

## Maternal behaviour of Awassi sheep and behaviour of the lambs during the first hour after parturition

Sabri GÜL<sup>1\*</sup>, Özkan GÖRGÜLÜ<sup>2</sup>, Mahmut KESKİN<sup>1</sup>, Zuhâl GÜNDÜZ<sup>1</sup>

<sup>1</sup>Department of Animal Science, Faculty of Agriculture, Mustafa Kemal University, Antakya, Hatay, Turkey

<sup>2</sup>Department of Biostatistics and Health Informatics, Faculty of Medicine, Ahi Evran University, Kırşehir, Turkey

Received: 18.04.2017 • Accepted/Published Online: 21.10.2017 • Final Version: 20.12.2017

**Abstract:** Data from sixty-one 2–5-year-old Awassi ewes (38 single and 23 twin births) were evaluated in order to determine behaviour at parturition and the following first hour. Observations were subjected to Kolmogorov–Smirnov and Shapiro–Wilk tests, Pearson's chi-square test, independent samples t-test, and ANOVA. The Awassi sheep exhibited sniffing action after parturition as the initial behaviour, choosing the back part of the lamb. First licking and sniffing times were found to decrease with maternal age; calculated average data for these characteristics were  $138.3 \pm 15.39$  and  $118.3 \pm 26.48$  s for singlets, and  $147.7 \pm 15.12$  and  $123.6 \pm 29.54$  s for twins, respectively ( $P < 0.05$ ). Total mean licking time was found to be  $27.9 \pm 0.81$  min in single births and  $26.2 \pm 0.90$  min in twin births. The mean first successful standing-up time was determined to be  $23.2 \pm 1.83$  min in single births,  $21.1 \pm 1.63$  min in the firstborn twin, and  $20.2 \pm 2.96$  min in the second-born twin ( $P < 0.05$ ). In the same order, the average suckling time of lambs was specified as  $34.3 \pm 2.27$  min,  $34.3 \pm 2.50$  min, and  $29.2 \pm 3.70$  min ( $P < 0.05$ ), respectively. In conclusion, Awassi ewes showed good maternal behaviour and encouraged their lambs in standing up and suckling.

**Key words:** Awassi sheep, maternal behaviour, lamb behaviour

### 1. Introduction

The first hours after parturition are an important time, since behavioural communication between the mother and her offspring is established within this period (1). Poindron et al. (2) stated that the first hour after parturition is crucial for the establishment of the maternal bond towards her newborn, as food supplementation to the lamb can be obtained through this bond regularly.

The maternal behaviour of the sheep affects survival and growth of the lamb and coordinates development of the mother–offspring relationship, which is essential for production and has importance for the improvement of reproductive efficiency. Many studies have described normal behavioural patterns of ewes and lambs (3,4). Ethologists and animal scientists have conducted many studies on different species over many years (3,5–7), and significant contributions to animal breeding and welfare have been obtained from these studies. Mothers' interest in offspring after parturition is as important as reproductive performance in sheep production. Nowak (8) found that the chances of the lamb's survival and protection against external conditions will be significantly influenced by the successful bond between a mother and her lamb. Ewe behaviour around lambing and just following the time

after parturition has a major impact on lamb survival, such as an effect on weaning weight and thus ewe productivity, particularly in extensive conditions (9,10). Specific behaviours of the ewe (licking and grooming, helping lamb with suckling) promote ewe–lamb recognition and a close relationship between the ewe and the lamb (11,12).

Dwyer et al. (13) stated that maternal behaviour in the ewe at the beginning of birth is formed by a vigorous bond to the amniotic fluids, resulting in licking and grooming and recognition of the lamb. These responses are oriented towards the olfactory attraction between the ewe and lamb. The licking action of the ewe is an important first step in preparing the neonatal lamb for its new environment and life. The licking also makes the lamb clean and dry.

There are behavioural differences between breeds as well as species, and these characteristics should be investigated. Some of the maternal behaviours which play a part in lamb survival are likely to be under genetic control. Variation in the expression of maternal behaviours could be affected by breed, birth number, ability of the mother, and maternal breeding status (14).

