J. Dairy Sci. 98:204–210
http://dx.doi.org/10.3168/jds.2014-8350

The effect of colostrum source (goat vs. sheep) and timing of the first colostrum feeding (2 h vs. 14 h after birth) on body weight and immune status of artificially reared newborn lambs

L. E. Hernández-Castellano,*† A. Morales-delaNuez,‡ D. Sánchez-Macías,§ I. Moreno-Indias,# A. Torres,‖ J. Capote,‖ A. Argüello,* and N. Castro*[1]
*Department of Animal Science, Universidad de Las Palmas de Gran Canaria, 35413 Arucas, Gran Canaria, Spain
†Veterinary Physiology, Vetsuisse Faculty, University of Bern, Bremgartenstrasse 109a, CH-3001 Bern, Switzerland
‡Facultad de Ciencia Pecuarias, Escuela Superior Politécnica de Chimborazo, EC-060150 Riobamba, Ecuador
§Department of Agroindustrial Engineering, Universidad Nacional de Chimborazo, EC-060150 Riobamba, Ecuador
#Unidad de Gestión Clínica de Endocrinología y Nutrición, Instituto de Investigación Biomédica de Málaga (IBIMA), Complejo Hospitalario de Málaga (Virgen de la Victoria), Universidad de Málaga, Ciber Fisiopatología de la Obesidad y Nutrición (CIBEROBN), Málaga 29010, Spain
‖Instituto Canario de Investigaciones Agrarias, La Laguna, Tenerife 38200, Spain

ABSTRACT

Several factors can affect lamb body weight (BW) and immune status during the first days of life, including colostrum source and timing of the first colostrum feeding. The aim of this study was to evaluate the effects of colostrum source (goat or sheep) and timing of the first colostrum feeding (2 or 14 h after birth) on lamb BW and immune status. In this study, 40 lambs were removed from their dams at birth and randomly assigned into 4 groups of 10 lambs each. Lambs were subsequently fed at 2 or 14 h after birth with goat or sheep colostrum. Blood samples and BW recording were performed before feeding. Blood plasma was used to measure the immunoglobulin concentration (IgG and IgM), chitotriosidase activity, and complement system activity (total and alternative pathways). In general, no differences in any of the measured variables were observed among the 4 groups, indicating that neither colostrum source nor timing of the first colostrum feeding had an effect on these variables. These findings may improve management on lamb farms that raise animals under artificial conditions, because our results indicate that it is not necessary to feed colostrum to lambs immediately after birth and that goat colostrum may be used to feed newborn lambs.
Key words: chitotriosidase, lamb, goat colostrum, complement system

INTRODUCTION

Newborn ruminants have 3 critical periods related to their immune system development during the first 2 mo of life: colostrum feeding, milk feeding, and weaning. Management in these periods affects final animal performance (Marsico et al., 1993; Massimini et al., 2007; Mastellone et al., 2011).

The importance of small dairy ruminants has increased significantly recent years (Lérias et al., 2013; Morales-delaNuez et al., 2014). Today, the number of high-production dairy sheep farms is increasing worldwide, but especially in developing countries (Lérias et al., 2014), where lambs are reared under an artificial feeding system to increase production of marketable sheep milk. Under this system, lambs are separated from their dams at an early age and then fed colostrum and milk replacer to increase the amount of milk available for processing into dairy products such as cheese or yogurt (Demiroren et al., 1995; Napolitano et al., 2008). Separating lambs from their dams early also simplifies their management (Emsen et al., 2004).

The consumption of colostrum by the progeny of ruminant species (cow, sheep, and goat) has a fundamental role in passive immune transfer and in the survival rate of newborns (Lascelles, 1979; Stelwagen et al., 2009; Hernández-Castellano et al., 2014a), as they are born hypo-gammaglobulinemic. For this reason, animals growing under an artificial rearing system need to be fed, by bottle, an adequate amount of colostrum during their first days of life, to obtain adequate passive immune transfer and increase future productivity (Morales-delaNuez et al., 2011). Nevertheless, the amount of colostrum produced by the dam and its composition can be affected by several factors such as nutrition or litter size (Banchero et al., 2004). In addition, lambs fed an inadequate amount of colostrum in the first hours of life are more susceptible to disease and mortality (Ahmad et al., 2000; da Nobrega et al., 2005; Nowak and Poindron, 2006). Therefore, it is crucial to

Received May 11, 2014.
Accepted September 17, 2014.
[1]Corresponding author: noemi.castro@ulpgc.es

provide an optimal colostrum source, and consequently, several studies have investigated the use of bovine colostrum as an alternative source to feed lambs in early life (Quigley et al., 2002; Moretti et al., 2010). However, studies report that lambs fed with cow colostrum run the risk of developing anemia (Winter and Clarkson, 1992; Winter, 2011; Ruby et al., 2012). For this reason, it is necessary to study another colostrum source from a phylogenetically closer species, such as goat, which may provide similar passive immune transfer to sheep colostrum and therefore would not affect the future performance of the offspring.

