



## Ruminant Research

## Effect of breed and litter size on the display of maternal perinatal and offspring postnatal behavior in dairy sheep



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## ABSTRACT

A preliminary study was conducted to examine the effects of breed and litter size on the expression of ewes' maternal and lambs' neonatal behavior in 3 Greek dairy breeds. Animal observations were carried out on 7 Karagouniko (3 single- and 4 twin-bearing ewes), 7 Chios (4 single- and 3 twin-bearing ewes), and 7 Orini Epirus (4 single- and 3 twin-bearing ewes) multiparous ewes during 12 hours before and after parturition of each lamb. Overall, labor was not significantly different among the 3 breeds, although was shorter for first-born twin lambs compared to singletons ( $P < 0.05$ ). Chios ewes devoted significantly more time grooming their lambs in the immediate postnatal period compared to the Karagouniko ewes ( $P < 0.05$ ), and the mean for the interaction between the ewe and the lambs (min/h) for the first 12-hour period after birth was higher in Chios compared to the other 2 breeds ( $P < 0.05$ ). As it was found, second-born twin lambs received less grooming attention than singles and first-born twins ( $P < 0.05$ ). In general, the birth of lamb stimulated intensive grooming attention for the first 30 minutes, followed by a gradual decline in the next 30-minute period ( $P < 0.05$ ). Latency for lamb to stand, walk, and reach the udder was not influenced by litter size and breed, although Chios tended to reach the udder later than the other lambs ( $P = 0.120$ ). The time standing during the first hour after birth was significantly higher in Karagouniko compared with Chios lambs ( $P < 0.05$ ). This study demonstrates that limited significant breed differences exist among the examined dairy breeds in several aspects of both maternal and neonatal behavior. Ewe behavioral patterns associated with the birth and care of the neonatal lambs are essential for the survival and growth of the offspring. Further experimentation is therefore warranted to reach to reliable conclusions and elucidate the factors that differentiate maternal and neonatal behavior in Greek sheep dairy breeds.

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## Introduction

Sheep constitute natural renewable resources and are very diverse in terms of genetic potential, distribution, function, and productivity. They are very valuable in mountainous regions and small farm situations, where large ruminants may be out of place because of limited land and other resources; such conditions exist in many regions of Greece (Zygyiannis, 2006). In the major sheep producing countries of the temperate zone, milk production is unimportant, except in some European countries, such as Greece

with the highest annual sheep milk production (approximately 700,000 tones) in Europe (FAO-STAT, 2015).

The most numerous dairy sheep breed in Greece is the Karagouniko, that it is originated in central Greece, and because of its endurance to difficult conditions and competitive milk and meat production performance, it is spread almost all over the Greek mainland. In addition, Chios sheep breed is widely known for its high milk production and prolificacy, and its superior genetic material is used for the upgrading of several flocks in the country (Bizelis et al., 2000; Charismiadou et al., 2000). Finally, Orini Epirou (Boutsiko) is a mountain sheep breed and raised, as other breeds of sheep in Greece, primarily for milk and secondly for meat production, although its yield is inferior compared to the other 2 breeds (Rogdakis, 2002). Previous researchers have already studied the genetic diversity and differentiation within and between Greek

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sheep breeds and have found that there is a clear genetic distinction among Karagouniko, Chios, and Orini Epirou dairy sheep breed (Rogdakis et al., 1995; Koutsouli and Rogdakis, 2002).

Sheep production is a very important enterprise in Greece, particularly in the mountainous less favored areas. Extensively managed dairy sheep often live in harsh and unfavorable environments and need specific adaptations that promote survival. Ewe behaviors associated with the birth and care of the neonatal lambs are therefore essential for the survival and growth of the offspring (Nowak et al., 2000). The vast majority of lamb preweaning mortality occurs within the first 3 days of postnatal life, and the main causes are related with the failure of neonatal adaptation to postnatal life due to inability to maintain body temperature, low lamb vigor, and poor establishment of maternal bond (Dwyer, 2008; Nowak et al., 2000). Maternal behavior has therefore a large impact on the offspring's performance, and its improvement is an important way to increase animal productivity and ensure animal well being (Grandinson, 2005). Especially, the response of the ewe to initial interactions with her lambs affects the development of attachment between them (Nowak et al., 1997). Ewes showing a poorer quality of maternal behavior (low levels of licking and grooming, infrequent low-pitched bleating, inconsistent udder acceptance) at parturition form a weaker bond with their lambs than ewes which display high levels of grooming (Dwyer and Lawrence, 1998; McGlone and Stobart, 1986).