Sheep are a fundamental source of income in Turkey, due to being preferred as livestock as well as topographic conditions. The Awassi sheep is an important fat-tailed

\* Correspondence: sabrigul@gmail.com

breed raised in the south-eastern part of Turkey, as well as in Iraq, Syria, Israel, and Jordan. This breed has good adaptability to hard conditions, scarce feed, and high environmental temperatures. The Awassi breed has also been imported to other countries because of its high milk production (15). There have not been any studies on maternal behaviour after parturition in Awassi sheep or of newborn Awassi lambs. The aim of this study was to investigate the maternal behaviour of ewes and their lambs in Awassi sheep.

## 2. Materials and methods

This study was carried out in the Research and Training Farm of Mustafa Kemal University in Antakya Province, Turkey. Antakya is located between 36°N and 36°E in the eastern Mediterranean region. Data from 61 hand-mated 2–5-year-old Awassi ewes (38 single and 23 twin births) were evaluated in the present study. Each ewe was taken into an individual pen (3 m × 2 m) on day 145 after mating; lambing was monitored on a 24-h basis. All behaviour of sheep and lambs was recorded by a Sony DCR-HC44E MiniDV video camera that was placed in the front of pen at a 1.5-m distance. Observations were begun when the foreleg of the lamb was seen, and recorded for the period from the expulsion of the first lamb and 1 h subsequent to the end of lambing. The data were transferred to computer and processed using the timeline of the video player. Lambs' main body parts were defined according to Ramirez et al (5), as (1) the head (comprises head and neck), (2) the middle part (comprises the genital area, buttocks, and thighs), and (3) the back part (comprises the trunk and the extremities). The first licking and sniffing times, and the amount of grooming of their offspring by the ewes during the first hour postpartum were measured for all main body parts separately; lamb expulsion time (time interval from

the first moment forelegs of offspring clearly leave the body) was recorded. In addition, the behaviours of lambs such as first attempts to stand up and suck, as well as the exact times for the first successful standing and suckling, were recorded.

### 2.1. Statistical analysis

Normal distribution assumption was tested with the Kolmogorov–Smirnov and Shapiro–Wilk tests before ANOVA and the independent t-test. The data are expressed as the mean ± standard error for continuous variables, and number and/or percentage for categorical variables. In this study, the chi-square test was used for categorical variables such as maternal behaviour (number). Independent t-test was used to compare single and twin groups, and ANOVA was used to compare 4 age groups (2, 3, 4, and 5 years) in the continuous variables of expulsion time, first licking and sniffing time, total licking time, first attempt to stand up time, successful standing up time, first attempt to suckle time, first suckle time (minute and second). DUNCAN multiple comparison test was used to determine significant differences in means after ANOVA.

Statistical Package for the Social Sciences v.21.0 for Windows (SPSS, Inc., Chicago, IL, USA) was used for analysis (16).

## 3. Results

In this study, duration of lamb expulsion time for all sheep is given in Table 1.

Maximum and minimum lamb expulsion times were found to be  $7.0 \pm 0.54$  and  $2.1 \pm 0.37$  min at the ages of 2 and 5, respectively, in single lamb births ( $P < 0.05$ ). A similar situation was observed for twin births. The expulsion time was longer for the first lamb than for the second lamb in twin births. Duration of delivery was longer in single births compared to twin births ( $P < 0.05$ ). Significant differences were found in the time interval between the firstborn lamb

**Table 1.** Expulsion time (mean ± standard error) for single- and twin-birth ewes of different ages (minutes).

Age	Single		Twin			P	First and second lambing interval in twins
	N		n	Firstborn	Second-born		
2	15	$7.0 \pm 0.54^{bB}$	4	$8.3 \pm 0.84^{bB}$	$3.7 \pm 0.66^{bA}$	*	$18.9 \pm 2.64$
3	12	$3.9 \pm 0.36^a$	3	$5.2 \pm 0.09^a$	$4.2 \pm 0.65^b$	NS	$22.6 \pm 4.71$
4	6	$2.5 \pm 0.47^{aA}$	9	$4.6 \pm 0.23^{aB}$	$3.2 \pm 0.33^{abA}$	*	$25.0 \pm 2.76$
5	5	$2.1 \pm 0.37^a$	7	$4.0 \pm 1.15^a$	$2.0 \pm 0.23^a$	NS	$19.6 \pm 2.61$
P		*		*	*		NS
Total	38	$4.70 \pm 0.41$	23	$5.20 \pm 0.49$	$3.08 \pm 0.24$		$22.03 \pm 1.55$

\* $P < 0.05$ ; NS: not significant ( $P > 0.05$ ); different lowercase superscript in same column and different capital superscript in same row indicate statistical difference.

and the second-born lamb in twin birth groups with 2- and 4-year-old ewes ( $P < 0.05$ ).

