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*Full Length Research Paper*

# Factors affecting the milk yield and composition of Rahmani and Chios sheep

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**Milk production and milk constituents were studied in 74 ewes of two purebred groups, Rahmani and Chios at the Experimental Animal Farm, Faculty of Agriculture, Al-Azhar University, Assiut, Egypt. Milk yield was recorded at weekly interval starting from the second week of lambing till the 15th week using lamb-suckling technique plus hand milking. Milk samples were collected for chemical analysis during early lactation (1st month), mid lactation (2th month), and late lactation (3nd month) and pooled into one sample per ewe. Breed of ewe had an effect (P<0.01) on total and average daily milk yield and length of lactation. Chios ewes had the highest lactation (87.99 kg in 101.3 day) than Rahmani ewes (53.15 kg in 92.62 day). Ewes rearing twins produced more milk than those suckling singles and the differences were significant (P<0.01). Lambing season had a significant (P<0.01) effect on average daily milk yield (P<0.05) on total milk yield and lactation length. The effect of age of ewe within breed was non-significant on average daily milk yield, total milk yield and lactation length, although ewes aged 4 to 5 years showed relatively higher milk yields than younger or older ewes. Rahmani and Chios ewes reached a maximum yield at the 5th week of lactation. Milk fat, solids not fat (SNF) and milk energy were significantly (P<0.01) influenced by breed of ewes, while total solids (TS), protein, ash and acidity not influenced by breed. Ewes lambed in February to March had significantly higher (P<0.01) TS, pH and (P<0.05) SNF and significantly lower protein than ewes lambed in October to November season. Age of ewe had a significant effect on fat percentage followed by milk energy, while no significant differences in percentages of TS, SNF, protein, acidity, pH and ash were observed. It is concluded that Chios ewes in Egypt have an important potential for milk production and possibility of improving milk production of the Rahmani ewes through selection program or crossing with Chios sheep.**

**Key words:** Milk production, milk composition, Rahmani sheep, Chios sheep.

## INTRODUCTION

Estimates of the amount of milk produced by lactating ewes provide information for the implementation of optimum management and feeding strategies for ewe and their lambs (Cardellino and Benson, 2002). Lamb survival and subsequent body weight gains until weaning reflect milk production ability of ewes (Torres and Hohenboken, 1979; Snowder and Glimp, 1991). In Egypt, several authors have reported that breed had significant effect on milk yield (Aboul-Naga et al., 1981; Mousa, 1991; Morsy, 2002; Hamdon, 1996, 2005). Season of lambing seems to have a relatively great influence on

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milk production. The effects of lambing season on milk yield have been attributed mainly to qualitative and quantitative differences in the available feeds as well as to climate factors.

In non-dairy ewes, the number of suckling lambs has a greater effect on milk yield than level of nutrition during pregnancy or lactation (Treacher, 1978). Most studies showed 30 to 50% increase in milk production of twin-suckling ewes over milk production of single suckling ewes. A further slight increase was observed in ewes suckling triplets (Treacher, 1983; Snowder and Glimp, 1991). It is generally accepted that milk yield increases with age and parity up to a maximum at third to sixth lactation, and declines thereafter (Treacher, 1978). The peak lactation yield is at least 25% greater than the yield of early lactation (Gatenby, 1986). Milk composition of ewes varies over a wide range because of differences between breeds. Furthermore, the contents and levels of major and minor components in milk are affected by the stage of lactation, daily variation, season, parity, type of birth, type of diet, physiological status and health of udder.

The objective of the study was to investigate the factors affecting the milk yield and composition of Rahmani and Chios sheep.

## MATERIALS AND METHODS

The present study was carried out at the Experimental Animal Farm, Faculty of Agriculture, Al-Azhar University, Assiut Branch, Assiut, Egypt.

