J. Dairy Sci. 99:1–10
http://dx.doi.org/10.3168/jds.2015-10682

The importance of calf sensory and physical preferences for starter concentrates during pre- and postweaning periods

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ABSTRACT

We performed 3 studies to evaluate the effects of feed sensory and form preferences in young calves on performance and rumen fermentation dynamics. In experiment 1, starter feeds containing wheat and soybean meal; wheat and canola meal; and oats and soybean meal were evaluated in 63 calves (9 ± 0.9 d old). In experiment 2, 37 crossbreed female calves were used from 4 to 45 d of age (weaning) in a cafeteria study consisting of 4 different presentations of the same starter feed: meal, pellet, pellet mixed with whole-cereal grains (WHG), and pellet mixed with steamed-rolled cereal grains (SRG). In experiment 3, 63 Holstein male calves (10 ± 1.03 d old) were randomly distributed to 2 treatments that consisted of feeding a pellet concentrate mixed with whole corn and barely grains (WHG) or the same pellet concentrate mixed with steamed-rolled corn and barley grains (SRG). In experiment 1, animals in all 3 treatments had similar intake and performance, and we found no differences in rumen fermentation parameters. In experiment 2, during the first week of study, calves had a greater preference for WHG; after the first week, calves had a greater preference for SRG. In experiment 3, starter concentrate intake was greater in WHG than in SRG concentrates between wk 5 and weaning. However, we observed no differences in growth or gain-to-feed ratio. Calves offered WHG concentrates had greater rumen pH and tended to have lower total rumen volatile fatty acid concentrations than those offered SRG concentrates. We concluded that preweaned calves preferred concentrates based on pellets mixed with steamed-rolled grains. When calves could not choose their starter feed, pellets mixed with steamed-rolled grains reduced concentrate intake and rumen pH compared to pellets mixed with whole grains, but performance was not impaired. Formulating starter concentrates according to calves' sensory and physical preferences had little effect on performance.

Key words: calves, choice, intake, performance

INTRODUCTION

The transition of dairy calves from a liquid to a solid diet is a crucial phase for ensuring sufficient concentrate and forage intake and avoiding a growth slump at weaning. Different feeding strategies have been studied at weaning to address this problem: (1) the use of feed additives to promote rumen development (Hill et al., 2009); (2) the use of ingredients with high sugar content to stimulate concentrate intake (Lesmeister and Heinrichs, 2005; Beiranvand et al., 2014); (3) changing the physical form of the feed (Bach et al., 2007; Terré et al., 2015); and (4) weaning groups of calves rather than individual hutches (Bach et al., 2010).

Miller-Cushon et al. (2014a) demonstrated that young calves have a marked preference for wheat, corn, and barley as energy ingredients, and for soybean as a protein ingredient. In contrast, young calves have a low preference for gluten feed, gluten meal, and canola meal. Montoro and Bach (2012) reported that calves given the opportunity to compose their own diet using 6 different ingredients in a cafeteria study were unable to balance their nutrient intake because they consumed excessive protein (without improving performance) compared with calves fed a starter feed balanced according to the NRC (2001) model. The findings of Miller-Cushon et al. (2014b) also demonstrated that calves had a high preference for soybean products. They found that calves had the capacity to sort in favor of soybean pellets in a starter concentrate composed of a mixture of 2 pellets, one containing soybean and the other containing the rest of the ingredients. It seems plausible to expect that formulating starter feeds for calves with highly preferred ingredients should enhance concentrate intake early in life.

Several studies have compared different feed presentations for dairy calves (Franklin et al., 2003; Bach et al., 2007; Terré et al., 2015), but studies evaluating calves' preferences for different feed form presentations are scarce. Bach et al. (2007) reported that solid feed consumption was greater in calves offered a multiparti-

Received November 25, 2015.
Accepted May 8, 2016.
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cle (or texturized) starter than in calves offered a meal starter feed, but interestingly, calves offered a meal feed were more efficient than those offered a multiparticle feed. Recent studies (Khan et al., 2011; Castells et al., 2012; Terré et al., 2015) have proposed feeding a concentrate pellet plus chopped hay or straw as an effective strategy for stimulating concentrate intake and increase rumen pH. However, Terré et al. (2015) compared a pelleted starter and chopped straw with the same starter offered either alone or as a mixture of pellet and whole corn and showed that calves eating the pelleted starter alone or with whole corn had similar rumen pH to calves eating the pelleted starter with straw. Several studies have shown that processing corn grain has little effect on calf performance (Bateman et al., 2009); whole corn and dry-rolled corn have been reported to improve concentrate intake most effectively (Lesmeister and Heinrichs, 2004).

