	G2
No. of animals	20	20
Total feed intake/h /p (as fed), kg:		
Concentrate feed mixture, kg	168.6	158.2
Berseem hay, kg	153.4	----
Silage, kg	----	365.9
Feed costs/h/p, LE:		
Concentrate feed mixture, LE	337.2	316.4
Berseem hay, LE	268.5	----
Silage, LE	----	279.9
Total feed costs/ewe/period, LE	605.7	596.3
Feed costs /kg of weaned lamb, LE	50.0	68.9
Revenues/ewe, LE	545	398.5
Benefit/Cost ratio	0.90	0.67

G1; ewes fed (Control), G2; ewes fed a diet contains halophytic silage. Prevailing market prices were applied to conduct economic indicators.

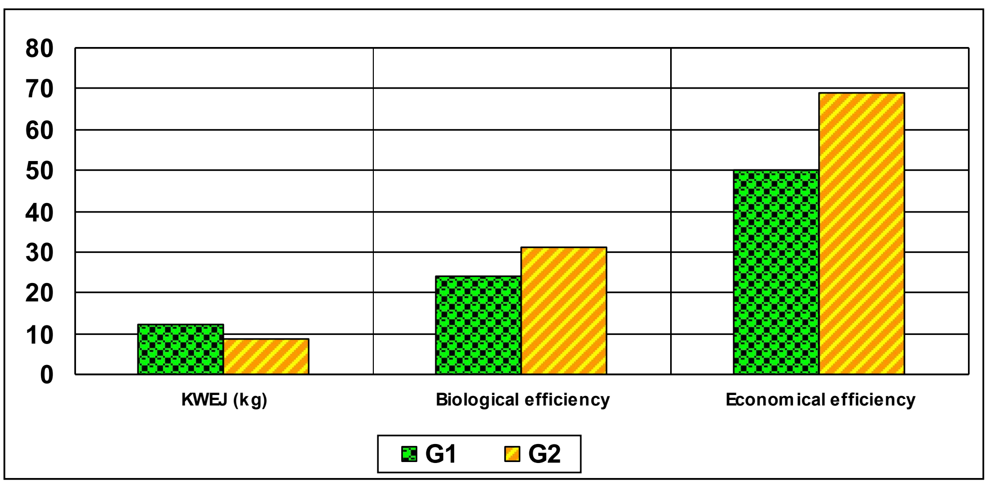

Figure 1. Biological and economical estimates of the two studied groups.

Conclusion

In conclusion, salt tolerant plants could play an important role in providing sheep with appropriate feedstuffs since the attained results demonstrated that silage composed of halophytic plants could be offered safely and without severe harmful to Barki sheep as an alternative feed resources in marginal areas in South Sinai. Nevertheless, more investigations are required to enhance its nutritive value in order to minimize the incidence of potentially harmful reproductive disorders.

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