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Effects of the provision of solid feeds enriched with protein or nonprotein nitrogen on veal calf growth, welfare, and slaughter performance

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ABSTRACT

The study compared the effects of enriching a basic solid feed mixture made of corn grain and straw with a protein source (extruded pea) or with urea on growth, health, behavior, and carcass quality of veal calves. Seventy-nine calves, divided according to their initial body weight (59.8 ± 6.9 kg) into 3 groups (5 pens of 5 or 6 animals per group), were allotted to 1 of 3 experimental feeding treatments: milk replacer plus an 85:15 (as-fed basis) mixture of corn grain and wheat straw (CGS); milk replacer plus a 72:15:13 mixture of corn grain, wheat straw, and extruded pea (CGS-EP); or milk replacer plus an 83.3:16:0.7 mixture of corn grain, wheat straw, and urea (CGS-U). All feeding treatments were targeted to provide 140 kg of dry matter (DM)/calf of solid feed during the 201-d fattening cycle, and the greater crude protein content of the mixtures supplemented with protein or urea was balanced by restricting to 96% the daily amount of milk replacer delivered to CGS. Results did not differ among feeding treatments for average daily gain or solid feed intake but, net of meal refusal events, the average daily intake of milk replacer was 1.73, 1.66, and 1.60 kg of DM/calf for CGS, CGS-EP, and CGS-U, respectively. The overall mean hemoglobin values from samples taken at d 11, 40, 83, 126, and 196 were lower for CGS-U calves (9.1 ± 0.2 g/dL) compared with CGS (9.8 ± 0.2 g/dL), whereas those of CGS-EP were intermediate (9.4 ± 0.2 g/dL). Behavioral observations showed a frequency of oral stereotypes <1.2% for all feeding treatments. Longer eating and chewing or ruminating time was recorded for CGS-U calves compared with CGS and CGS-EP calves. All carcasses had satisfactory color for the veal market and none of the carcass traits were affected by the feeding treatments. The proportions of tongues and lungs with signs of lesions, forestomach development, abomasal lesions, and rumen plaques did not differ among feeding treatments. Hyperkeratinization of rumen papillae was observed only in CGS-U calves with a prevalence of 11.3%. Based on these findings, providing a corn grain and straw solid feed mixture enriched with extruded pea or urea was an effective strategy to reduce milk replacer consumption, lowering total feeding cost per calf by 3.0 to 3.4% and 6.9 to 7.2%, respectively. This economic advantage was supported by the lack of detrimental effects on calf growth performance, behavior, and carcass quality. However, the occurrence of rumen papillae hyperkeratosis may raise some concerns about the use of urea.

Key words: veal calf, solid feed, nitrogen source, welfare

INTRODUCTION

Legislation on animal welfare in Europe made mandatory the provision of solid feed to milk-fed veal calves but without specific guidelines regarding their type and composition (European Council Directive 2008/119/EC, 2008; European Union, 2009). In recent years, the veal calf industry has faced a sharp increase in production costs driven by the global increase in the price of skim milk powder. This has spurred farmers to develop new feeding plans using large amounts of solid feeds with different compositions as partial substitutes for the expensive milk replacers. Cereal grains were preferentially used for their low iron content, which allowed production of pale-colored meat. However, several studies proved that, despite promoting fast gain (Suárez et al., 2006), cereal grains were not the ideal option for calf welfare because of their negative effects on gastrointestinal health and behavior (Cozzi et al., 2002a; Mattiello et al., 2002). A suggested alternative was partial replacement of the grains with a roughage source, which has been shown to promote chewing and reduce oral stereotypies (Cozzi et al., 2002b) and decrease rumen mucosa hyperkeratosis and plaques (Brscic et al., 2011). Recently, Prevedello et al. (2012) studied the effect of introducing a protein source in the solid feed, along with a proportional reduction of the amount of milk replacer. Results showed that this feeding strategy, in which the chemical composition of the solid feed

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was closer to that of diets for preweaned calves, was effective in improving veal calf health and welfare and reducing milk replacer meal refusals and rumen mucosa alterations. Aiming at reducing the cost of feed, diets for fattening cattle commonly combine feed proteins with small amounts of nonprotein nitrogen sources such as urea (Duff et al., 2003; Zinn et al., 2003). So far, this strategy has not been tested on veal calves, but the use of urea might be particularly interesting as an iron-free source of nitrogen that should not have a direct effect on meat color.

To make a scientific contribution to the definition of a suitable solid feed for veal calves, the present study compared the effects on growth, health, behavior, and carcass quality of a basic mixture made of corn grain and straw provided alone or enriched with a protein source (extruded pea) or with urea.

