Small Ruminant Research 84 (2009) 108–115

Contents lists available at ScienceDirect

Small Ruminant Research

journal homepage: www.elsevier.com/locate/smallrumres

Effect of artificial *vs.* natural rearing on milk yield, kid growth and cost in Payoya autochthonous dairy goats

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ARTICLE INFO

Article history:
Received 2 March 2009
Received in revised form 18 June 2009
Accepted 22 June 2009
Available online 19 July 2009

Keywords:
Cost
Kids growth
Milk quality
Milk yield
Payoya dairy goat
Rearing system

ABSTRACT

Seventy full lactations of Payoya dairy goats were used to study the effect of two different kid-rearing systems, natural or artificial, on milk yield, composition, hygiene-sanitary quality, kid growth and rearing cost. Two animal groups were established, one with goats under natural rearing (NS) and the other under artificial rearing (AR). In the NS group, the kids had free access to goat milk 18–20 h a day and were suckled up to 5 weeks of age and then the dams were milked twice daily. Dams in the AR were separated from their kids at 48 h post-partum; then, kids were reared artificially, and the dams were milked twice daily. The number of animals used in each type of rearing system was 35 (23 goats giving birth to twins and 12 goats giving birth to a single kid). Each week during suckling phase the volume of milk produced was measured, and individual samples were taken. From 5th week and until 210 days lactation, test-day yields recorded at intervals of 30 ± 3 days were obtained. The chemical composition of the milk, the bacteriology, and the somatic cell count was analyzed. The kids of both sexes were assigned to two groups, natural suckling (NS, $n = 58$) and *ad libitum* artificial rearing (AR, $n = 58$). Within each treatment, two groups of kids were formed depending on prolificacy: first group with kids from single birth ($n = 12$) and the second with twin kids ($n = 46$). Birth weight and weight every week upto the 4th week of life were recorded. During the 5 weeks of lactation the total milk yield per goat was higher for the NS group (140.2 L *vs.* 95.4 L; $P < 0.001$), although the total amount of marketable milk was greater for the AR group, with a difference of some 21 L ($P < 0.05$). Throughout the entire lactation the milk yield was higher in the group of natural rearing (total yield of 508 L *vs.* 400 L; $P < 0.05$). Although a significant effect of prolificacy was found during suckling phase ($P < 0.001$), during 30 weeks of lactation this factor did not affect milk yield ($P > 0.05$). For the milk composition and hygiene-sanitary quality there were no effects on the type of rearing system or the type of birth ($P > 0.05$). No significant effect was observed either for the feeding system or the sex or the prolificacy on the live weight of the kids at 28 days and the postnatal growth rate from birth to 28 days ($P > 0.05$). Natural rearing system had higher cost per kid comparing with artificial rearing system (€18.63/kid *vs.* €14.70/kid, respectively). However, when comparing total incomes during a full lactation, goats with natural rearing system had a higher income because of increment of total milk production (€29.95/kid).

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doi:10.1016/j.smallrumres.2009.06.014

1. Introduction

Andalusia is the Spanish region with the highest population of dairy goats, comprising essentially autochthonous breeds, as the Payoya breed. The origin of this breed is undefined, although possibly was originated from the conjunction of the Alpine and Pirenaic stocks, also influenced by the convex stock (Herrera and Luque, 2007). Their importance has grown and actually there are around 15,000 Payoya goats, most of the flocks having a grazing-based management (Ruiz et al., 2008). Average milk production is 440 kg per goat and year, with lactations of 7 months (González-Casquet et al., 2005). The fat and protein contents of milk are 4.27% and 3.53%, respectively (Herrera and Luque, 2007). On average, 1.58 kids are produced per goat and year, with the birthing dates concentrated between August to November (47%), and December to February (40%) (Castel et al., 2004).

As the main role of dairy goat farming is to yield marketable milk, early weaning of kids is important if milk is to be sold at a good price, and thereby increase farm profitability. Artificial rearing is closely linked to their intensification and to their specialisation in milk production and in some Spanish regions, such as Murcia and the Canaries its use is widespread (Argüello et al., 2004). However, in Andalusia and especially in the hilly areas, the use of artificial rearing is not habitual (Mena-Guerrero et al., 2005). Among producers of autochthonous breeds there is a general belief of the existence of a marked maternal–young bond so that, if the artificial rearing system is practised, the milk yield and growth of the kids would be reduced (Sánchez, unpublished data). Moreover, due to the investment costs and the increase in labour required numerous technicians and breeders are not convinced that artificial rearing is of interest (Mantecón et al., 2000). Nevertheless, there are hardly any works studying the effect of the type of rearing system on the yield of goat milk and rearing costs. In a recent work, Delgado-Pertíñez et al. (2009) in the Florida breed and during the suckling phase, found that the total milk yield per goat was higher for the goats with natural rearing than those with artificial rearing (93.6 L *vs.* 71.2 L) and though the costs were slightly lower for the artificial rearing group (€14.5/kid *vs.* €15.4/kid, respectively), the extra income per naturally suckled kid was €5.18 as consequence of the additional per goat milk production in the natural suckling group. However other authors (Keskin, 2002; Peris et al., 1997) found no differences in the milk yield throughout lactation.

