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Effects of bacterial inoculants in milk on the performance of intensively reared calves

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ABSTRACT

The aim of this study was to evaluate the effects of probiotics on the feed intake, body weight gain (BWG), feed efficiency (FE) and fecal microbiota of intensively reared calves fed milk inoculated with probiotic bacteria in a computerized milk feeder system. Thirty Holstein calves were allocated into three groups: group A, supplemented with an inoculum comprising *Lactobacillus casei* DSPV 318T, *Lactobacillus salivarius* DSPV 315T and *Pediococcus acidilactici* DSPV 006T; group B, supplemented with an inoculum comprising *Lactobacillus plantarum* DSPV 354T; and group C, control without probiotics. The calves were examined for 21 days. Inocula were added to the tank milk, and the daily dose for each calf was approximately 10 log CFU. The total *Lactobacillus*, inoculum strains, coliforms, yeast and enterococci in the stool and the total *Lactobacillus*, inoculum strains and pH in the tank milk were determined weekly. The lactic acid bacteria (LAB) in groups A and B produced enough acid to bring the milk to a pH lower ($P < 0.05$) than that of the control milk. Fermentation increased the shelf life of the milk, thereby avoiding the need to frequently discard the milk and reducing the costs for the use of the computerized milk feeder system. The probiotics-stimulated milk intake ($P < 0.05$) was compared with that of the control group. *L. casei* DSPV 318T, *L. salivarius* DSPV 315T, *P. acidilactici* DSPV 006T and *L. plantarum* DSPV 354T were present in the gastrointestinal tracts of the calves in the probiotics groups. In addition, the *Lactobacillus*/coliform ratio was greater than 1 in the probiotics groups and lower than 1 in the control group. BWG and FE were higher for group B than for group C. The presence of *L. plantarum* DSPV 354T and its dominance over coliforms in the fecal microbiota might have positive effects on the growth performance of calves.

Abbreviations: BWG, body weight gain; DMI, dry matter intake; FE, Feed efficiency; LAB, lactic acid bacteria.

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1. Introduction

Probiotics have been widely studied as prophylactics in intensive systems to maintain intestinal balance, improve performance and reduce the incidence of intestinal pathogens (Mokhber-Dezfouli et al., 2007; Signorini et al., 2012; Frizzo et al., 2011b). In these systems, probiotics are typically added to the milk or milk replacer immediately before it is consumed by the calf (Cruywagen et al., 1996; Ewaschuk et al., 2004; Higginbotham et al., 1998; Jenny et al., 1991). In these cases, the probiotics are individually dosed for each calf, generating more work on the farm for the implementation of this tool. Furthermore, when consumed, the bacteria are live but inactive because they are not activated prior to addition to the feed.

Group feeding conditions using computerized feeder systems increase the risk of disease transmission (Maatje et al., 1993). However, the use of computerized systems is becoming a more common rearing practice on dairy farms, primarily due to the reductions in labor requirements (Morrison et al., 2010). Morrison et al. (2010) previously reported on the use of probiotics in the group feeding of calves using a computerized feeder system, but there are no published data on the effects of probiotics for milk fermentation directly in the feeder tank.

The probiotic effect exerted on the host will depend on the composition of the inoculum. Each strain has unique characteristics (Ripamonti et al., 2011; Monteagudo-Mera et al., 2012), and thus, the effect on the parameters of interest must be evaluated for each particular inoculum. This study evaluates the effects of probiotic inocula on the performance of calves under group feeding conditions, in which the strains are metabolically active at the time of administration. The computerized milk feeder system could be a suitable method for the administration of probiotic inocula, ensuring that microorganisms are viable and metabolically active at the time of intake and that the delivered concentration is adequate for each animal. The hypothesis tested in this work is that supplementation of milk-fed calves with probiotic strains through an automated system will improve performance.

The aim of this study was to evaluate the effect of probiotic bacteria administered with milk on the feed intake, body weight gain (BWG), feed efficiency (FE) and fecal microbiota of intensively reared calves fed milk inoculated with probiotic bacteria in a computerized milk feeder system.

2. Materials and methods

2.1. Animals and housing

The experiments were performed on a farm in the province of Santa Fé (Argentina) during autumn (average temperature: 11.6 °C). Thirty female Holstein calves (*Bos taurus*) with an average age of 20 ± 2.5 days and an average initial body weight of 37 ± 3.1 kg were used. Each group was housed in a 480 m^2 barnyard. The animals were fed using a computerized milk feeder system (DeLaval CF150®), with a maximum of 6 L/d.calf of pasteurized milk and feed starter, with water available *ad libitum*. The equipment was cleaned every 12 h. For cleaning, the milk was removed from the feeder tank. Once the system was clean, the milk for the probiotics groups was returned to the tank, and the milk for the control group was discarded and replaced with fresh milk.

Animal care was provided according to the guidelines for the care and use of animals in research and teaching (FASS, 1998). The protocol used was approved by the Advisory Committee on Ethics and Security of the Facultad de Ciencias Veterinarias, Universidad Nacional del Litoral (Santa Fe, Argentina).

2.2. Experimental design

The animals were divided into three groups of 10 animals (group A, group B, and group C (control)) using a completed randomized design based on the live weight. Calves were examined for a period of 21 days. Individual measurements of milk and starter intake were recorded on a daily basis. The ratio of milk to starter for each animal was controlled using a computerized system that regulates and records the individual dose of feed intake. Starter was given *ad libitum*. The body weight gain (BWG) of the animals was measured weekly, after 1, 2 and 3 weeks of inoculum administration.

The feed efficiency (FE) was calculated as using the following equation:

$$\mathrm{FE} = \frac{\text{kg of weekly weight gain}}{\text{kg of weekly dry matterintake}} \quad (1)$$

where dry matter (DMI) was calculated as follows:

$$\mathrm{DMI} = (\text{weekly milk intake (L)} \times 0.129) + \text{concentrate intake (kg)} \times 0.95 \quad (2)$$

where 0.129 is the solid concentration of the milk according to Alais (1985) and 0.95 is the solid concentration of the starter according to the supplier (Iniciador Terneros PLT, Boostermix Bovinos, Alimental®).

2.3. Microorganisms

The probiotic inoculum administered to group A comprised *Lactobacillus casei* DSPV 318T, *Lactobacillus salivarius* DSPV 315T and *Pediococcus acidilactici* DSPV 006T, with the following rDNA GenBank accession numbers: FJ787305, FJ787306