There was no difference between the first and the second lambing time interval in twin births in relation to ewes' ages. The minimum and maximum time intervals were  $18.9 \pm 2.64$  and  $25.0 \pm 2.76$  min for 2- and 4-year-old ewes, respectively.

First observed maternal behaviour of ewes after parturition is given in Table 2. All ewes stood up immediately after birth and then began maternal behaviour. The number of ewes that showed sniffing and licking behaviours as the first activity after parturition were 22 and 16 heads respectively in the single-birth group. While the number of ewes that preferred to first sniff the head of the lamb was 7, 15 ewes preferred the back part of their lambs in the single-birth group. In this group, the place first licked was observed to be the head for 9 of the lambs; for 7 of them, the back part. Similar behaviour was detected for twin-lambing ewes. Sniffing behaviour was observed more times than licking behaviour for both the first and second lamb in the twin-birth group. There were no significant differences between birth types or between the first- and second-born lambs in twin births.

Licking behaviour of the ewe after birth massages and dries the lamb's body, and encourages the newborn to stand up and ingest the colostrum. Intervals between parturition and first licking or sniffing behaviour of dams are given in Table 3. As seen in this table, the interval for both single- and twin-birth groups was reduced with increased age. Average time for first licking after parturition was  $138.3 \pm 15.39$  s in single births and  $154.2 \pm 15.12$  s in twin births. The first sniffing time interval was  $118.31 \pm 26.48$  s and  $123.6 \pm 29.54$  s, respectively, with the same birth group mentioned above.

Ewes' licking behaviour times according to body part of the newborn lambs during the first hour after birth are given in Table 4. Ewes mostly preferred the middle part of the body after parturition in both birth types, followed by the back and head regions. While the differences were not statistically important for age and body part groups in single-birth groups, the choice of licking either the head and back parts was affected by age in the twin group ( $P < 0.05$ ). While grooming numbers decreased in the single-birth group with the dam's age, this behaviour increased in the twin-birth group (Figure 1).

**Table 2.** First maternal behaviour and places chosen by ewes after parturition (number).

Behaviour		First act		First place sniffed		First place licked	
		Sniffing	Licking	Head	Back	Head	Back
Single		22	16	7	15	9	7
Twin	first lamb	13	10	5	8	2	8
	second lamb	13	10	3	10	6	4
P		0.564	0.505	0.449	0.307	0.113	0.504

$P > 0.05$ .

**Table 3.** First licking and sniffing time (mean  $\pm$  standard error) after parturition (seconds).

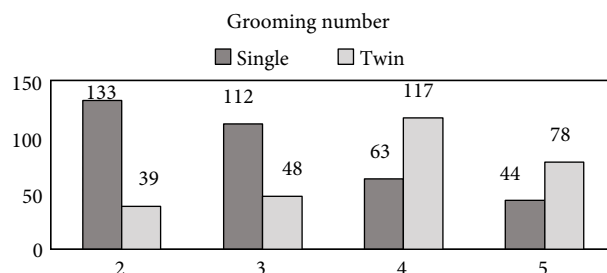
Age	n	Single birth		n	Twin birth	
		Licking	Sniffing		Licking	Sniffing
2	15	$157.2 \pm 21.29^a$	$149.1 \pm 14.72^a$	4	$183.0 \pm 44.45^a$	$148.8 \pm 54.25^a$
3	12	$136.7 \pm 35.58^a$	$137.4 \pm 26.17^a$	3	$160.8 \pm 21.51^a$	$132.2 \pm 17.11^a$
4	6	$140.6 \pm 36.63^a$	$124.6 \pm 31.54^a$	9	$147.5 \pm 30.25^a$	$113.2 \pm 22.34^a$
5	5	$83.0 \pm 22.11^b$	$54.4 \pm 20.35^b$	7	$99.5 \pm 41.15^b$	$92.7 \pm 74.83^b$
P		*	*		*	*
Mean	38	$138.3 \pm 15.39$	$118.3 \pm 26.48$	23	$147.7 \pm 15.12$	$123.6 \pm 29.54$

\* $P < 0.05$ ; different lowercase superscript in same column indicates statistical difference.