### Animals and management

Animals were housed under semi-open sheds. Ewes were mated for the first time at age of one year and rams at two years. All ewes grazed Egyptian clover (Berseem) during winter and crop residues available besides the green maize (Darawa) during summer plus concentrate mixture at the rate of 0.5 kg/head/day which was gradually increased to 0.750 kg/head/day during late pregnancy and lactation periods. Concentrate mixture contains 140 g crud protein/kg ration. The concentrate pelleted diet contained 68% ground corn, 15% wheat bran, 15% decorticated cotton seed meal, 1.5% limestone and 0.5% salt. Fresh water and mineralized salt blocks were freely available all time. Milk yield was recorded at weekly interval starting from the second week of lambing till the 15th week using lamb-suckling technique (Mousa and Shetawi, 1994) plus hand milking. Lambs were separated from their mothers at 8.0 p.m on the day before measuring milk production. In the following day, lambs were weighted at 8 a.m., and left to suckle their dams till satisfaction, then reweighed and kept away from their mothers, while the residual milk in the udder of each ram were hand milked and weighted.

At 4 p.m., the lambs were weighted again before and after suckling and the residual milk in udder were also hand-milked and weighted. The amount of milk consumed by each lamb in the morning and afternoon was calculated by the difference between weight recorded before and after suckling. A ewe's hand-milked yield (in the morning and afternoon), the daily milk intake by her suckling afternoon was calculated by the difference between weight recorded before and after suckling. A ewe's hand-milked yield (in the morning and afternoon), the daily milk intake by her suckling lambs was added to give an estimate of her 24-h milk production. The 24-h milk production per each ewe was multiplied by 7 to give the estimate of weekly milk production. This was carried out each week from parturition to weaning. After weaning all individual yield dropped below 100 g/day, when milking was terminated.

Milk samples were collected for chemical analysis during early lactation (1st month), mid lactation (2nd month), and late lactation (3nd month) and pooled into one sample per ewe. Acidity and pH were measured. Percentages of fat, ash and protein were determined (Ling, 1956), total solids (B.S.L, 1951), Milk energy values were calculated from the chemical composition using the following equation, according to Economides (1986):

Calorific value (Mj/kg) = 1.94 + 0.43 x.

Where: x = fat %.

### Statistical analysis

Data were statistically analyzed using the GLM procedure of the SAS package, 8.1 version (SAS, 1998). Analysis was performed according to the following linear model:

$$Y_{ijklm} = \mu + B_i + T_j + BS_k + A_l + e_{ijklm}.$$

Where:

$Y_{ijklm}$ = the trait of study, $B_i$ = fixed effect of the $j^{th}$ ewe breed (j = Rahmani and Chios ewes), $T_j$= fixed effect of the $j^{th}$ lamb birth type (j= single and twin), $BS_k$= fixed effect of the $k^{th}$ birth season (k = February to March and October to November), $A_l$ = fixed effect of the $l^{th}$ age of ewes (l = 1, 2, 3, 4 and 5) where, 1 = 2years old or less, 2 = ≤ 3years old, 3 = ≤ 4years old, 4 = ≤ 5years old, and 5 = > 5years old., $e_{ijklm}$= effect of the $m^{th}$ random error.

## RESULTS AND DISCUSSION

### Milk yield and lactation length

Results in Table (1) indicated that average daily milk yield (ADMY), total milk yield (TMY) and lactation length (LL). Chios ewes had greater (P<0.01) average daily milk yield, total milk yield and lactation length than Rahmani ewes. Hamdon (2005) reported that breed differences in total milk yield and lactation length were highly significant (P<0.01). Rahmani and Chios ewes reached to a maximum yield at five week of lactation (5.6 kg/week for Rahmani and 9.1 kg/week for Chios). (Table 1 and Figure 1). After attaining the peak, milk yield decreased gradually till the end of the lactation period. The same trend was reported by Morsy (2002) who showed that daily milk yield reached the peak in the $5^{th}$ week of lactation in Chios ewes, while, in Ossimi and crossbred ewes milk yield reached the peak in 3rd week of lactation

**Table 1.** Least square means ± standard errors of some factors affecting milk yield (kg) and lactation length (day) in Rahmani and Chios ewes.

