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Effects of short-chain fructooligosaccharides on growth performance of preruminant veal calves

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ABSTRACT

This study was conducted to evaluate the effects of 2 different daily doses of short-chain fructooligosaccharides (scFOS), a prebiotic ingredient, added to a calf milk replacer on growth performance, carcass characteristics, and fecal concentrations of short-chain fatty acids of preruminant veal calves. In total, 112 male Prim'Holstein calves, between 8 and 10 d of age, were randomized in this study according to their body weight and were bred until the age of 168 d. They were fed a calf milk replacer containing 5% soluble wheat proteins as well as cereal-based pellets, the composition of which was adapted to cover the needs of the animals throughout the study. After 2 wk of adaptation, the calf milk replacer was supplemented or not supplemented with a daily dose of 3 or 6 g of scFOS. Growth performance of calves, as measured by body weight, cold carcass weight, feed intake, average daily gain, and feed conversion ratio, was recorded and feces samples were taken to evaluate short-chain fatty acid concentrations. The inclusion of wheat proteins in milk replacer did not negatively affect the growth performance of calves in comparison with general standards. The addition of scFOS in the milk reduced the feed conversion ratio of veal calves in a dose-dependent manner and tended to increase the carcass weight. A general trend was observed for an increased production of total short-chain fatty acids in time, but scFOS decreased acetate proportion to the benefit of butyrate proportion. These data suggest that inclusion of scFOS in the calf milk replacer allowed the growth performance of preruminant calves to be enhanced, possibly via a modification of the activities of microbial fermentation.

Key words: veal calf, growth performance, prebiotic, fructooligosaccharide

INTRODUCTION

Short-chain fructooligosaccharides (**scFOS**) are soluble fibers naturally found in vegetables, such as onion, garlic, or wheat. They can also be produced by the transfructosylation of sucrose. Short-chain fructooligosaccharides are composed of a mixture of oligosaccharides consisting of glucose linked to fructose units by β-(1,2) links that are not digestible by human enzymes but can be fermented by some strains of *Bifidobacterium* and *Lactobacillus* in the large intestine of humans (Roberfroid et al., 2010) and animals (Howard et al., 1995; Swanson et al., 2002a; Xu et al., 2003), including veal calves (Bunce et al., 1995; Philippeau et al., 2010). According to Gibson et al. (2004), scFOS are recognized to have prebiotic properties: (1) they are resistant to gastric acidity, to hydrolysis by mammalian enzymes, and to gastrointestinal absorption; and (2) they are fermented by intestinal bacteria; (3) thus, they selectively stimulate the growth, activity, or both of bacteria associated with health and well-being.

As shown in veal calves and in other animal species, by modulating the gut microbiota, scFOS can enhance the bacterial production of short-chain FA (**SCFA**) in the large intestine. Cecal and colonic cells can use these fermentation products, especially butyrate, as an energy source, leading to an improved mucosal structure. In piglets, dietary supplementation with scFOS has been shown to increase villus height and crypt depth in the large intestine (Howard et al., 1995; Spencer et al., 1997; Tsukahara et al., 2003). Possibly linked to the selectivity of the fermentation of scFOS in the large intestine, scFOS may improve the zootechnical performance of commercial animal species such as pigs or broilers (Howard et al., 1999; Xu et al., 2003, 2005). In veal calves fed a high quantity of lactose, a short-term dietary supplementation with scFOS enhanced ADG and feed conversion ratio (**FCR**; Kaufhold et al., 2000).

The objectives of this experiment were to evaluate, during the whole period of rearing, the effects of 2 different daily doses of scFOS added to a calf milk replacer (**CMR**) containing wheat proteins on growth

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Table 1. Composition of the basal calf milk replacer

Item	Starter feed (d 8 to 36)	Grower feed (d 37 to 92)	Finisher feed (d 93 to 168)
Ingredient composition, % (as fed)			
Whey	52.7	48.2	44.3
Whey protein concentrate PS35	15.5	18.7	14.2
Others vegetable proteins	6.0	4.5	4.5
Wheat protein hydrolysate[1]	5.2	6.0	5.7
Copra	4.9	4.4	4.1
Lard	4.9	7.0	5.4
Tallow	4.9	6.1	8.5
Soybean oil-palm oil	1.6	—	—
Palm	1.1	—	—
Premix	1.0[2]	1.0[2]	1.0[2]
Soy	0.5	—	—
Rapeseed	0.1	—	—
Calcium carbonate	0.4	0.5	0.7
Lysine	0.4	0.4	0.4
Monopotassium phosphate	0.2	—	—
Adjuvant/additive	0.8	0.8	0.8
Wheat flour	—	2.5	4.0
Lactose	—	—	1.3
Buttermilk 0%	—	—	5.0
Nutrient composition, % (calculated)			
Crude fat	17.3	18.5	19.0
Ash	7.1	6.6	6.5
CP	19.56	20.60	19.45
Lysine	1.53	1.65	1.57
Methionine + cysteine	0.85	0.90	0.85
Proteins from dairy products	11.73	12.35	11.68
Proteins from vegetable products	7.83	8.24	7.77
Digestible energy, kcal/kg	4,444	4,546	4,547

[1]Solpro 508 (Syral Belgium NV, Aalst, Belgium).

[2]Premixes were different for each period. The starter feed did not contain lysine.

performances, carcass characteristics, and fecal concentrations of SCFA of veal calves.

MATERIALS AND METHODS

The present experiment complied with French ethics laws and was conducted under the direction of G. Bertrand from Institut de l'Elevage (Le Rheu, France).

Animals and Diets

A total of 112 male Prim'Holstein calves, between 8 and 10 d of age, were used in this experiment. A few days after their arrival, the animals were allocated to 1 of 3 groups according to their BW (n = 36 in the control group, and n = 38 in the other 2 groups). Animals were fed a CMR, without skim milk but containing soluble hydrolyzed wheat proteins (Solpro 508, Syral Belgium NV, Aalst, Belgium), given in buckets, twice a day during the entire study. After 2 wk of feeding, the CMR was supplemented or not supplemented with an equivalent dose of 3 or 6 g/d of scFOS (Profeed P95, 95% of scFOS with a degree of polymerization between 3 and 5; Beghin Meiji, Marckolsheim, France) immediately before distribution to the animals. The composition of the basal milk replacer is given in Table 1.

Animals also received solid feeds under the form of cereal-based pellets, once a day within 1 h after the morning CMR feeding. The composition of the solid feed was adapted to the requirements of the animals throughout the study. From d 8 to 36 of life, the solid feed (starter feed) was distributed at the level of 20 to 50 g/d per calf; from d 37 to 92, 60 to 160 g of the grower feed was offered per day; and from d 93 to the end of the experiment (d 168) animals received 160 to 250 g of the finisher feed per day. A transition period lasting 6 d between each type of feed was respected.

Measurements of Growth Performance and Health Records

All calves were weighed at the beginning of the study (d 8; equivalent to 8 d of age), at d 43, 64, 92, 120, and the day before slaughter (d 167). Feed intake was recorded during each feeding period of the study (growing period: d 8 to 92; finishing period: d 93 to 168). From these data, ADG and FCR were calculated.

At the end of the study (d 168), animals were stunned approximately 30 s before slaughter and exsanguination. The cold carcass weight, defined as the weight of the animal after bleeding and removal of the viscera, feet, head, hide, and tail, was recorded.