**Table 4.** The body parts and total licking time in both birth types (mean  $\pm$  standard error) (minutes).

Single birth				
Age	n	Head	Middle part	Back part
2	15	4.9 $\pm$ 0.49	14.5 $\pm$ 0.89	7.6 $\pm$ 0.78
3	12	4.9 $\pm$ 0.64	13.6 $\pm$ 1.21	8.4 $\pm$ 1.16
4	6	6.3 $\pm$ 0.52	13.0 $\pm$ 1.83	7.0 $\pm$ 1.14
5	5	5.7 $\pm$ 1.02	15.6 $\pm$ 1.42	7.7 $\pm$ 0.68
P		NS	NS	NS
Total	38	5.2 $\pm$ 0.32	14.1 $\pm$ 0.61	7.8 $\pm$ 0.51
Twin birth				
2	4	6.6 $\pm$ 0.42 <sup>a</sup>	15.9 $\pm$ 1.34	5.7 $\pm$ 0.88 <sup>a</sup>
3	3	3.5 $\pm$ 0.40 <sup>b</sup>	13.1 $\pm$ 1.51	9.3 $\pm$ 1.69 <sup>b</sup>
4	9	4.9 $\pm$ 0.64 <sup>ab</sup>	14.0 $\pm$ 0.98	6.5 $\pm$ 0.50 <sup>ab</sup>
5	7	4.3 $\pm$ 0.53 <sup>b</sup>	13.1 $\pm$ 1.23	8.0 $\pm$ 1.09 <sup>ab</sup>
P		*	NS	*
Total	23	4.8 $\pm$ 0.33	13.9 $\pm$ 0.61	7.2 $\pm$ 0.48

\*P < 0.05; NS: not significant (P > 0.05).

**Figure 1.** Grooming numbers of mothers during the first hour after parturition.

The newborn receiving colostrum by immediately standing up after birth is as important as the mother's behaviours. All of the lambs successfully stood up during the first hour after parturition (Table 5).

The effect of ewe age was significant for first attempts at suckling and first suckling times in both birth types, but was significant for standing attempts and successful standing-up times only for the twin-birth type (P < 0.05). The behaviour of neonates was affected by these actions in all age and birth-type groups. In this study, the average first attempt at standing and successful standing-up times after parturition were 14.74  $\pm$  1.32 min and 23.20  $\pm$  1.83

min for single births, 14.8  $\pm$  1.43 min and 21.1  $\pm$  1.63 min for the firstborn twins, and 12.5  $\pm$  2.21 min and 20.2  $\pm$  2.96 min for second-born twin lambs, respectively (Table 5; Figure 2).

All newborn lambs failed in the first effort at suckling behaviour as well as the first attempt to stand up (Figure 3). Average first attempt for suckling and suckling time was 28.4  $\pm$  2.07 and 34.3  $\pm$  2.27 min for single births, 27.0  $\pm$  2.13 and 34.3  $\pm$  2.50 min for the firstborn twin, and 25.2  $\pm$  3.39 min and 29.2  $\pm$  3.70 for the second-born twin lambs, respectively (Figure 3).