| Items | N | LSM±SE | | |
|---|---|---|---|---|
| | | ADMY/g | TMY/kg | LL /day |
| Overall mean | 74 | 715.2 ± 85.04 | 70.57 ± 9.651 | 96.96 ± 6.014 |
| **Breed of ewes** | | ** | ** | ** |
| Rahmani | 49 | 561.6 ± 18.2 | 53.15 ± 2.07 | 92.62 ± 1.29 |
| Chios | 25 | 868.8 ± 19.7 | 87.99 ± 2.24 | 101.3 ± 1.39 |
| **Birth type** | | ** | ** | ** |
| Single | 62 | 654.3 ± 12.8 | 62.34 ± 1.45 | 93.69 ± 0.90 |
| Twins | 12 | 776.1 ± 25.8 | 78.79 ± 2.93 | 100.2 ± 1.83 |
| **Lambing Season** | | ** | * | * |
| February to March | 44 | 746.6 ± 16.3 | 72.74 ± 1.85 | 95.54 ± 1.15 |
| October to November | 30 | 683.8 ± 18.5 | 68.40 ± 2.10 | 98.34 ± 1.31 |
| **Ewe age** | | Ns | Ns | Ns |
| 2years or less | 14 | 708.1 ± 25.3 $^{ab}$ | 70.30 ± 2.87 $^{ab}$ | 96.92 ± 1.79 $^{ab}$ |
| ≤3years old | 17 | 705.9 ± 25.1 $^{ab}$ | 70.74 ± 2.85 $^{ab}$ | 98.58 ± 1.78 $^{ab}$ |
| ≤4years old | 14 | 701.0 ± 23.9 $^{b}$ | 70.85 ± 2.71 $^{ab}$ | 100.0 ± 1.69 $^{a}$ |
| ≤5years old | 14 | 754.1 ± 24.6 $^{a}$ | 72.92 ± 2.79 $^{a}$ | 95.47 ± 1.74 $^{ab}$ |
| >5years old | 15 | 707.0 ± 26.5 $^{ab}$ | 68.02 ± 3.01 $^{b}$ | 93.71 ± 1.87 $^{b}$ |

*= (P < 0.05), ** = (P < 0.01). , NS = (P > 0.05). $^{a, b}$: Means within the same classification followed by different letters significantly ( P < 0.05 ). ADMY= average daily milk yield (g); TMY = total milk yield (kg); LL = lactation length, day.

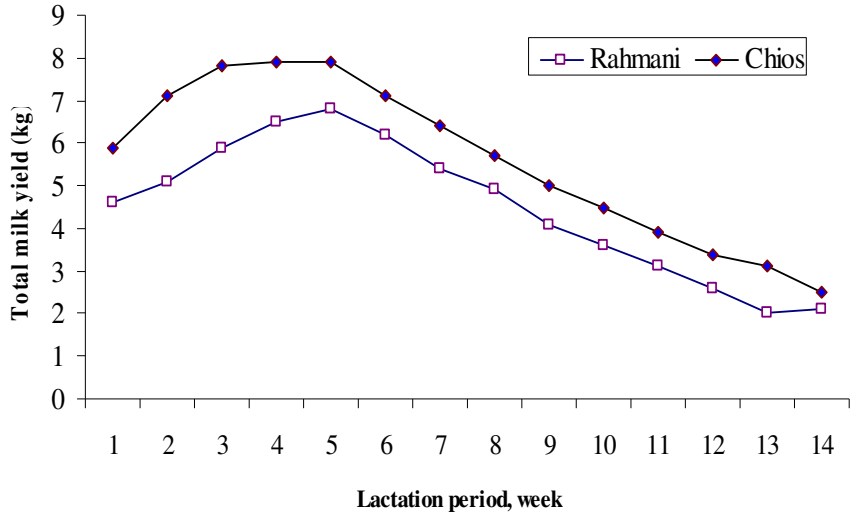


**Figure 1.** Lactation curve of Rahamni and Chios ewes.

and decline thereafter. Mousa (1991) and Hassan (1995) reported that after the peak, lactation declines more or less rapidly depending on the breed. Maharem (1996), Hamdon (2005) and Mousa et al. (1997) found that peak of milk yield was attained at the second week of lactation.

