Milk yield measured by oxytocin plus hand milking and weigh-suckle-weigh methods in ewes originating from local crossbred in Turkey

N. ÜNAL,* F. ATASOY1, H. AKÇAPINAR1, S. KOÇAK2, A. YAKAN2, H. EROL3 and M. UĞURLU2

SUMMARY

Milk yield of ewes crossbred between Kivircik and Akkaraman (KAB1) and crossbred between Chios and Akkaraman breeds (CAB1) was evaluated during the whole lactation period. Two methods were compared: the weigh-suckle-weigh (WSW) and oxytocin plus hand milking (O plus HM) methods and the correlations between milk yield and growth of lambs were estimated. A total of 44 ewes and 52 lambs (36 single, 16 twins) were used. Measurements of milk yield for 6 hours were determined at 14-day intervals using the two methods (WSW and O plus HM). Overall mean milk yield estimates determined using O plus HM were significantly higher than those evaluated from the WSW method. CAB1 ewes produced significantly more milk than the KAB1 ewes. The milk yield differences between ewes suckling single and twin lambs were highly significant. The results also indicated that lamb live weight and milk production are highly correlated during early and middle lactation and these correlation coefficients decline as lactation progresses.

Keywords : Milk yield, ewes, growth, genotype.

RÉSUMÉ

Production laitière et croissance de l’agneau.

La production laitière de brebis issues de croisements entre les races Kivircik et Akkaraman (KAB1) d’une part, et entre les races Chios et Akkaraman (CAB1), d’autre part, a été évaluée au cours de la période de lactation. Deux méthodes ont été comparées : la méthode basée sur la pesée suivie de l’allaitement et de la pesée successive de l’agneau et la méthode qui associe l’administration d’ocytocine à la traite manuelle. Les coefficients de corrélation entre la production laitière et la croissance des agneaux ont été estimés. Un total de 44 brebis et 52 agneaux (36 issus d’une portée simple et 16 issus d’une portée double). La production laitière a été évaluée pendant 6 heures à des intervalles de 14 jours à l’aide des 2 méthodes. La production laitière moyenne globale déterminée à l’aide de la méthode associant l’administration d’ocytocine à la traite manuelle a été significativement plus élevée que celle obtenue à partir de la méthode basée sur la pesée suivie de l’allaitement et de la pesée successive de l’agneau. Les brebis CAB1 ont produit plus de lait que les brebis KAB1. La production laitière a été influencée par le nombre d’agneaux allaités. Ces résultats montrent que les valeurs de production laitière estimées par la méthode associant l’administration d’ocytocine à la traite manuelle sont supérieures à celles basées sur la pesée suivie de l’allaitement et de la pesée successive de l’agneau et que la production laitière des brebis CAB1 est supérieure à celle des brebis KAB1. Ces résultats indiquent également que le poids de l’agneau et la production laitière sont fortement corrélés au début et au milieu de la lactation et que cette corrélation diminue en fin de gestation.

Mots-clés : Production laitière, brebis, croissance, génotype.

Introduction

Sheep milk is a widely used livestock product in the Mediterranean and the Balkan regions for making dairy products, while it is generally used for human consumption as fresh milk in Asia [1]. According to the FAO [3], total sheep milk production of the world was 8 574 126 tons in 2005, the principal producers being China with 13.1 %, Italy with 9.6 %, Turkey with 8.8 %, Greece with 8.2 % and Spain with 4.7 %.

Turkey has a number of sheep breeds which are generally multipurpose breeds with low production levels. However, the Chios and Kivircik breeds are noted for having higher production levels than others. Chios is well known for its high milk yield, early sexual maturity and outstanding prolificacy, while Kivircik is noted for its fattening performance and meat quality. Akkaraman breed (White Karaman), fat tailed, is distributed throughout Central Anatolia which is the largest region of Turkey [1]. The Chios and Kivircik breeds have been used as improvers for obtaining new prolific types for lamb and milk production. For this purpose, Chios and Kivircik breeds were crossed with some local breeds [12, 13].

It is very important that an ewe from dam line used for commercial breeding has adequate milk production for its lamb(s). Therefore, crossbred ewes for commercial breeding should be evaluated in terms of meat and milk production. Lamb survival and subsequent body weight gains until weaning age reflect the milk production ability of ewes. The relationship between lamb growth rate and milk production is strongest from birth to 6-8 week postpartum [11].
Several methods of estimating ewe milk production such as weigh-suckle-weigh, hand milking, hand milking after oxytocin injection and machine milking have been reported [4, 5, 6, 7]. Hence testing of different methods to estimate milk production has an importance in order to reach a scientifically significant evaluation of lactating ewes and determining the best method.