**Table 5.** Some behaviour of lambs after birth in both birth types (mean  $\pm$  standard error) (minutes).

					Twin birth		
	Age	N	Single birth	n	First lamb	Second lamb	P
First attempt to stand up time	2	15	14.0 $\pm$ 1.94 <sup>B</sup>	4	11.7 $\pm$ 5.14 <sup>aAB</sup>	9.4 $\pm$ 4.87 <sup>aA</sup>	*
	3	12	15.4 $\pm$ 2.95	3	15.9 $\pm$ 2.29 <sup>b</sup>	15.9 $\pm$ 7.55 <sup>b</sup>	NS
	4	6	15.9 $\pm$ 3.55	9	15.3 $\pm$ 2.08 <sup>b</sup>	16.6 $\pm$ 3.91 <sup>b</sup>	NS
	5	5	13.8 $\pm$ 2.37 <sup>B</sup>	7	15.4 $\pm$ 2.79 <sup>bB</sup>	7.4 $\pm$ 2.90 <sup>aA</sup>	*
Total		38	14.7 $\pm$ 1.32	23	14.8 $\pm$ 1.43	12.5 $\pm$ 2.21	NS
P			NS		*	*	
Standing up time	2	15	22.4 $\pm$ 2.96 <sup>B</sup>	4	18.1 $\pm$ 5.76 <sup>aA</sup>	17.3 $\pm$ 7.16 <sup>aA</sup>	*
	3	12	23.5 $\pm$ 3.45 <sup>A</sup>	3	24.3 $\pm$ 3.57 <sup>bA</sup>	27.1 $\pm$ 2.72 <sup>bb</sup>	*
	4	6	25.5 $\pm$ 4.86 <sup>B</sup>	9	20.3 $\pm$ 2.30 <sup>ba</sup>	24.6 $\pm$ 4.61 <sup>bb</sup>	*
	5	5	22.0 $\pm$ 5.29 <sup>B</sup>	7	22.5 $\pm$ 3.09 <sup>bb</sup>	13.2 $\pm$ 3.86 <sup>aA</sup>	*
Total		38	23.2 $\pm$ 1.83 <sup>B</sup>	23	21.15 $\pm$ 1.63 <sup>AB</sup>	20.2 $\pm$ 2.96 <sup>A</sup>	*
P			NS		*	*	
First attempt to suckle time	2	15	27.0 $\pm$ 3.13 <sup>ab</sup>	4	24.7 $\pm$ 7.26 <sup>aAB</sup>	22.7 $\pm$ 9.03 <sup>aA</sup>	*
	3	12	28.6 $\pm$ 4.02 <sup>aA</sup>	3	31.8 $\pm$ 6.19 <sup>bb</sup>	31.2 $\pm$ 4.21 <sup>bb</sup>	*
	4	6	36.0 $\pm$ 5.76 <sup>b</sup>	9	26.0 $\pm$ 3.36 <sup>a</sup>	29.8 $\pm$ 5.44 <sup>b</sup>	*
	5	5	27.8 $\pm$ 6.13 <sup>a</sup>	7	27.7 $\pm$ 3.53 <sup>ab</sup>	18.2 $\pm$ 4.44 <sup>a</sup>	*
Total		38	28.4 $\pm$ 2.07 <sup>B</sup>	23	27.0 $\pm$ 2.13 <sup>AB</sup>	25.2 $\pm$ 3.39 <sup>A</sup>	*
P			NS		*	*	
First suckling time	2	15	32.5 $\pm$ 3.57 <sup>ab</sup>	4	29.5 $\pm$ 7.57 <sup>aA</sup>	28.0 $\pm$ 10.23 <sup>aA</sup>	*
	3	12	34.4 $\pm$ 4.45 <sup>a</sup>	3	35.9 $\pm$ 6.44 <sup>b</sup>	35.6 $\pm$ 14.38 <sup>b</sup>	NS
	4	6	39.2 $\pm$ 5.46 <sup>bb</sup>	9	33.4 $\pm$ 3.80 <sup>abA</sup>	32.6 $\pm$ 6.58 <sup>abA</sup>	*
	5	5	33.3 $\pm$ 6.65 <sup>ab</sup>	7	37.6 $\pm$ 4.92 <sup>bC</sup>	22.6 $\pm$ 4.41 <sup>aA</sup>	*
Total		38	34.3 $\pm$ 2.27 <sup>B</sup>	23	34.3 $\pm$ 2.50 <sup>B</sup>	29.2 $\pm$ 3.70 <sup>A</sup>	*
P			NS		*	*	

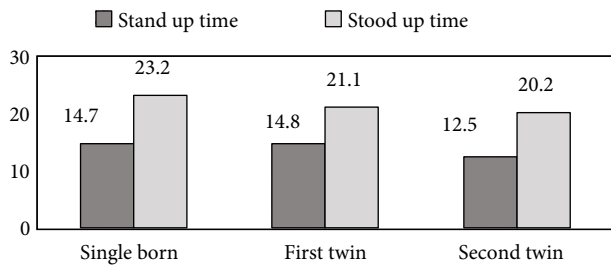
Columns shown in capitals; rows shown in lower case; \*P < 0.05; NS: not significant (P > 0.05).