**Table 2.** Least square means and standard error of some factors affecting milk yield at different weeks of lactation in Rahmani and Chios sheep.

| Sources of variation | LSMEANS (±SE) for milk yield (kg) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1st week | 2nd week | 3rd week | 4th week | 5th week | 6th week | 7th week | 8th week | 9th week | 10th week | 11th week | 12th week | 13th week | 14th week |
| Overall mean | 5.25± 1.02 | 6.1± 1.0 | 6.9± 1.12 | 7.2± 1.13 | 7.4± 1.16 | 6.6± 1.03 | 5.9± 1.12 | 5.3± 0.92 | 4.5± 0.81 | 4.1± 0.74 | 3.6± 0.75 | 3.0± 0.66 | 2.6± 0.63 | 2.3± 0.66 |
| **Ewe breed** | ** | ** | ** | ** | ** | ** | ** | ** | ** | ** | ** | ** | ** | * |
| Rahmani | 4.4± 0.22 | 5.3± 0.24 | 5.5± 0.24 | 5.6± 0.24 | 5.6± 0.25 | 5.0± 0.22 | 4.5± 0.22 | 3.9± 0.19 | 3.4± 0.17 | 2.9± 0.16 | 2.5± 0.16 | 2.1± 0.14 | 1.9± 0.16 | 1.9± 0.28 |
| Chios | 6.1± 0.24 | 6.9± 0.26 | 8.2± 0.26 | 8.8± 0.26 | 9.1± 0.27 | 8.2± 0.24 | 7.3± 0.24 | 6.7± 0.21 | 5.6± 0.19 | 5.2± 0.17 | 4.6± 0.17 | 3.9± 0.15 | 3.2± 0.15 | 2.7± 0.16 |
| **Birth type** | ** | ** | ** | ** | * | * | ** | * | ** | ** | ** | ** | ** | NS |
| Single | 4.6± 0.15 | 5.1± 0.15 | 5.9± 0.17 | 6.5± 0.17 | 6.8± 0.17 | 6.2± 0.16 | 5.4± 0.15 | 4.9± 0.14 | 4.1± 0.12 | 3.6± 0.11 | 3.1± 0.11 | 2.6± 0.10 | 2.0± 0.11 | 2.1± 0.29 |
| Twins | 5.9± 0.30 | 7.1± 0.30 | 7.8± 0.34 | 7.9± 0.34 | 7.9± 0.35 | 7.1± 0.31 | 6.4± 0.31 | 5.7± 0.28 | 5.0± 0.25 | 4.5± 0.23 | 3.9± 0.23 | 3.4± 0.20 | 3.1± 0.21 | 2.5± 0.16 |
| **Season** | NS | * | NS | NS | ** | * | * | * | * | NS | NS | NS | NS | NS |
| February to March | 5.3± 0.19 | 6.3± 0.19 | 6.8± 0.22 | 7.3± 0.22 | 6.8± 0.22 | 6.9± 0.22 | 6.2± 0.19 | 5.4± 0.17 | 4.7± 0.16 | 4.2± 0.14 | 3.6± 0.14 | 3.1± 0.13 | 2.6± 0.14 | 2.3± 0.22 |
| October to November | 5.2± 0.22 | 5.9± 0.22 | 6.9± 0.25 | 7.0± 0.25 | 5.9± 0.25 | 6.3± 0.25 | 5.6± 0.22 | 5.1± 0.20 | 4.3± 0.18 | 3.9± 0.16 | 3.4± 0.16 | 2.9± 0.15 | 2.5± 0.16 | 2.3± 0.25 |
| **Ewe age** | NS | NS | NS | NS | NS | NS | NS | NS | NS | NS | NS | NS | NS | NS |
| 2years or less | 5.1± 0.30$^{a}$ | 6.1± 0.29$^{a}$ | 7.1± 0.33$^{a}$ | 7.2± 0.33$^{a}$ | 7.3± 0.34$^{a}$ | 6.4± 0.30$^{b}$ | 5.9± 0.30$^{bc}$ | 5.1± 0.27$^{b}$ | 4.3± 0.24$^{b}$ | 3.9± 0.22$^{b}$ | 3.4± 0.22$^{b}$ | 3.0± 0.20$^{b}$ | 2.9± 0.23$^{a}$ | 2.8± 0.31 |
| ≤3years old | 5.4± 0.30$^{a}$ | 6.2± 0.29$^{a}$ | 6.5± 0.33$^{a}$ | 6.8± 0.33$^{a}$ | 7.1± 0.34$^{a}$ | 6.3± 0.30$^{ab}$ | 5.9± 0.30$^{ab}$ | 5.4± 0.27$^{a}$ | 4.7± 0.24$^{a}$ | 4.3± 0.22$^{a}$ | 3.7± 0.22$^{a}$ | 3.1± 0.18$^{ab}$ | 2.8± 0.21$^{a}$ | 2.4± 0.26 |
| ≤4years old | 5.1± 0.29$^{a}$ | 6.0± 0.28$^{a}$ | 6.7± 0.32$^{a}$ | 7.0± 0.32$^{a}$ | 7.1± 0.33$^{a}$ | 6.6± 0.30$^{a}$ | 6.0± 0.28$^{a}$ | 5.3± 0.26$^{a}$ | 4.7± 0.23$^{a}$ | 4.1± 0.21$^{a}$ | 3.6± 0.21$^{a}$ | 3.2± 0.19$^{a}$ | 2.7± 0.18$^{a}$ | 2.3± 0.24 |
| ≤5years old | 5.8± 0.29$^{a}$ | 6.2± 0.29$^{a}$ | 7.2± 0.32$^{a}$ | 7.8± 0.33$^{a}$ | 8.0± 0.33$^{a}$ | 6.9± 0.30$^{bc}$ | 6.0± 0.29$^{c}$ | 5.4± 0.26$^{b}$ | 4.5± 0.23$^{b}$ | 4.1± 0.21$^{b}$ | 3.5± 0.21$^{b}$ | 3.0± 0.20$^{b}$ | 2.5± 0.23$^{b}$ | 2.0± 0.39 |
| >5years old | 4.9± 0.32$^{b}$ | 5.9± 0.31$^{b}$ | 6.7± 0.35$^{b}$ | 7.0± 0.35$^{b}$ | 7.4± 0.36$^{b}$ | 6.8± 0.32$^{c}$ | 5.8± 0.31$^{d}$ | 5.2± 0.28$^{c}$ | 4.4± 0.25$^{c}$ | 3.8± 0.23$^{c}$ | 3.4± 0.23$^{c}$ | 2.6± 0.21$^{c}$ | 2.0± 0.26$^{c}$ | 1.9± 0.25 |

