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# Aseasonal sheep and goat milk production in the Mediterranean area: Physiological and technical insights<sup>☆</sup>



M. Todaro<sup>a,\*</sup>, M. Dattena<sup>b</sup>, A. Acciaioli<sup>c</sup>, A. Bonanno<sup>a</sup>, G. Bruni<sup>d</sup>,  
M. Caroprese<sup>e</sup>, M. Mele<sup>f</sup>, A. Sevi<sup>e</sup>, M. Trabalza Marinucci<sup>g</sup>

<sup>a</sup> Department of Agricultural and Forest Sciences (SAF), University of Palermo, viale delle Scienze, 13, 90128 Palermo, Italy

<sup>b</sup> AGRIS Sardegna (Agricultural Research Agency of Sardinia), Department of Animal Science, 07040 Olmedo, Italy

<sup>c</sup> Department of Agri-Food Production Sciences and the Environment (DISPAA), University of Firenze, Via delle Cascine, 5, 50144 Firenze, Italy

<sup>d</sup> Regional Breeders Association of Lombardia, Via Kennedy, 30-26013 Crema, Italy

<sup>e</sup> Department of the Sciences of Agriculture, Food and Environment (SAFE), University of Foggia, Via Napoli, 25, 71122 Foggia, Italy

<sup>f</sup> Department of the Sciences of Agriculture, Food and Environment, University of Pisa, Via del Borghetto, 80, 56124 Pisa, Italy

<sup>g</sup> Department of Pathology, Diagnostic and Veterinary Clinic, University of Perugia, Via S. Costanzo 4, 06126 Perugia, Italy

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## ABSTRACT

Aseasonal or out-of-season milk production for small ruminants raised in Mediterranean areas refers generally to milk having to be produced at a time that corresponds to summer which is when conditions are generally unfavourable with respect to both physiological aspects and nutritional factors related to seasonal climatic trends. In fact, sheep and goat milk production in the Mediterranean basin is mostly based on pasture utilization and thus follows the pasture availability pattern. This causes a strong seasonal pattern to the amount of milk processed by cheese processes plants, with the peak being in the spring, a marked reduction in early summer and nil or low availability of milk from August to October–November (autumn). In this paper, the reproduction cycles and managerial techniques that can be applied in the Mediterranean environment to reduce or eliminate the seasonality of milk production are discussed. The use of the “ram effect” at the end of the anoestrous season and light treatment can be effective and simple tools to maintain milk yield in the summer period. However, even if sheep and goats are considered to be among the most heat-tolerant species, the exposure to high ambient temperatures has a detrimental impact on their production and reproductive performances, immune function and udder health. The use of effective nutritional strategies, the provision of shaded areas and adequate housing density could then reduce the heat stress.

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## 1. Introduction

About 46% of the world sheep milk originates from the Mediterranean area. The most important countries in terms

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\* Corresponding author. Tel.: +39 0 91 23896061;  
fax: +39 0 91 6515531.

E-mail address: [massimo.todaro@unipa.it](mailto:massimo.todaro@unipa.it) (M. Todaro).

of the number of dairy sheep and goats are Greece, Italy, Spain, France and Turkey in Europe, and Algeria, Egypt and Libya in North Africa (FAOSTAT, 2013). Even if the number of dairy sheep and goats in the European Mediterranean countries are less than in the North African countries, the number of fresh sheep and goat milk yielded in Europe is more (Table 1).

The productive cycle of Mediterranean sheep and goats is very closely linked to the Mediterranean climate which is characterized by a mild winter, with rainfall occurring in

**Table 1**  
Sheep and goats reared in the Mediterranean area, 2011 (FAOSTAT, 2013).

Country	Dairy sheep (no.)	Fresh sheep milk (tonnes)	Goats (no.)
<i>Europe</i>			
Greece	7,254,000	773,000	3,350,000
Italy	5,468,990	417,839	658,800
Spain	2,800,000	519,600	1,260,000
France	1,297,651	273,550	944,210
<i>North Africa</i>			
Algeria	13,848,690	320,000	2,578,950
Turkey	11,561,144	892,822	3,033,111
Egypt	2,260,000	113,000	1,240,000
Libya	2,235,800	60,000	520,000
Morocco	944,300	37,700	1,684,700
Tunisia	320,000	25,000	486,300
Israel	155,000	16,540	36,000

autumn and spring, and a very dry summer. Accordingly, the fresh forage availability is low in autumn and abundant in spring. The typical breeding system in the Mediterranean area implies one lambing per year, with the mating season starting in late spring for mature ewes and in early autumn for young ewes (about 20% of the flock) the latter are successfully mated only when their body weight is about 65–70% of normal adult weight. The lambing period for mature ewes occurs between October and December (autumn to early winter) to exploit the seasonal availability of the natural pastures at their best. Generally, the older the ewes, the earlier the lambing; while, late winter is the lambing period of the primiparous ewes. In general, only 75% of the mated young ewes conceive and lamb; the others are successfully mated only in the next spring and lamb at about 24 months of age in the autumn that is during the lambing season of the mature ewes.

