Research Journal of Animal Sciences 2 (5): 144-148, 2008
ISSN: 1993-5269

Normal and Residual Milk Yields in Sicilo-Sarde Ewes: Effects of Litter Size and the Weaning Age of Lambs

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Abstract: Seventy five Sicilo-Sarde dairy ewes were divided into 3 equally sized groups homogeneous for litter size, 18 and 7 ewes with single and twin lambs, respectively. A weaning mode was applied for each group: lambs weaned at 45 days of age (GI), lambs gradually weaned between 45 and 90 days of age and fully separated from ewes at 90 days of age (GII) and lambs weaned at 90 days of age (GIII). During the suckling period, milk production was estimated by the hormonal method (5 IU of oxytocin). During the milking period, normal and residual milk were determined by hand milking followed by the injection of 2.5 IU of oxytocin. Milk production during the suckling period was not affected by litter size ($p>0.05$). It was estimated at 64.6, 81.1 and 109.2 kg for ewes with single lambs 59.7, 77.2 and 111.9 kg for ewes with twins in GI, GII and GIII, respectively. Compared to the 90 day weaning, early and progressive weaning have resulted in higher commercialised milk yield from both single (65.7 and 72.6 kg vs. 46.6 kg) and twin (75.2 and 67.6 kg vs. 48.6 kg) suckling ewes. The effect of litter size on collected milk was important ($p<0.05$) only in the case of early weaning. The weaning mode of lambs had also affected ($p<0.01$) the residual milk which was 24.5, 28.5 and 18.2 kg for GI, GII and GIII, respectively. This residual quantity of milk depended ($p<0.05$) on the number of suckled lambs during only the first 6 milking weeks. Milk production of Sicilo-Sarde ewes may be improved by applying early or progressive weaning regimes.

Key words: Sicilo-sarde ewes, weaning mode, litter size, milk yield, oxytocin

INTRODUCTION

Presently, there are approximately 4 million sheep in Tunisia, of which 20,000 are Sicilo-Sarde, the only dairy sheep breed in the country. This sector has experienced a dramatic decrease during the last 15 years, resulting in a 90% reduction in the number of the dairy ewes which indicates that this breed is threatened by disappearance.

Although, the limited mean milk yield (70 kg/ewe/lactation) of the Sicilo-Sarde Ewes (SSE) under traditional management (Khaldi and Farid, 1981; Djemali *et al*., 1995), its milk production is totally used for cheese manufacturing. On the other hand, the suckled milk is relatively important during the first 3 months of lactation. It is up to 102 and 134 kg for single and twin suckling ewes, respectively. The flock management is comparable to that of meat breeds, mainly with respect to the suckling period which lasts more than 3 months (Djemali *et al*., 1995; Mohamed and Khaldi, 2006). The improvement of the SSE' performances necessitates the characterisation of their potential for milk production in addition to applying appropriate management.

The objective of the study is to estimate milk yield and residual milk and to determine the effects of litter size and the weaning age of lambs on these 2 parameters.

MATERIALS AND METHODS

The experiment was conducted in «Béja» in the north-west of Tunisia. This region has a Mediterranean sub-humid climate where the annual average rainfall reaches 600 mm.

Animals: Seventy five, 3-7 years old Sicilo-Sarde ewes were used during the whole experimental period (7 months). They were divided into 3 homogeneous groups for litter size and weaning mode. The first group (GI) included 25 ewes with lambs weaned at 45 days of age. The second group (GII) included 25 ewes with lambs

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having been progressively weaned between 45 and 90 days of age. Lambs were separated from their mothers during the night and ewes were hand-milked in the morning. A full separation of lambs from ewes occurred at 90 days of age. The last group (GIII) included 25 ewes with lambs weaned at 90 days of age. Ewes were maintained on ameliorated natural pastures (predominantly Festuca Ovina and Medicago Sativa) and complemented with vetch-oat hay in addition to 400 g of concentrate/ewe/day during the last 6 weeks of pregnancy and the whole lactation period.

Measures: All ewes were weighed monthly and 24 h after parturition. During the suckling period, milk yield was estimated every week by the hormonal method (McCance, 1959; Ricordeau *et al.*, 1963). This method consists in emptying twice the udder at 2 h intervals (10 and 12 am) following oxytocin injection: the first emptying was obtained by 2 hand milkings where the second one was preceded by a 2.5 IU oxytocin injection. The second emptying was carried out by hand milking following 5 IU oxytocin injection. The quantity of milk collected from the second emptying was multiplied by 12 to obtain milk produced in 24 h.