* Significant (P<0.05), ** Significant (P<0.01); Ns = not significant. a, b means in the same column within classification with different subscript for each factor differ (P<0.05).

## Lambing season

Lambing season had a significant effect on average daily milk yield (P<0.01), total milk yield and lactation length (P<0.05). Ewes lambed in February to March season produced more milk than those lambed in October to November season (72.74 *vs.* 68.40 kg). On the other hand, ewes lambed in October to November season showed longer lactation length than those lambed in February to March season (98.34 vs. 95.54 day). This result may be due to the differences in nutrition and management systems between the two seasons. The increase in milk yield of ewes lambed in February to March season compared to those lambed in October to November was unexpected. This result may be due to the ewes fed on concentrate and green fodder plants (Egyptian clover) during late pregnancy period and the whole lactation period in February to March season and good ventilation in housing in the farm and the moderate climate in this time of the year. These results are in good agreement with those reported by Hamdon (2005) who found that Chios and Farafra ewes lambed at the spring season had greater milk yield (69.5 kg) compared to ewes lambed at the summer season (61.15 kg) and autumn season (58.45 kg). Morsy (2002) reported that season of lambing had a highly significant effect on both total milk yield and lactation length. These results indicated that milk yield of the February to March season declined steadily after the peak of lactation (at the 4th and 5th weeks), while October to November season declined sharply after its peak (Table 1).

## Birth type (number of lambs suckled)

Least square means and standard error of average daily milk, total milk yield and lactation length in Rahmani and Chios ewes rearing single or twin lambs are shown in Tables 1 and 2. Birth

type affected (P<0.01) average daily milk yield, total milk yield and lactation length. Average daily milk was greater (P<0.01) in ewes rearing twin lambs (776.1 g/day) compared with ewes rearing singles (654.3 g/day). Total milk yield was greater (P<0.01) in ewes rearing twin lambs (78.79 kg) compared with ewes rearing singles (62.34 kg). The increase in average daily milk yield and total milk yield due to rearing twins versus singles were 18.1 and 25.6%, respectively. These results attributed to the ability of twin lambs to empty the udder of their dams completely especially of the early lactation period (Muro, 1965). More frequent sucklings were observed by twins compared to single lambs.