#### 4. Discussion

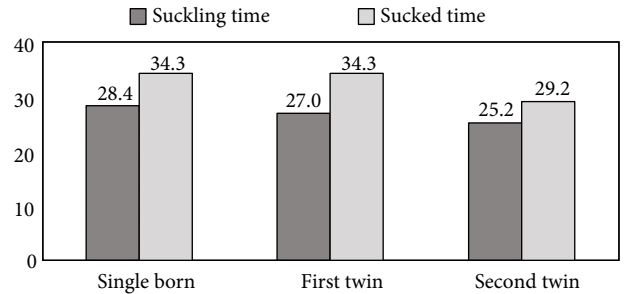
The present study illustrated some behavioural characteristics of Awassi sheep and their offspring during the first hour after parturition. According to the results (Table 1), lamb expulsion time of 2-year-old ewes was longer than that of 5-year-old ewes in both single and twin births (7.0  $\pm$  0.54 and 2.1  $\pm$  0.37, respectively). This finding is in line with the reports by Dwyer and Lawrence (17), Dwyer (3), and Ekiz et al. (18).

All ewes were concerned with their lambs and focused on the amniotic fluids on their coats immediately after

birth. It is known that amniotic fluids are crucial for the establishment of a bond between a mother and her newborn. This fluid carries some chemosensory information that facilitates exclusive bonding (19). At this point, sniffing and licking behaviours come into play. In the current study, the average time for first licking after parturition was 138.3  $\pm$  15.39 s in single births and 154.2  $\pm$  15.12 s in twin births, and the first sniffing time interval was 118.31  $\pm$  26.48 s and 123.6  $\pm$  29.54 s, respectively, for the same birth groups mentioned above. Although ewes in all birth-type groups exhibited more sniffing



**Figure 2.** First attempt to stand up times and successful standing-up times.



**Figure 3.** First attempt to suckle times and suckle times.

behaviour than licking behaviour, the differences were not significant. Maternal recognition of the ewes' offspring through persistent licking and sniffing during the first postpartum hours has been described in several domestic ungulates (3,20,21). Dwyer and Lawrence (17) stated that primiparous ewes are slower to begin licking or grooming their lambs after birth. Keller et al. (22) also showed that primiparous ewes were slower to show a preference for their lamb in recognition in comparison with multiparous ewes (23). Within a few minutes of parturition, the mother rises and starts to lick her offspring, especially starting with its head and neck. This behaviour of licking the newborn after birth optimises the offspring's respiratory system and encourages them to stand up for suckling. This licking begins at the back region or head and progressively continues towards the rest of the body. Ramirez et al. (5) observed that the kids' genital area is a place of special attention for the doe. Therefore, it is possible that the ewe, during the first hour postpartum, helps its offspring to stand and suckle through licking.

All sheep gave birth in a recumbent position and stood up immediately after parturition. The first movement of the ewe is considered as recognition and acceptance of the lamb. In this study, the first act of mothers was observed to be sniffing behaviour, and the first sniffed place in single births was the back region. In the twin-birth group, either the head or back parts were the first sniffed. Gonzalez and Goddard (1) determined that ewes spent the first 30 min after birth licking the firstborn lamb and second-born lamb ( $21.1 \pm 1.77$  vs.  $14.2 \pm 1.51$  min), respectively. Ekiz et al. (18) reported that Kivircik ewes did not show any differences between the first and twin lambs in terms of the total intensity or duration of maternal care. The birth type of lambing encouraged intensive grooming attention for the first 30 min (24). Our data show that Awassi ewes groom their lambs carefully in both birth types.

