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A survey of *Salmonella* spp and *Campylobacter* spp in dairy goat faeces and bulk tank milk in the Murcia region of Spain

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This study was designed to investigate the occurrence of *Salmonella* spp and *Campylobacter* spp in faeces samples from 222 healthy Murciano-Granadina dairy goats reared on 12 farms in Spain and in samples of bulk tank milk from 11 of those herds. Neither *Salmonella* spp nor *Campylobacter* spp were isolated from any of the samples. Our results suggest that, under the management practices applied to this breed in Spain, Murciano-Granadina goats are not likely to be a significant reservoir for these food-borne pathogens.

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Introduction

Salmonella spp and *Campylobacter* spp are important food-borne pathogens and the consumption of goat's meat (Pépin *et al.*, 1997) or unpasteurised goat's milk and cheese have been associated with some outbreaks of infection in humans (Harris *et al.*, 1987; Rampling, 1998). Both *Salmonella* spp and *Campylobacter* spp have been associated with disease in goats (Prescott and Bruin-Mosch, 1981; Smith and Sherman, 1994) but they are also found in animals that show no signs of clinical illness. In dairy cows, the main source of contamination of bulk tank milk is faecal shedding of these pathogens by asymptomatic animals and this has led to the proposal of on-farm management interventions to enhance the safety of dairy products (Ruegg, 2003). As opposed to the situation for poultry, pigs, cattle and sheep, very few large-scale epidemiological studies have been undertaken on goats as potential faecal carriers of *Salmonella* spp and *Campylobacter* spp. To our knowledge, such a study has not been performed in Spain.

The objective of this investigation was to check for the presence of faecal carriers of *Salmonella* spp and *Campylobacter* spp among healthy Murciano-Granadina goats on 12 Spanish farms. The bulk tank milk of these farms was also tested for both pathogens.

Materials and methods

The study was conducted over a three-month period from May to July 2003 on 12 Murciano-Granadina goat herds reared on farms of the Asociación Española de Criadores de la Cabra Murciano-Granadina (ACRIMUR), in the Murcia (southeastern) region of Spain. This organisation is responsible for the national breeding programme for this particular breed. There was no movement of animals or personnel between the farms studied. The herds ranged in size from 120 to 450 lactating goats, machine-milked once daily. In all herds, the milking parlour was separated from the housing area and the milk was conducted by milk pipeline to the receiver jar connected by milk delivery line to the refrigeration tank located in a separate room. Milking routine did not include prior udder preparation or milking-unit sanitation between goats and post-dipping teat disinfection was carried out using iodine solution by dipper cup or teat sprayer. After milking, the milking equipment was cleaned according to the standard protocols provided by the manufacturer. Animals were periodically immunised against enzootic abortion, contagious agalactia and enterotoxaemia. All the herds were classified free of brucellosis and tuberculosis and were under a mastitis control programme based on monitoring the somatic cell count and selective antibiotic dry therapy. The practice of artificial rearing, in which kids are withdrawn after parturition and fed pasteurised colostrum and milk replacer, was implemented in eight of the herds. Nine of the 12 herds were allocated indoor space with free access to an open yard and were fed a balanced total mixed ration and alfalfa hay. The other three herds were given a similar diet but had access to pasture (three hours per day).

On the day of sampling, the farm owners declared that their herds had not had abortions nor were any of their animals currently suffering from digestive disorders. Healthy animals were randomly selected and 222 faeces samples were collected. Animals of up to four weeks of age were classified as goat kids (n=40), those between one and nine months old were classified as replacement animals (n=81) and those older than nine months were classified as adults (n=101). Faeces were obtained directly from the rectum using swabs and transferred to tubes containing Amies transport medium (Deltalab, Barcelona, Spain) or Cary Blair transport medium (Deltalab). Additionally, one sample of bulk tank milk was taken from each of the 11 herds. Milk samples were collected into sterile containers (30ml) after agitation

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of the bulk tank milk at 5°C. On the day of sampling, all samples were submitted to the laboratory by express mail in refrigerated containers and they were processed within 24 hours of reception.

The procedures for the isolation of *Salmonella* species included enrichment of swabs with Amies transport medium and enrichment of milk samples in tetrathionate broth (Difco, Becton Dickinson, Sparks, Maryland, USA), supplemented with 40mg/ml novobiocin (Sigma, Sigma-Aldrich, St. Louis, Missouri, USA). After 24 hours of incubation at 37°C, samples were plated onto XLD agar (Difco), and they were incubated for 24 hours at 37°C.