Similar results were reported by Hassan (1984) who found that the differences due to type of birth were highly significant. However, Hassan (1995) indicated that ewes rearing twins produced more milk (74.8 kg) than those reared single lambs (71.2 kg), during 138 and 136 days, respectively. Similar results were obtained by Mousa et al. (1997) and Hamdon (2005).

**Ewe age**

The effect of age of dam on average daily milk, total milk yield and lactation length was not significant (Table 1). However, ewes aged (≤ 4 to ≤5 years) give relatively higher milk yield (72.92 kg) than younger or older ones. Ewes aged (>5 years old) gave the lowest milk yield (68.02 kg), followed by the first group aged (2 year old or less). These results are in general agreement with Mousa (1991) who reported that there were no detectable effects of age of dam on either suckled or total milk production.

Furthermore, Mousa et al. (1997), Morsy (2002) and Hamdon (2005) reported that age of ewe had no significant effect on milk yield.

**Milk composition**

The percentages of fat, SNF and milk energy (Mj/kg ) were 5.62%, 11.9% and 4.36, (Mj/kg) respectively for Rahmani ewes, while those of Chios ewes were 4.73%, 13.3% and 3.97 (Mj/kg), respectively. Also, Peeters et al. (1992) and Hassan (1995) found that differences among genotypes in fat% were not significant. Ploumi et al. (1998) found that SNF% ranged between 6.81 to 13.9% for Chios milk. In contrast, Hassan (1995) showed that SNF% was 12.12 and 12.34% for Ossimi and Saidi milk, respectively, but the breed difference was not significant. Protein percentage, total solids, acidity, pH and ash were not significantly affected by breed. This results agree with those of Maharem (1996) working on Awassi and Barki ewes. He showed that genotype differences were non-significant. Also, Morsy (2002) found that ewe breed had no significant effect on protein percentage for Chios, Ossimi and their crosses. The higher milk energy of Rahmani ewes may be attributed to higher fat%.

The same results were reported by Morsy (2002) on Chios and Ossimi ewes and Hamdon (2005) on Chios and Farafra ewes (Table 3).

**Lambing season**

Milk fat percentage in ewes lambed in February to March months were slightly higher than that of ewes lambed in October to November months. The same trends were found with acidity and milk energy. The results of the present study indicated that February to March lambing ewes had significantly higher (P<0.01) TS, pH and (P<0.05) SNF than ewes lambed in October to November season. In contrast, ewes lambed in October to November season had highly significant (P<0.05) protein percentage compared to ewes lambed in February to March season. These results may be attributed to the availability of fresh Egyptian clover and metabolic as well as endocrine changes related to the climate and the negative correlation between milk yield and fat percentage. Similarly, Morsy (2002) reported that the ewes lambed in winter season had the highest values of fat%, protein% and milk energy compared with ewes lambing in summer season.

Hamdon (2005) found that autumn lambing ewes (October) had higher fat, TS, SNF, ash% and value of milk energy (MJ/kg) than summer and spring lambing seasons.

**Ewe age**

The chemical components of milk were not significantly affected by ewe's age, except fat% and milk energy. Fat percentage was lower (P<0.05) in older ewes compared with that of younger ewes. These results may be attributed to negative association between milk production and fat percentage, where ewes at this age produced higher milk than other groups. The same trend was observed with milk energy, where milk energy was low (P<0.05) in ewes aged (≤5years old) compared with younger ewes. On the other hand, no significant differences were observed of ewe age on percentages of TS, SNF, protein, acidity, PH and ash. Lateif et al. (1989) found that age of ewe had a significant effect on the percentages of protein milk, where it was the highest at the age of 3 to 4 years. Hassan (1995) reported that age of ewe had no significant effect on fat, TS and SNF percentages.