During the milking period, ewes were milked twice a day. The first, at 8 am consisted in 2 udder emptying where the second one was preceded by a 2.5 IU oxytocin injection. The second milking, carried out at 3 pm, was identical to the morning 1. In both milkings, the first and second emptying represent normal and residual milk, respectively.

Progressive weaning has lasted 45 days. Lambs grazed on pasture with ewes during the day and were isolated at night. During this transition period, suckled, residual and normal quantities of milk were measured. A first emptying at 8 am was obtained by 2 hand milkings where the second one was preceded by a 2.5 IU oxytocin injection. Milk production and residual milk were then collected from the first and second milking, respectively. A second emptying was performed at 10 am by the injection of 5 IU of oxytocin. Milk recorded from this last emptying was multiplied by 3.5 to estimate the quantity of milk suckled by a lamb on a daily basis during the semi-weaning period. The 3.5 coefficient was derived from the average time lambs have stayed with ewes.

Statistical analysis: Data were analysed by GLM in SAS (1989). The statistical model used was as follows:

$$Y_{ijk} = \mu + N_i + S_j + N^*S_{ij} + e_{ijk}$$

Y_{ijk} = Normal milk yield, residual milk yield, suckled milk, or live weight.
μ = An over all mean.
N_i = Effect of the lambing mode i (i = simple or twin)
S_j = Effect of the weaning mode j (j = 45 days weaning, progressive weaning, or 90 days weaning),
N^*S_{ij} = Effect of lambing by weaning mode.
e_{ijk} = A residual effect with $e_{ijk} \sim N(0, \sigma^2_e)$.

Pair wise comparisons of least squares means of factors that were significant by the F test at the 5% level were made by the student t-test (The TDIFF option in GLM in SAS).

RESULTS AND DISCUSSION

Variation of ewes' live weights: The evolution of ewes' live weights during pregnancy and up to 6 months in lactation is given in Fig. 1. The mean of live weight at mating was around 35 kg. There was a decrease in ewes own live weights during pregnancy. This decrease was higher in twin (4.84 kg) than in single mothers (0.62 kg). Weight losses indicate that animals were underfed during the whole gestation and they had to use their corporal reserves in order to satisfy nutritional needs. High requirements of twin-bearing ewes compared to the single-bearing ones were associated with higher weight losses (Table 1). Similar findings were reported in the Barbarine (Khaldi, 1979, 1983, 1984) and the Manchega (Molina *et al.*, 1991) ewes. These authors explained weight losses by insufficient feed resources. On the other hand, there was an increase in ewes' live weights during the milking period (Table 1). The weight gain of ewes

Table 1: Variation of ewes live weights (kg) with the weaning mode and the number of suckled lambs

Item	LWFP-LWB	LWD-LWFP
Single suckling ewes	-0.62±2.44^a	2.10±4.56^a
Twin suckling ewes	-4.84±2.70^b	5.30±3.37^b
Weaning at 45 days	-2.42±2.75^a	2.42±4.11^a
Semi- weaning starting at 45 days	-1.62±2.82^a	2.87±4.18^a
Weaning at 90 days	-1.37±3.48^a	2.44±5.29^a

LWFP: Live Weight Following Parturition, LWB: Live Weight at Breeding, LWD: Live Weight at Drying, Means in the same row for the same factor with different superscripts are different at p = 0.05, ±: standard error of the mean

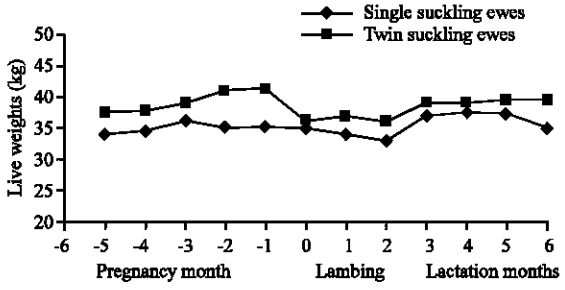

Fig. 1: Evolution of Sicilo-Sarde ewes' live weights

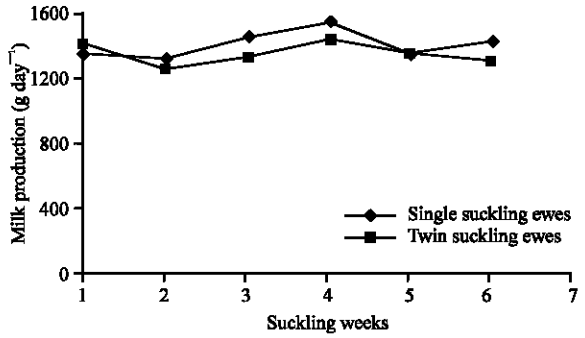

Fig. 2: Evolution of milk production by Sicilo-Sarde ewes during 45 suckling days