The procedures for the isolation of *Campylobacter* species included enrichment of swabs with Cary Blair transport medium and enrichment of milk samples in Bolton selective enrichment broth (Oxoid, Basingstoke, UK). The broths were incubated at 37°C for 48 hours in a microaerophilic atmosphere achieved using commercial gas-generating kits (CampyGen, Oxoid). Following incubation, samples were plated on Karmali selective medium (Oxoid) and Abeyta-Hunt-Bark agar (Hunt *et al*., 2001) and they were incubated in a microaerophilic atmosphere at 37°C for 48 hours.

Results and discussion

Neither *Salmonella* nor *Campylobacter* spp were recovered from the faeces samples or milk samples. In Italy, Cortesi *et al.* (1984) evaluated *Salmonella* carriage in 40 healthy goat kids at slaughter, and recovered *Salmonella* from the intestinal contents of only one animal. However, in Nigeria, Adesiyun *et al.* (1988) isolated *Salmonella* spp from intestinal contents, bile and mesenteric lymph nodes in 19 (9.5%) of 200 slaughtered goats, although these bacteria could be isolated from the intestinal contents of only five (2.5%) of the animals studied.

The carriage rates reported in those studies on intestinal contents of animals at slaughter contrast with the null rate in our survey; perhaps, the difference in procedure for the collection of the samples may have been a significant contributory factor to that contrast. Samples taken at slaughter can lead to overestimates of normal prevalence, since it has been shown that the stress of transportation and of food withdrawal experienced by animals before slaughter increases the number of shedders of *Salmonella* spp among these animals (Ekperigin and Nagaraja, 1998). The overall impression from the three studies is that *Salmonella* spp are rarely isolated from the intestinal contents or faeces of healthy goats.

Here, failure to find *Campylobacter* spp in the faeces of any of the healthy goats is consistent with the results of an earlier study in Norway in which neither *Campylobacter jejuni* nor *Campylobacter coli* was found in any of the rectal swabs and stool specimens of the goats examined (Rosef *et al*., 1983). Nevertheless, other investigators have reported the isolation of *Campylobacter* spp from rectal swabs or faeces samples of healthy goats, although rates have been highly variable. In Canada, Prescott and Bruin-Mosch (1981) were able to identify *C. jejuni* in 2.7% of the animals studied. Turkson *et al.* (1988), in Kenya, found *Campylobacter* species in 6.3% of the goats sampled, and Abrahams *et al.* (1990) in Ghana detected *C. jejuni,* but not *C. coli*, in a high proportion (33.3%) of the goats tested. These different carriage rates could be attributable to contact of goats with other animal species. Thus, Jiwa *et al.* (1994) explored the prevalence of *Campylobacter* spp in healthy goats kept under various management systems in Tanzania and observed that goats kept away from other farm animals, irrespective of whether the management system was good or poor, were negative for *Campylobacter* spp. However, three out of 20 goats confined to a small area, but in contact with *C. coli*-positive pigs and chickens became infected with *C. coli*. The results of that study suggest that goats are not natural hosts of *Campylobacter* spp and that pigs and poultry may be a source of infection. Hence, the lack of faecal carriers of *Campylobacter* spp reported here could be explained by the fact that the goats were not in contact with other animals, together with other factors such as the breed of goat and the environmental conditions.

The failure to isolate *Salmonella* spp or *Campylobacter* spp from the bulk tank milk of the herds examined here does not provide evidence of contamination by faecal carriers, which are generally the main source of these pathogens in raw milk. This finding is in agreement with those obtained by other authors, who failed to detect these bacteria in unpasteurised milk from goats (Jiwa *et al.*, 1994; Little and de Louvois, 1999; Foschino *et al*., 2002; Morgan *et al*., 2003; Muehlherr *et al*., 2003). In cow bulk tank milk samples, several studies have reported a frequency of isolation that ranged between 0.4% and 12.3% for *C. jejuni* and between 0.2% and 8.9% for *Salmonella*. The results so far obtained for the milk of healthy goats suggest that goat's milk is a safer product than cow's milk. However, further studies are necessary to evaluate the risk of these pathogens contaminating milk in the bulk tank whenever there are clinical cases in the herd.

In conclusion, the healthy Murciano-Granadina dairy goats examined were free of *Salmonella* spp and *Campylobacter* spp. This suggests that, under the management practices applied to this breed in Spain, there is a very low risk that Murciano-Granadina goats will serve as a reservoir for these food-borne pathogens.

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