**Table** 3. Least-square means ± standard errors of some factors affecting milk composition from Rahmani and Chios ewes.

| Items | N | LSM ± SE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Fat% | TS% | SNF% | Protein% | Ash% | Milk energy (Mj/kg) | Acidity% | PH |
| Overall mean | 51 | 5.18± 0.60 | 17.75± 0.94 | 12.6 ± 1.1 | 5.15± 0.69 | 0.77± 0.07 | 4.17± 0.26 | 18.35± 0.012 | 6.37± 0.26 |
| **Breed** | | ** | Ns | ** | Ns | NS | ** | Ns | Ns |
| Rahmani | 30 | 5.62 ± 0.13 | 17.5 ± 0.20 | 11.9 ± 0.23 | 5.1 ± 0.15 | 0.74 ± 0.015 | 4.36 ± 0.05 | 18.2 ± 0.25 | 6.35 ± 0.06 |
| Chios | 21 | 4.73 ± 0.16 | 18.0 ± 0.25 | 13.3 ± 0.29 | 5.2 ± 0.19 | 0.79 ± 0.020 | 3.97 ± 0.07 | 18.5 ± 0.33 | 6.38 ± 0.07 |
| **Lambing season** | | Ns | ** | * | * | ** | Ns | Ns | ** |
| February to March | 26 | 5.23 ± 0.12 | 18.2 ± 0.19 | 13.0 ± 0.22 | 4.9 ± 0.14 | 0.74 ± 0.015 | 4.19 ± 0.05 | 18.6 ± 0.25 | 6.57 ± 0.05 |
| October to November | 25 | 5.11 ± 0.13 | 17.3 ± 0.19 | 12.2 ± 0.22 | 5.4 ± 0.14 | 0.79 ± 0.015 | 4.14 ± 0.05 | 18.1 ± 0.25 | 6.16 ± 0.05 |
| **Ewe age** | | * | Ns | Ns | Ns | NS | * | Ns | Ns |
| 2years or less | 7 | 5.10 ± 0.23$^{ab}$ | 17.8 ± 0.36 | 12.7 ± 0.41 | 4.9 ± 0.27 | 0.75 ± 0.028 | 4.13 ± 0.09$^{ab}$ | 17.7 ± 0.46 | 6.39 ± 0.10 |
| ≤3years old | 11 | 5.62 ± 0.20$^{ab}$ | 17.7 ± 0.31 | 12.2 ± 0.36 | 5.0 ± 0.23 | 0.76 ± 0.024 | 4.36 ± 0.09$^{ab}$ | 17.9 ± 0.40 | 6.31 ± 0.09 |
| ≤4years old | 12 | 5.21 ± 0.18$^{b}$ | 17.3 ± 0.28 | 12.3 ± 0.32 | 5.3 ± 0.21 | 0.79 ± 0.022 | 4.18 ± 0.08$^{b}$ | 18.2 ± 0.36 | 6.46 ± 0.08 |
| ≤5years old | 10 | 4.71 ± 0.21$^{b}$ | 17.9 ± 0.33 | 13.1 ± 0.39 | 5.3 ± 0.25 | 0.75 ± 0.026 | 3.97 ± 0.09$^{b}$ | 18.8 ± 0.43 | 6.30 ± 0.09 |
| >5years old | 11 | 5.22 ± 0.22$^{a}$ | 18.0 ± 0.34 | 12.7 ± 0.39 | 5.1 ± 0.25 | 0.77 ± 0.027 | 4.19 ± 0.09$^{a}$ | 19.1 ± 0.44 | 6.35 ± 0.09 |

a, b means in the same column within classification with different subscript for each factor differ (P<0.05). R= Rahmani ewes, C= Chios ewes.

## Conclusion

Milk yield of Chios ewes was higher than Rahmani ones and average daily milk yield were 868.8 and 561.6 g/day of Chios and Rahmani ewes, respectively. The moderate estimates in this study indicate the possibility of improving milk production of the Rahmani ewes through selection program or crossing with Chios sheep. Also, the Chios breed has potential to serve as a useful resource in increasing efficiency of sheep production in Upper Egypt and may have particular utility in low-input farming systems.

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