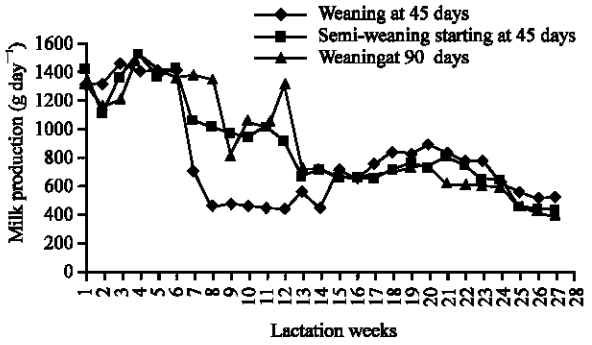

Fig. 3: Lactation curves of Sicilo-Sarde ewes by the weaning mode of lambs

during the milking period may be explained by improved feed supplies from pastures by the beginning of the spring season. Similar results were reported in the Awassi (Stern *et al*., 1978), the Barbarine (Atti and Abdennabi, 1995) breeds.

Milk production during the suckling period: Shapes of lactation curves were comparable for single and twin suckling ewes during the first 6 weeks of the suckling period (Fig. 2). The production pick occurred around the 4th week of lactation for both types of mother. The quantity of milk produced by ewes during the suckling period seemed not to depend on litter size (Table 2). Moreover, irrespective of the number of suckling lambs, suckled milk yield varied ($p<0.001$) with the weaning mode (early weaning at 45 days, semi-weaning, or late weaning at 90 days). The suckled yield was on the average 63.5, 80.1 and 109.9 kg in GI, GII and GIII, respectively.

There was an important decline in milk production at the moment of transition from the suckling to the milking period. This decline was not dependant on the number of suckled lambs. It however, varied with the age of lambs at weaning ($p<0.001$). Milk production loss during the transition from the suckling to milking was up to 65, 37

Table 2: Milk production of sicilo-sarde ewes during the suckling period (kg) by the weaning mode and the number of suckled lambs

	Weaning at 45 days	Semi-weaning starting at 45 days	Weaning at 90 days
Single suckling ewes	64.6±13.9^{a}	81.1±17.0^{b}	109.2±28.2^{c}
Twin suckling ewes	59.7±9.3^{a}	77.2±16.0^{b}	111.9±14.0^{c}
Aggregate	63.5±12.7	80.1±16.7	109.9±24.6

Means in the same row with different superscripts are different at p = 0.001, ±: standard error of the mean

Table 3: Normal milk yield (kg) produced by sicilo-sarde ewes during the milking period by the weaning mode and the number of suckled lambs

	Weaning at 45 days	Semi-weaning starting at 45 days	Weaning at 90 days
Single suckling ewes	65.7±14.7^{a}	72.6±13.7^{b}	46.6±10.1^{c}
Twin suckling ewes	75.2±7.6^{b}	67. 6±13.1^{ab}	48.6±9.9^{c}
Aggregate	68.1±12.6	71.6±15.5	47.2±10.1

Means in the same row with different superscripts are different at p = 0.05, Means in the same line with different superscripts are different at p = 0.001, ±: standard error of the mean

and 52% in GI, GII and GIII, respectively. The decrease of milk production might be explained by the brutal breaking of the mother-kid relationship at weaning. These observations are in agreement with those reported by Ricordeau and Denamur (1962) and Barillet *et al*. (2002).

Maintaining lambs with their mothers during half a day in the case of the progressive weaning did not totally suppress stimulation of ewes. Nevertheless, a moderate decline in milk yield was also observed in GII ewes. Similar trends (a decrease in produced milk) were observed by Ricordeau and Denamur (1962) and Ricordeau *et al*. (1962). Furthermore, Caja (1990) reported that weaning causes sizable reductions in milk production in almost all breeds. These reductions varied from 30-40% in the Lacaune, Préalpes du Sud, Manchega and Awassi breeds (Flamand and Morand-Fehr, 1982; Labussière, 1988). Likewise, Marnet (1997) pointed out that the decline in milk production at weaning (23-35%) might be explained mainly by a reduced emptying frequency (20-25%) and with a lesser degree by mother-kid separation (3-7%). Work done showed that the separation of lambs from ewes causes a suppression of the milk ejecting reflex; which is expressed by a reduction in secretor cells. Two to 3 weeks of milking are necessary to re-establish the milk ejecting reflex. Zamiri *et al*. (2001) mentioned that several hormones, including oxytocin, are secreted under the influence of suckling or milking stimuli. Reduced milk production following the weaning of lambs may be due to decreased secretion of any one of these hormones as a consequence of decreased suckling stimuli. These authors showed that if the oxytocin has a stimulatory effect on mammary metabolism, one might expect its daily. injection after weaning to prevent or at least slow down the trend in the sudden milk drop that is noticed in weaned ewes.