MATERIALS AND METHODS

Animals and Housing

This study was carried out using 81 male Polish Frisian veal calves reared in a commercial veal calf farm located in the Veneto region (Italy) in compliance with the legislation on their protection [European Council Directive 2008/119/EC, 2008 (European Union, 2009); Decreto Legislativo 2011/126 (Ministero della Salute, 2011)]. Two out of 81 calves were excluded early from the study because they did not habituate to the bucket milk feeding and were, therefore, moved from the trial pens to the weaning pen of the farm. The remaining 79 calves, weighing 60.4 kg ± 4.1 (±SD) of BW upon the arrival at the farm, were allotted according to their initial BW to 3 experimental groups in 5 contiguous group pens within treatment of 5 or 6 animals located within the same barn. All pens had fully slatted wooden floors and allowed a space of 1.8 m^2/calf.

Feeding Treatments and Management

After an adaptation period of 35 d in which all calves received the same feeding plan of milk replacer and an 85:15 mixture (as-fed basis) of corn grain and 5-cm chopped wheat straw (Table 1), the 3 groups of calves were randomly assigned to 1 of the following feeding plans: (1) milk replacer plus the basic solid mixture provided during the adaptation period (**CGS**); (2) milk replacer plus a 72:15:13 mixture (as-fed basis) of corn grain, 5-cm chopped wheat straw, and extruded pea, respectively (**CGS-EP**); and (3) milk replacer plus an 83.3:16:0.7 mixture (as-fed basis) of corn grain, 5-cm chopped wheat straw, and urea, respectively (**CGS-U**). Details of the experimental diets are given in Table 1.

Regardless of treatment group, all calves received the same milk replacers. A starter milk replacer (Spraymes Rosso 50, Sloten Italia, Crema, Italy) containing 50% skim milk powder was provided during the adaptation period of 35 d. During the subsequent transition period of 20 d, calves were gradually shifted to a grower-finisher milk replacer (Spraymes Verde Unico Energy 30, Sloten Italia) made with 30% skim milk powder (Table 1). The daily amount of milk replacer powder and its concentration in the liquid diet were progressively increased during the fattening period from 193 to 2,800 g of DM/calf and from 4 to 18%, respectively. The daily concentration of milk replacer was the same across feeding treatments but, to provide isonitrogenous diets, the greater N content of the solid mixtures supplemented

Table 1. Chemical composition (mean ± SD) of the feeds delivered to veal calves during the fattening cycle

	Milk replacer		Solid feed (as-fed basis)		
Item	Starter[1]	Grower/finisher[2]	Corn grain + straw (85:15)	Corn grain + straw + extruded pea (72:15:13)	Corn grain + straw + urea (83.3:16:0.7)
DM, %	96.5 ± 0.2	96.5 ± 0.4	88.3 ± 0.6	88.8 ± 0.5	88.4 ± 0.7
CP, % of DM	23.8 ± 0.6	22.1 ± 1.4	7.6 ± 0.1	10.0 ± 0.1	9.6 ± 0.6
Ether extract, % of DM	18.7 ± 0.3	22.8 ± 1.0	3.5 ± 0.4	3.5 ± 0.4	3.5 ± 0.4
Ash, % of DM	7.4 ± 0.2	7.8 ± 0.3	2.1 ± 0.2	2.3 ± 0.2	2.2 ± 0.2
NDF, % of DM	0.2 ± 0.1	0.4 ± 0.1	22.5 ± 1.3	23.1 ± 1.1	23.2 ± 1.3
NFC,[3] % of DM	49.9 ± 0.4	46.9 ± 0.9	64.2 ± 1.8	61.0 ± 1.5	61.6 ± 2.2
Iron, mg/kg	5.6 ± 0.8	7.9 ± 1.2	29.9 ± 14.3	35.9 ± 14.1	30.6 ± 15.1
Gross energy, MJ/kg of DM	20.6	21.3	18.8	18.7	18.8
UFV,[4] /kg of DM			1.14	1.13	1.12

[1]Ingredient composition of starter milk replacer: skim milk powder, whey powder, vegetable and animal lipid sources, starch, wheat protein, and premix.

[2]Ingredient composition of grower/finisher milk replacer: whey powder, skim milk powder, vegetable and animal lipid sources, starch, and premix.

[3]NFC calculated as 100 − (NDF + CP + ether extract + ash).

[4]Unité *fourragère* viande (76.1852 MJ) estimated using reference values proposed by INRA (1988) for solid feed ingredients.