The objectives of this work were to study milk yield ability of Kivircik x Akkaraman B1 (KAB1) and Chios x Akkaraman B1 (CAB1) ewes during the entire lactation period; and to compare the weigh-suckle-weigh (WSW) and oxytocin + hand milking (O+HM) methods for measuring ewe milk yield; and to determine correlations between the milk yield and lamb growth.

### Materials and Methods

#### ANIMALS AND MANAGEMENTS

The study was conducted at the Lalahan Livestock Research Institute in Ankara, Turkey, where a steppe climate prevails. The geographical coordinates for the area are 33° N and 40° E.

Animals used in the study consisted of 25 ewes and 29 lambs from KAB1 genotype, and 19 ewes and 23 lambs from CAB1 genotype. After obtaining Kivircik x Akkaraman F1 and Chios x Akkaraman F1 crossbreds, the F1 females were mated with Kivircik and Chios rams to get Kivircik x Akkaraman B1 (KAB1) and Chios x Akkaraman B1 (CAB1) genotypes. The crossbreeding studies to obtain KAB1 and CAB1 ewes were reported in detail [13]. The number of ewes milked and lambs born by genotypes and lactation number subclasses are shown in Table I.

#### DATA COLLECTION

Measurements of milk yield were initiated on the 14th day after the date of the first lambing and continued at 14 day intervals using two methods: weigh-suckle-weigh and oxytocin injection + hand milking. The birth season of lambs lasted two weeks, thus the ewes and the lambs were not on the same lactation and growth time during control days. Therefore, absolute data of lambs and ewes on the days investigated were corrected by using interpolation method. The weight of lambs and amount of milk after milking were measured using an electronic scale (precision: 10 g).

On the first day of the control period, milk yield was determined using the WSW method [5, 7]. The 6-h test period included two suckling sessions. At the beginning of a test period, lambs were separated from their dams and held in a pen which allowed sight and smell contact between the ewes and lambs. The lambs were allowed to suckle after the separation period. Feeder were arranged so that the lambs had no access to the ewe’s feed, but access to lamb grower feed and alfalfa hay after 3 weeks age. Some ewes were physiologically dried off while the others were lactating after 126th day of lactation. The mean lactation duration was approximately 150 days.
ewes/lamb(s) pairs were correctly matched. After the first and second separation, the lambs were weighed prior to suckling and weighed immediately after suckling. The differences between pre- and post-suckling weights were defined as milk consumption and indirectly as 6-hour milk yield. Extracted faeces and urine by lambs during suckling periods were not collected.

On the second control day, the Oxytocin + Hand Milking method was applied to all of ewes. The lambs were separated from their dams and held in a pen which was used the day before. Following a 6-hour separation period, the ewes were intravenously administered (IV) 8 IU oxytocin. After 2 minutes, the ewes were milked out rapidly by hand. The amount of milk obtained was defined as the 6-hour milk yield. All ewes were milked out by same three hand milker and ewes were randomly allocated to hand milker.

STATISTICAL ANALYSIS

Data were analysed using General Linear Mixed Model Procedures of SPSS [2]. The experimental design was convenient to split-split plot with repeated measurements on animals. The model for 6-hour milk yield for different days of lactation included fixed effects: milk yield estimation methods (O+HM, WSW), genotype (KAB1, CAB1), lactation number (1, 2, 3), type of rearing (Single, Twin) and interactions between milk yield estimation methods and the other fixed effects. When the data of overall mean for 6-hour milk yield were analysed, the model mentioned above was added with the fixed effect of the lactation day. Correlation coefficients between 6-hour milk yield and lamb weight were calculated for each genotype [14].

Results

Means of 6-hour milk yield measured using different methods during different lactation days of KAB1 and CAB1 ewes are presented in Table II. Different results were found when milk yield was determined using either WSW and O+HM methods and the differences in milk yield according to the milk yield estimation methods were statistically significant during lactation period (P<0.05-P<0.001). The effect of genotype was significant between 28 to 84 days of lactation (P<0.05), however it had a highly significant effect on the overall mean of lactation (P<0.001). While lactation number had no significant effect on 6-hour milk yield, type of rearing presented a significantly effect on early days of lactation period (P<0.05, P<0.01). Overall mean for 6-hour milk yield was significantly influenced by type of rearing (P<0.001). No two-way interactions between milk yield estimation methods and the other fixed effects were found significant at different lactation days, while interaction between milk yield estimation methods with days of lactation was statistically significant (P<0.05) for overall mean of lactation.