The viability rate of offspring depends on suckling the first milk, colostrum. For this purpose, offspring must stand up as soon as possible. In this study, all lambs tried to stand up for suckling and succeeded during the first hour after

they were born. It was observed that some of the ewes were helping the neonates by gently nudging them towards their udders; many studies have reported that mothers helped their offspring to stand up and reach the udder (5,25,26). The average first attempt at standing after parturition and successful standing-up time were  $14.74 \pm 1.32$  min and  $23.20 \pm 1.83$  min, respectively. Our results are similar to those of the study by Ramirez et al. (5), who reported a first standing-up time of 7.18 min for single-birth kids and 8.67 min for twin-birth kids. Abdul-Rahman and Yaro (27) reported that the standing-up times ranged from 4 to 79 min, averaging 24.01 min, in Djallonke lambs. Madani et al. (28) found successful standing-up time after birth to be within 23.45 min, while Dwyer (3) reported the first attempt for standing up time as 5.7 min, and successful standing-up time was 19.04 min.

Suckling plays an important role for ewes in establishing a bond with their lambs. Therefore, high milk production in ewes may influence the quality of the relationship between a lamb and its mother (12,29). We found that the average first attempt for suckling and suckling times was  $28.4 \pm 2.07$  and  $34.3 \pm 2.27$  for single births,  $27.0 \pm 2.13$  and  $34.3 \pm 2.50$  min for the first twin and  $25.2 \pm 3.39$  and  $29.2 \pm 3.70$  for the second twin lamb, respectively. Dwyer (3) reported an average successful suckling time of 19.04 min, while Abdul-Rahman and Yaro (27) found a mean time for first successful suckling of 35.35 min (a range from 5 to 105 min) in Djallonke lambs. Madani et al. (28) observed that standing after birth and reaching the udder occurred within  $32.7 \pm 19.02$  min and suckling began within 41.9 min in Djellal lambs. The results of the current study are in line with the findings for suckling behaviour reported in these different studies (28,30).

In conclusion, successful interaction between the ewe and newborn lamb is crucial for the lamb's survival. Some of the observations in this study are that (a) all sheep gave birth by being recumbent, (b) lamb expulsion time for young ewes was longer than for older ewes in both single and twin births, (c) sniffing was observed as the first behaviour after birth, (d) some of the ewes helped

the neonates by gently nudging and hitting the foreleg towards their udders. Finally, even though behavioural characteristics observed in this study may vary depending

on ewes' ages and the birth type, it can be said that Awassi ewes showed good maternal behaviour and encouraged their lambs to stand up and suckle.