Precocial mammalian species, such as sheep, are characterized by a small litter of fully developed young capable of following the mother shortly after birth. Moreover, sheep is also a "follower" species (Lent, 1974); thus, the lamb needs to keep up with its dam soon after birth. As a result, the rapid development of interindividual recognition and exclusive care is of vital importance because neonates are entirely dependent on the protection, guidance, and resources provided by their mother (Nowak et al., 1997). At birth, ewes display several patterns of maternal behavior that promote 2 main functions: (1) facilitate the transition of the lamb from prenatal to postnatal life and (2) form a bond between the ewe and her lamb/s that allows her to restrict maternal care exclusively toward her own offspring (Dwyer and Lawrence, 2005). Ewes acquire this ability to recognize their lambs rapidly, and their attachment is established within 2–4 hours after birth (Poindron et al., 1993). On the other hand, lambs can recognize their mothers at close quarters within 12 hours after birth (Nowak et al., 1987) and at a distance after 24 hours (Nowak, 1991).

No studies exist that describe ewes' maternal and lambs' neonatal behavior in dairy sheep breeds. As a result, the objective of the present study was the examination of the breed and litter size effects on the expression of ewes' maternal and lambs' neonatal behavior in 3 Greek breeds of dairy sheep with different productive and behavioral characteristics.

## Material and methods

### Animals

Animal observations were carried out on 21 randomly selected multiparous ewes of the same body score; 7 Karagouniko (3 single- and 4 twin-bearing ewes), 7 Chios (4 single- and 3 twin-bearing ewes), and 7 Orini Epirus (4 single- and 3 twin-bearing ewes). Ewes were synchronized in estrus using progesterone sponges (Ovigest, Laboratories Hipra S.A., Spain) and naturally mated to 1 of 6 rams of the same breed as the ewe (2 per breed). Ewes were brought to individual straw-bedded pens (2 × 4m) in the last week of gestational period and given *ad libitum* access to concentrated feed, alfalfa hay, and fresh drinking water.

### Data recording

Ewes gave birth to lambs in December and remained with their lambs in pens until 2 days after birth, when they were moved outside. Ewes perinatal and lambs postnatal behavior was continuously recorded using video cameras with infrared lighting (TX-14300A, Turbo-X, Plaisio, Magoula Attikis, Greece) during 12 hours before and after birth of each lamb. Each camera was placed in a fixed position to record behavior patterns in each pen. The recorded data were stored in a digital video recorder equipped with a hard disk (TX168, Telexper Inc, USA). Table 1 gives the definitions of ewe and lamb behavioral parameters observed during the perinatal period. In case of twin-bearing ewes, time "zero" for recording was the birth of the first lamb, apart from the grooming and lamb-related behaviors. In general, ewes were allowed to give birth and care for their lambs unaided and intervention was kept to a minimum. However, lambing assistance was given if the ewe had failed to facilitate sucking within the first hour after birth, and for this reason, sucking attempts and latency to first successful sucking were not included in the analyses.

### Statistical analysis

The data were initially analyzed using a general linear model with breed, type of birth, birth order, sex of lamb, and time of birth as fixed effects. Significant departures from normal distribution for variables were assessed using the normal quartile plots along with values for skewness and kurtosis. After these tests, some variables clearly deviated from normal distribution (labor, grooming, latencies, etc). In these cases, nonparametric analyses were thus used, and the comparison of behavioral parameters among breeds was performed by the Kruskal-Wallis test and between singleton- and twin-bearing ewes by the Wilcoxon-Mann-Whitney test. Differences were tested at 0.05 significance level, and the results are presented either as means ± standard error (general linear model) or medians (lower upper quartile, Q1-Q3; non-parametric tests). The effects of lamb sex and time of birth were not significant and were therefore excluded from the models. The R project (The R project for statistical computing, 2014) was used for the statistical analyses.

**Table 1**

Definition of behavioral parameters recorded during the 12 hours before and after birth

Parameter	Definition
Ewe	
Standing	Acts of walking or standing immobile
Lying	Sleeping or sitting at any position (unsleeping, stretched)
Feeding/drinking	Acts of eating in a feeder and drinking in a waterer
Overall labor	Time from first appearance of fluids to full expulsion of the lamb
Grooming directed at "head-neck" or "forelegs and flank" or "hindquarters"	Licking or nibbling movements directed toward the body part of "head-neck" or "forelegs and flank" or "hindquarters" of the lamb
Interaction with lambs	Cumulative acts of grooming, sniffing, and facilitating sucking toward the lamb or lambs (in single- and twin-bearing ewes, respectively)
Lamb	
Latency and attempts to stand	The time and attempts of lamb to stand after parturition
Latency to walk	The time for lamb to walk after parturition
Latency to reach udder	The time for lamb to reach udder after parturition

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