Criteria of hygienic and bacteriological quality of ewe and goat milk are outlined in the European Union (EU) Directive 92/46 (Council of the European Communities, 1992), as last amended by Directive 94/71/EC. Their compliance is of vital importance for the survival of commercial dairy goat farmers (Boyazoglu and Morand-Fehr, 2001). The limit for SCC in ewe and goat milk has not yet been definitely established (Raynal-Ljutovac et al., 2007). Nevertheless, for Europe and for fresh milk Barbosa et al. (1994) have advised a threshold of 1,500,000 cells/mL. In the case of number of bacteria, Spanish legislation (Real Decreto 402/96, modifying 1679/94), set the limit at 500,000 bacteria/mL for fresh milk. Despite this, there are very few studies on the characterisation and effect of management practices for the hygiene-sanitary quality of milk on dairy goat farms in Spain (Delgado-Pertíñez et al., 2003), and only one in which the effect of the type of rearing system has been studied (Delgado-Pertíñez et al., 2009).

With regard to the effect of the rearing systems on Payoya kids' growth no studies are known. However, the results obtained in others autochthonous breeds are somewhat contradictory. Thus Sanz et al. (1987, 1990), Peña-Blanco et al. (1994), Tejón et al. (1995), and Delgado-Pertíñez et al. (2009) found no differences in daily gains with regard to rearing system. There are, however, works showing that there is a higher growth rate among naturally suckled kids (Rodríguez et al., 1988; Piasentier et al., 2000; Argüello et al., 2004).

The present study was aimed at investigating the effect of two kid-rearing systems, natural or artificial, on kid growth and on yield, composition, and hygiene-sanitary quality of milk in Payoya dairy goats. It was also aimed at comparing kids' rearing costs between both rearing systems.

2. Materials and methods

2.1. Experimental farm and goats

A total of 70 goats were selected as animal base from a dairy goat farm that bred the autochthonous Payoya breed. The farm was located in the Sierra of Cádiz (Andalusia, South Spain), where this breed predominates (Ruiz et al., 2008). All goats chosen were in their 3rd to 5th parity and kidded in October. Two treatments were established. In one, the goats suckled their kids up to 5 weeks of age (natural suckling group, NS) and kids had free access to suckling 18–20 h a day. In the other, kids were reared on milk replacer (artificial rearing group, AR). For each treatment, the number of goats used was 35. Within each treatment, two groups of goats were formed, depending on prolificacy: one group of goats which gave birth to twins (DB, $n = 23$) and the other which gave birth to a single kid (SB, $n = 12$). Both experimental groups were feed in a semi-intensive system based on the grazing of natural pastures (Castel et al., 2003; Nahed et al., 2006). Goats were grazing 4–6 h/day during suckling phase and 8–16 after weaned. A supplementary concentrate was added for both groups at a flat rate of 1.5–2 kg/day (92.8% OM, 15.3% CP, 4.1% EE, and 18.5% CF); alfalfa hay was available for consumption *ad libitum*.

The kids of both sexes were assigned to two groups, natural suckling (NS, $n = 58$) and *ad libitum* artificial rearing (AR, $n = 58$). Within each treatment, two groups of kids were formed, depending on prolificacy, one with kids from single birth ($n = 12$) and the other with twin kids ($n = 46$). NS rearing took place in the open field with metal drums for shelter (Mena-Guerrero et al., 2005) and kids remained with their dams from birth to weaning with free access to goat milk during 18–20 h a day. AR kids were colostrum hand fed during the first 2 days of life on the farm itself. After the colostrum feeding period, the kids were taken to the Corsevilla Cooperative's artificial rearing centre where they were accommodated in artificial rearing slatted-floored rooms, as described by Delgado-Pertíñez et al. (2009). A commercial kid milk replacer (Elvor kids, SOFIVO, Conde-sur-Vire, France; Table 1) was given warm (36–38 °C), reconstituted at 17% (w/w), continuously mixed (half a liter each time) and offered *ad libitum* on a 24-h basis. Water was supplied *ad libitum* to kids. Birth weight and weight every week from birth until week 4 of age were recorded in kids from both groups, because the kids in the AR group were slaughtered at week 4 when they reached commercial slaughtering weight. The kids in the NS group, however, were left with their mothers until 5 weeks of age to be able to follow the impact of suckling on milk production until this time. No mortalities were recorded during the trial.

2.2. Milk sample collection

Samples were taken weekly from birth until the 5th week postpartum. In the AR group, the goats were milked twice daily (09:00 h and