The aseasonal milk production for small ruminants raised in Mediterranean areas means that milk has to be produced at a time that corresponds to the summer and generally in unfavourable conditions with respect to both the physiological aspects and nutritional factors related to the seasonal climate trends. Examples of aseasonal milk production have been recorded with the practice of 3 lambings over 2 years that exists in some regions of Italy such as Tuscany (Secchiari et al., 1988; Biagioli et al., 1989), Castilla-La Mancha and Castilla-Leon in Spain (Milán et al., 2011) and Israel (Galal et al., 2008), where lamb meat makes an important contribution to the farmers' income.

Generally, lambs are slaughtered or weaned after a suckling period of approximately 30 days. After the weaning of lambs, ewes are usually milked twice daily until late spring or early summer. Then despite the different periods of lambing, the young and mature ewes simultaneously stop milk production and become dry when the forage pastures dry up, because of the high summer environmental temperatures.

Under these conditions, the flow of nutrients and energy from the pasture to the grazing sheep show two critical constraints: a feed shortage in winter and a sharp decrease in herbage availability and quality from spring to summer. Thus, although in most situations feeding is still based on grazing natural pastures, forage crops and their supplementation with hay and concentrates have been increasing

in importance in areas especially where irrigation is possible. So, for instance, dairy ewes of high producing breeds, such as the Awassi and Assaf, are managed in Israel (Gootwine and Pollott, 2000; Pollott and Gootwine, 2004) and Spain (Caja and Rancourt, 2002) under intensive production systems that are mainly milk orientated based on an accelerated lambing regime, machine milking and a prevalence of zero grazing. Indeed, ewes are fed indoors in loose stalls with rationed forage and concentrates or totally mixed rations.

Nowadays, in the Mediterranean area, dairy sheep and goat farming systems vary from extensive (marked seasonal milk production, dual-purpose breeds, low feed supplementation, transhumance, hand milking, absence of farm facilities, farm-made cheese) to intensive systems (seasonal or continuous milk production, improved local breeds or crosses, exploitation of forage crops, high feed supplementation, machine milking and housing facilities, industrial cheeses) according to the economic relevance of the production chain and the specific environment and breed.

Extensive farms continue to be the reality for the breeding of sheep and goats that are able to take advantage of the marginal areas of agricultural land. Also, in this type of farming system, where milk production is highly seasonal, it is possible to manage the mating activity by techniques of reproduction and plan the lambing periods and obtain fresh milk over the entire year, especially in the summer season.

However, it must be pointed out that in high and medium latitudes, the annual temperature and photoperiod are the two fundamental variables, together with food availability, that control the seasonal reproductive cycle of sheep and goats. Indeed, wide areas of the Mediterranean basin are characterized by ambient temperatures in late spring and summer that often exceed sheep's thermal neutral zone (5–25 °C) (Curtis, 1983; Costa et al., 1992). According to Silanikove (2000), if the ambient temperature at night drops below 21 °C for 3–6 h, the animal has sufficient opportunity to lose all of the heat gained from the previous day. Unfortunately, during the summer nights, the temperatures in some environments often exceed 21 °C. According to Sevi et al. (2001), milk production only decreases in lactating ewes when they are exposed to a temperature humidity index (THI) greater than 80%. The photoperiod is another important factor that affects reproduction and the periods of the year when reproductive activity is absent or high, especially in breeds that originate from geographical areas at high latitudes. Thus, appropriate managerial strategies must be developed to allow sheep and goats to produce milk out of season.

## 2. The seasonality of the reproductive cycle and possible management strategies

### 2.1. The reproductive physiology of sheep and goats: an introduction

Sheep and goats are considered to be prolific species, despite the fact that most breeds of both species have seasonal reproductive cycles. During each annual reproductive cycle, there is a season of low or absent reproductive

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