<table>
<thead>
<tr>
<th>Items</th>
<th>Days of Lactation</th>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milk yield estimation methods</td>
<td></td>
<td></td>
</tr>
<tr>
<td>O+HM</td>
<td>±28.4 ±30.4 ±36.3</td>
<td>±25.1 ±20.7 ±14.9</td>
</tr>
<tr>
<td>WSW</td>
<td>±31.2 ±45.1 ±52.6</td>
<td>±27.0 ±25.7 ±14.2</td>
</tr>
<tr>
<td>Genotypes</td>
<td>±26.8 ±27.8 ±25.3</td>
<td>±24.5 ±27.0 ±24.1</td>
</tr>
<tr>
<td>KAB1</td>
<td>±26.3 ±26.5 ±35.8</td>
<td>±25.9 ±20.9 ±20.5</td>
</tr>
<tr>
<td>CAB1</td>
<td>±45.6 ±55.4 ±62.0</td>
<td>±40.5 ±36.3 ±30.1</td>
</tr>
<tr>
<td>Lactation number</td>
<td>±25.6 ±25.3 ±33.8</td>
<td>±25.1 ±20.4 ±19.9</td>
</tr>
<tr>
<td>Type of rearing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Twin</td>
<td>±37.9 ±38.3 ±51.8</td>
<td>±37.3 ±30.2 ±29.6</td>
</tr>
<tr>
<td>TOTAL</td>
<td>±20.3 ±20.9 ±28.2</td>
<td>±20.4 ±16.6 ±16.2</td>
</tr>
</tbody>
</table>

Table 2. Means (±SE) of 6-hour milk yield according to fixed effects (g). O+HM: Oxytocin + Hand Milking, WSW: Weigh-Suckle-Weigh KAB1: Kırkırık x Akkaraman First Backcrossed, CAB1: Chios x Akkaraman First Backcrossed. Non significant (P>0.05); * P<0.05; ** P<0.01; *** P<0.001.
Lactation curves for 6-h milk yield of KAB₁ and CAB₁ ewes as measured by both O+HM and WSW methods are shown in Figure 1. Lactation curves for ewes having various lactation number and ewes rearing single and twin lambs are also presented in Figure 2 and 3. Milk yield of KAB₁ ewes measured with WSW method peaked around the 4th week of lactation, while the O+HM method was associated to a peak on the 6th week. On the other hand, milk yield of CAB₁ ewes measured using both methods peaked at the 6th week of lactation.

Table III presents the correlations between 6 h milk yield measured by O+HM and by WSW methods and lamb live weights. The correlation coefficients of lamb weight and milk yield of ewes estimated by WSW method on various days were within the wide range of 0.10 to 0.64 for the KAB₁ genotype and 0.04 to 0.57 for the CAB₁ genotype. Corresponding values for O+HM were within the same range of 0.15 to 0.64 and 0.10 to 0.60, respectively.
Discussion

Multiple methods to estimate the ewe milk production are recommended for reliable evaluation of ewes [4, 5, 6]. The weigh-suckle-weigh method is one of the most frequently cited methods for measuring milk production. However this method has limitations for estimating milk production due to its inability to accurately measure small amounts of milk consumed by young lambs, changes in lamb appetite during measurement times and ignoring urine and faecal losses between weighing [5]. The other method for measuring milk production is hand milking after oxytocin injection. It is difficult to measure milk yield of hand milking exactly from ewes that were not accustomed to milking, especially ewes from local sheep breeds. Thus, it is better to measure milk yield by hand milking after oxytocin injection instead of only hand milking. In this study, significantly greater mean values of 6-h milk yield at various lactation days were obtained by O+HM method when compared to the WSW method. During the entire lactation period, WSW estimates for overall mean of lactation represented 48.3% of mean value obtained with the O+HM method (287.8 and 426.7 g) (P<0.001), and ranged from 16.5 and 128.7 % at various lactation days. The present results indicates that oxytocin injection before hand milking contributes a higher estimation than the WSW method. Furthermore, it is possible that ignoring urine and faecal losses during suckling periods has a negative effect on milk yield estimated by the WSW method. Banda et al [4] reported that milk estimates from hand milking in Dorper sheep and crosses with local sheep were lower than those obtained from the weigh-sucke-weigh and oxytocin + hand milking methods. The significant difference in estimates of 6 h milk yield between WSW and O+HM methods throughout lactation were also in agreement with the results of Dooney et al [7] who showed that use of oxytocin + machine milking method gave higher yield estimates than did the WSW method. It was further reported that oxytocin was useful in ensuring complete milk letdown. Similar findings were also reported by Benson et al [5] whom indicated higher estimates for oxytocin + machine milking method than WSW method, although the differences between the methods were not significant. In this study, the two way interaction between milk yield estimation methods and days of lactation was significant (P<0.05) for overall mean of lactation, indicating that milk yield estimates by using WSW and O+HM methods differs at various lactation days. The findings of the present study showed that milk yield measurements were consistently and significantly higher with the O+HM method than with the WSW method throughout lactation.