The hypothesis of the present study was that offering preferred ingredients in a starter concentrate to young calves would be an effective practice for stimulating concentrate intake. We also hypothesized that if calves showed preferences for a specific presentation of starter concentrate during the preweaning period, offering that presentation during preweaning would help calves through the transition toward a full solid diet. The objectives of this research were to determine strategies for stimulating concentrate intake (and growth performance) early in life using preferred ingredients in the formulation of starter concentrates for young calves, and quantifying the potential changes (and their consequences) in preferences for feed presentation before and after weaning.

MATERIALS AND METHODS

Experiment 1

Sixty-three Holstein male calves (9 ± 0.9 d old, 41.4 ± 1.26 kg of BW) were randomly distributed to 3 groups, each receiving 1 of the following solid feeds: (1) a pelleted starter feed containing wheat, a highly preferred energy source, and soybean meal, a highly preferred protein source (**WS**); (2) a pelleted starter feed containing wheat, a highly preferred energy source, and canola meal, a poorly preferred protein source (**WC**); and (3) a pelleted starter feed containing oats, a poorly preferred energy source, and soybean meal, a highly preferred protein source (**OS**). The ingredients and nutrient composition of these 3 starter feeds are described in Table 1.

Calves were purchased from commercial farms, raised in the facilities of Torre Marimon (Caldes de Montbui, Spain), and managed according to the recommendations of the Animal Care Committee of Institut de Recerca i Tecnología Agroalimentàries (**IRTA**). Animals were housed in individual pens (1.6 × 1.0 m) and bedded with sawdust. Three days after arrival, calves were vaccinated against respiratory syncytial virus (Rispoval RS; Pfizer Animal Health, Madrid, Spain). All calves received the same milk replacer (**MR**) containing 25% CP and 19.2% fat (Sprayfo Excellent 60; Sloten BV, Deventer, the Netherlands). Milk replacer was offered in 2-L bottles twice daily at 0700 and 1600 h. During the first 7 d of the study, calves were offered 4 L of MR/d at 12.5% DM concentration. Then, calves received 6 L of MR/d at 12.5% DM concentration until d 35 of the study. From d 36 to 42 of the study, calves received only a morning feeding of 3 L at 12.5% DM. Calves were weaned at d 43of the study, and the study ended on d 56 (65 ± 0.9 d old).

A pelleted starter feed and barley straw (85% NDF, 58% ADF, 2.4% CP, on a DM basis) were fed ad libitum in 2 separate buckets 1 h after the morning MR. Straw was chopped using a forage chopper machine

Table 1. Ingredient and chemical composition (DM basis) of experimental concentrates fed to calves in experiment 1[1]

Item	WS	WC	OS
Ingredient, %			
Wheat meal	22.0	22.0	—
Corn meal	24.0	18.0	26.5
Barley meal	11.7	9.2	17.2
Oats meal	—	—	24.0
Soybean meal	17.5	—	18.5
Wheat middlings	12.0	12.0	12.0
Canola meal	—	15.0	—
Peas meal	—	12.0	—
Corn dried distillers grains	—	10.0	—
Soybean hulls	10.5	—	—
Tallow	0.5	—	—
Premix[2]	0.2	0.2	0.2
Calcium carbonate	0.5	0.5	0.5
Dicalcium phosphate	0.3	0.3	0.3
Sodium chloride	0.8	0.8	0.8
Chemical composition			
CP, %	18.4	18.3	20.1
NDF, %	22.4	22.9	19.7
ADF, %	10.9	10.5	8.9
Starch, %	43.8	44.0	43.7
Ether extract, %	4.5	5.3	4.1
Ash, %	5.4	5.2	6.3
ME,[3] Mcal/kg	2.92	3.00	3.05

[1]WS = concentrate based on wheat and soybean meal; WC = concentrate based on wheat and canola; OS = concentrate based on oat meal and soybean meal.

[2]Mineral and vitamin composition: vitamin A 2,500,000 IU/kg, vitamin D_3 500,000 IU/kg, vitamin E 1,500 IU/kg, vitamin B_1 125 mg/kg, vitamin B_2 125 mg/kg, ferrous sulfate 5,750 mg/kg, zinc oxide 8,750 mg/kg, cupric sulfate 2,500 mg/kg, manganous oxide 7,500 mg/kg, cobalt 100 mg/kg, potassium iodide 150 mg/kg, sodium selenite 25 mg/kg, magnesium oxide 12,000 mg/kg.

[3]Calculated using NRC (2001) equations.