Timing of the first colostrum feeding (**TFCF**) is another important factor that affects immune status and, therefore, the future productivity of adult animals (Hernández-Castellano et al., 2014b). For ruminants, the period between 12 and 36 h after birth is critical for absorption of colostrum IgG (Chen et al., 1999; Nowak and Poindron, 2006; Castro-Alonso et al., 2008) to acquire an adequate initial immunoglobulin concentration in blood (O'Doherty and Crosby, 1997; Quigley et al., 2000; Christley et al., 2003). Nevertheless, it is necessary to study how a delay in TFCF could affect the final immune status in the lamb's bloodstream, as this could affect the future performance.

One of the most important immune variables is the immunoglobulin concentration (mainly IgG and IgM). However, other immune variables directly affect lamb immune status, such as chitotriosidase (**ChT**) activity and complement system activity, and play an important role in the final animal productivity. As described by Argüello et al. (2008), ChT is an important component of innate immunity against chitin-containing pathogens. Chitotriosidase is a functional chitinase with a high homology to chitinases that belong to family 18 of glycosyl hydrolases. Although research on chitotriosidase has been undertaken in humans (Musumeci et al., 2005) and goats (Argüello et al., 2008; Hernández-Castellano et al., 2011; Moreno-Indias et al., 2012b), this enzyme has never been described in sheep or lambs. Chitotriosidase is predominantly a secretory protein that is expressed only in the late stage of monocyte differentiation and it is capable of hydrolyzing chitin in the cell wall of fungi and nematodes (Barone et al., 1999).

Complement system activity—comprising the total (**TCA**) and alternative (**ACA**) pathways—plays an important role in host defense mechanisms against infectious microbes, because it is involved in specific and nonspecific immunity (Rodríguez et al., 2009). The complement system in mammals has been well described, particularly in humans and mice as well as in cows and goats (Castro et al., 2008; Mayilyan et al., 2008; Rodríguez et al., 2009; Moreno-Indias et al., 2012a). However, few studies have described complement system activity in sheep and lambs (Oswald et al., 1990).

The aim of this study was to determine the evolution of BW and immune status (IgG and IgM concentrations, ChT activity, and complement system activity) at d 0, 1, 2, 3, 4, 5, and 20 after birth in relation to colostrum source (goat vs. sheep) and TFCF (2 vs. 14 h after birth).

MATERIALS AND METHODS

The study was performed in the Department of Animal Science of the Universidad de Las Palmas de Gran Canaria, Canary Islands (Spain) on 40 lambs (20 males and 20 females) of the Canary dairy breed. Animal procedures were approved by the ethical committee of the university.

Colostrum-Feeding Period

At birth, 40 singleton lambs were removed from their dams. Because dams underwent estrous synchronization and were subsequently mated, all lambs were born over a few days in the same period (May 2013).

During the first 2 h after birth, lambs were dried, weighed, and ear tagged. Thereafter, lambs were equally divided by sex and then randomly divided into 4 groups with 10 lambs each (5 males and 5 females) based on the method of colostrum feeding and without contact with the dam. Goat colostrum 2 h (**GC2**) and goat colostrum 14 h (**GC14**) groups received a goat colostrum pool (41 mg of IgG/mL of colostrum) that was previously pasteurized at 63°C for 30 min according to Trujillo et al. (2007). Sheep colostrum 2 h (**SC2**) and sheep colostrum 14 h (**SC14**) groups received a sheep colostrum pool (65 mg of IgG/mL of colostrum) that was pasteurized by the procedure previously described. The timing of the first meal of colostrum is critical because optimal absorption of immunoglobulins occurs before 4 h of life and decreases rapidly after 12 h after birth (Vasseur et al., 2010). Therefore, lambs from GC2 and SC2 were bottle-fed colostrum at 2, 14, and 24 h after birth, whereas GC14 and SC14 lambs were only bottle-fed colostrum at 14 and 24 h after birth. Because no recommendation about the requirements of colostrum (IgG/kg of BW) in artificially reared lambs was found in the literature, all lambs used in this study received a total colostrum amount equivalent to 4 g of IgG/kg of BW during the colostrum period (24 h after birth), according to the recommended concentration for goat kids (Castro et al., 2005). All pens used in this study were equipped to maintain room temperature