## References

- Gonzalez SG, Goddard PJ. The provision of supplementary colostrum to newborn lambs: effects on post-natal lamb and ewe behaviour. *Appl Anim Behav Sci* 1998; 61: 41-50.
- Poindron P, Levy F, Keller M. Maternal responsiveness and maternal selectivity in domestic sheep and goats: the two facets of maternal attachment. *Dev Psychobiol* 2006; 49: 54-70.
- Dwyer CM. Behavioural development in the neonatal lamb: effect of maternal birth related factors. *Theriogenology* 2003; 59: 1027-1050.
- Dwyer CM. The welfare of the neonatal lamb. *Small Ruminant Res* 2008; 76: 31-41.
- Ramirez A, Quiles A, Hevia ML, Sotillo F. Behaviour of the Murciano-Granadina goat during the first hour after parturition. *Appl Anim Behav Sci* 1998; 56: 223-230.
- Nowak R, Poindron P. From birth to colostrum: early steps leading to lamb survival. *Reprod Nutr Dev* 2006; 46: 431-446.
- Dodd CL, Pettiford WS, Edwards JEH, Hazela SJ. Measures of behavioural reactivity and their relationships with production traits in sheep: a review. *Appl Anim Behav Sci* 2012; 140: 1-15.
- Nowak R. Suckling, milk, and the development of preferences toward maternal cues by neonates: from early learning to filial attachment? *Adv Stud Behav* 2006; 36: 1-58.
- Nowak R. Neonatal survival: contributions from behavioural studies in sheep. *Appl Anim Behav Sci* 1996; 49: 61-72.
- O'Connor CE, Jay NP, Nicol AM, Beatson PR. Ewe maternal behaviour score and lamb survival. *Proc NZ Soc Anim Prod* 1985; 45: 159-162.
- Alexander G. What makes a good mother? Components and comparative aspects of maternal behaviour in ungulates. *Proc Aust Soc Anim Prod* 1988; 17: 25-41.
- Nowak R, Murphy TM, Lindsay DR, Alster P, Andersson R, Uvnas-Moberg K. Development of a preferential relationship with the mother by the newborn lamb: importance of the sucking activity. *Physiol Behav* 1997; 62: 681-688.
- Dwyer CM, Gilbert C L, Lawrence AB. Prepartum plasma estradiol and postpartum cortisol, but not oxytocin, are associated with inter individual and breed differences in the expression of maternal behaviour in sheep. *Horm Behav* 2004; 46: 529-543.
- Cloete SWP, Scholtz AJ. Lamb survival in relation to lambing and neonatal behaviour in medium wool Merino lines divergently selected for multiple rearing ability. *Aust J Exp Agr* 1998; 38: 801-811.
- Üstüner H, Oğan, MM. Main productive performance of Awassi sheep in the central Anatolian region of Turkey. *Turk J Vet Anim Sci* 2013; 37: 271-276.
- SPSS. IBM Corp. Released 2012. IBM SPSS Statistics for Windows, Version 21.0. Armonk, NY, USA: IBM Corp.
- Dwyer CM, Lawrence BA. Maternal behaviour in domestic sheep (*Ovis aries*): constancy and change with maternal experience. *Behaviour* 2000; 137: 1391-1413.
- Ekiz B, Kocak Ö, Özcan M, Yılmaz A. Effects of parity and litter size on maternal behaviour in Kivircik ewes. *Acta Agr Scand, Section A-An* 2007; 57: 81-88.
- Poindron P, Otal J, Ferreira G, Keller M, Guesdon V, Nowak R, Lévy F. Amniotic fluid is important for the maintenance of maternal responsiveness and the establishment of maternal selectivity in sheep. *Animal* 2010; 4: 2057-2064.
- Levy F, Keller M, Poindron P. Olfactory regulation of maternal behavior in mammals. *Horm Behav* 2004; 46: 284-302.
- Lévy F, Keller, M. Olfactory mediation of maternal behavior in selected mammalian species. *Behav Brain Res* 2009; 200: 336-345.
- Keller M, Meurisse M, Poindron P, Nowak R, Ferreira G, Shayit M, Levy F. Maternal experience influences the establishment of visual/auditory, but not olfactory, recognition of the newborn lamb by ewes at parturition. *Dev Psychobiol* 2003; 43: 167-176.
- Gougoulis DA, Kyriazakis I, Mavrogianni VS, Fragkou IA, Skoufos J, Tzora A, Taitzoglou IA, Kokoli AN, Fthenakis GC. Patterns of maternal-offspring behaviour of dairy sheep and potential association with mammary health. *Can J Anim Sci* 2007; 87: 469-478.
- Dwyer CM, Lawrence AB. Variability in the expression of maternal behaviour in primiparous sheep: effects of genotype and litter size. *Appl Anim Behav Sci* 1998; 58: 311-330.
- Arnold GW, Morgan PD. Behaviour of the ewe and lamb at lambing and its relationship to lamb mortality. *Appl Anim Ethol* 1975; 2: 25-46.
- Ceyhan A, Sezenler T, Yüksel MA, Yıldırım M. Maternal and lamb behaviour of the Karacabey Merino ewes at pre- and post-parturition. *Res Opin Anim Vet Sci* 2012; 2: 402-408.
- Abdul-Rahman II, Yaro M. The effect of sex, birth weight and type of birth on neonatal behaviour of Djallonke sheep and West African dwarf goats. *Glob Vet* 2010; 4: 409-415.
- Madani T, Allouche L, Saffidine N, Kaouane N, Belkasmı F, Semara L. Maternal and neonatal behaviors of Ouled Djellal sheep breed and their effects on production parameters (Short Communication). *Small Ruminant Res* 2013; 114: 46-50.
- Mahboub HDH, Ramadan SGA, Helal MAY, Aziz EAK. Effect of maternal feeding in late pregnancy on behaviour and performance of Egyptian goat and sheep and their offspring. *Glob Vet* 2013; 11: 168-176.
- Owens JL, Bindon BM, Edey TN, Piper LR. Behaviour at parturition and lamb survival of Boorola Merino sheep. *Livest Prod Sci* 1985; 13: 359-372.