Table 4: Residual milk (kg) in sicilo-sarde ewes during the milking period by the weaning mode and the number of suckled lambs

	Weaning at 45 days	Semi-weaning starting at 45 days	Weaning at 90 days
Single suckling ewes	25.2±4.7^{a}	28.4±6.5^{a}	18.1±4.1^{b}
Twin suckling ewes	22.7±3.9^{ab}	28.9±6.8^{a}	18.5±4.5^{b}
Aggregate	24.5±4.5	28.5±6.5	18.2±4.2

Means in the same row with different superscripts are different at p = 0.001, ±: standard error of the mean

Table 5: Total milk yield (kg) produced by sicilo-sarde ewes by the weaning mode and the number of suckled lambs

	Weaning at 45 days	Semi-weaning starting at 45 days	Weaning at 90 days
Single suckling ewes	156.7±21.9^{a}	183.0±31.6^{b}	174.9±34.0^{ab}
Twin suckling ewes	157.2±19.7^{a}	172.5±26.3^{ab}	178.7±20.1^{ab}
Aggregate	156.3±21.4	180.8±30.6	176.0±30.5

Means in the same row with different superscripts are different at p = 0.05, ±: standard error of the mean

Normal milk yield: During the milking period, the number of born lambs had a significant effect ($p<0.05$) on milk production of their mothers (Table 3) only for the early weaning mode (45 days weaning). A similar finding was reported by Baelden *et al.* (2005). Regardless of the number of suckled lambs, the weaning age (45 days or 90 days) was an important source of variation ($p<0.001$) of the normal milk yield. The quantity of this milk was higher in GI ewes (68.1 kg) than in GIII ewes (47.2 kg). It's evident that the difference in normal milk yield between these 2 ewe groups is caused by a longer milking period (140±7 days) for the early weaning compared to that in the late weaning (98±4 days). Similar results were found in the Awassi and Chios (Lawlor *et al*., 1974) and Sicilo-Sarde breeds.

Residual milk: Least squares means of residual milk yield by the weaning mode and the number of suckled lambs are given in Table 4. Total residual milk did not vary with litter size during the milking period. However, it varied ($p<0.001$) with the age of lambs at weaning during the same milking period. This quantity of milk was higher for early than for late weaning. During the whole milking period, the residual milk represented up to 38% of ewes' total milk production. Retention of milk by all ewes may be explained by a reduced milk ejection reflex following the disappearance of stimulations induced by lambs throughout the suckling period (Lollivier *et al*., 2002).

Total milk yield: Lactation curves of ewes by weaning mode are illustrated in Fig. 3. Total milk production varied with the applied weaning mode ($p<0.05$). Milk produced in the case of the progressive weaning (180.8±30.6 kg) was higher than that in the early (156.3±21.4 kg) or late (176.0±30.5 Kg) weaning. On the other hand, litter size had no effect on total milk production (Table 5). The length of lactation (suckling+milking period) was not affected by the weaning and birth modes of lambs. The average lactation duration was similar among the 3 groups (185 days) of ewes.

CONCLUSION

Results of this study show that the Sicilo-Sarde ewes were underfed during gestation. Single and twin ewes had to use their corporal reserves to cover their nutritional needs which resulted in important reductions of animals' live weights by the end of pregnancy. Litter size seemed not to affect the quantity of milk produced by suckled females. Milk production declined dramatically at the transition from the suckling to the milking period. Progressive weaning starting at 45 days has considerably improved the quantity of commercialised milk yield. The important quantity of residual milk during the milking period may indicate limited production performances of the Sicilo-Sarde breed whose behaviour is comparable to that of a meat breed. The improvement of dairy performances of Sicilo-Sarde ewes requires the improvement of feeding conditions, early weaning of lambs and selection of superior animals on their milking ability.

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