Milk productions of ewes show large inter-individual variations. Factors such as genotype, nutrition, method of measuring milk yield, age, parity, stage of lactation, milk let down and number of suckling lambs are responsible for variations. Milk production measurements in this study were consistently higher with CAB1 ewes than with KAB1 ewes through lactation period, and there was a highly significant difference for overall mean of lactation between two genotypes (333.4 and 381.2 g) (P<0.001). Pure Chios breed is well-known for its high fertility and milk yield. As a matter of fact, CAB1 ewes had a better performance in terms of 6 h milk yield. Reports of daily milk production in the literature for Chios x Akkaraman F1 ewes and Kiwirick X Akkaraman F1 ewes were found to be 430.6 and 301.9 g [12], with hand milking method without using oxytocin. Corresponding values for KAB1 and CAB1 ewes were 275.2 and 453.8 g [10], respectively. In the
present study, daily milk production for KAB1 and CAB1 ewes were estimated at 1333.6 and 1524.8 g, respectively, in agreement with other researchers [5, 6, 8]. Therefore milk production measurements of KAB1 and CAB1 ewes in this study were substantially higher than values reported previously for those genotypes by using hand milking method without using oxytocin. These values are similar to daily milk production estimates reported for Chios ewes reared under intensive management conditions (2.0-2.5 kg) [9] and Awassi ewes reared in state farm conditions (1.51 kg) [9], but are greater than values of 250 to 500 g estimated in other studies for Turkish local breeds [1, 9, 12] while all ewes used in this study have never been selected for milk production and mothering instinct. Furthermore, it was stated that the ewes which were not accustomed to milking did not show their milk production capacity.

Milk yield in the present study was not different according to lactation number except during the third lactation when ewes yielded more milk than the others. These results confirm that ewes have an increase in milk production from early to intermediate ages.

It is generally accepted and supported in the literature that ewes rearing twin lambs produce more milk than those rearing singles [5, 6, 12]. The ability of twin lambs to completely empty the mammary glands has been cited as a main factor [8]. In this study, ewes rearing twin lambs produced 19.8% more milk than those rearing singles during lactation.

The lactation curve for 6-h milk yield measured by the WSW method in KAB1 ewes peaked two weeks earlier than that of measured by O+HM. However, lactation curve of CAB1 ewes measured by both methods peaked around 6th week of lactation and presented more determined peak point than that of KAB1 ewes. This may be due to the fact that the sheep breeds with high milk yield show a standard lactation curve rather than the breeds with low milk yield [1]. Lactation curves of 6 h milk yield of KAB1 and CAB1 ewes measured by WSW method showed dramatically a drop from peak point to the 56th day. This may be explained by the young lambs started to consume feed and aflaffa hay.

Milk yield of the first lactation ewes measured by the WSW method peaked at the 4th week of lactation while it peaked around at the 6th week by the O+HM method. The second lactation ewes had a lactation peak at approximately 6 week of lactation, while the third lactation ewes peaked two weeks earlier than those of the second lactation ewes. The lactation curve measured by the O+HM method in the first lactation ewes showed more determined peak point than the others.

Lactation curves for ewes rearing single and twin lambs determined by O+HM method showed a peak at 6 week of lactation; however ewes rearing single lambs peaked two week earlier than those of ewes rearing twin lambs in the WSW method. Ewes rearing twin lambs displayed more determined peak point than ewes rearing single.

Milking ability of an ewe is one of the principal factors influencing weights of lambs during pre-weaning period. Lamb live weight and milk production were highly correlated during early and middle lactation and these correlation coefficients declined as lactation progressed. This was expected because lamb weights and maintenance requirements continued to increase while milk production declined. BANDA et al [4] and BENSON et al [5] reported the same trend as found in this study. Correlation coefficients between 6 h milk yield measured by both methods and lamb live weights in KAB1 were generally higher than those of CAB1.

In conclusion, milk yield estimated by method of hand milking after oxytocin injection was higher than method of weight-suckle-weight during entire lactation period. Milk production of CAB1 ewes were higher than KAB1 ewes, and milk production of KAB1 and CAB1 ewes were substantially higher than reported previously for these genotypes by using hand milking without using oxytocin. Lamb live weight and milk yield were highly correlated during early and middle lactation period and these correlation coefficients declined as lactation progressed.

References