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Abstract

To evaluate the effect of roasting soybeans and corn on performance of young dairy calves, newborn Holstein calves (n= 132) were blocked by sex and birth date and randomly assigned to one of six isonitrogenous calf starters. The starters were formulated using soybean meal or soybeans roasted at 280 or 295 °F. Each of these protein sources was used with either raw corn or corn roasted at 280°F. Diets were offered ad libitum from .5 to 8 wk of age. Calves were fed milk at 4% of birth weight twice daily and weaned when they consumed 1.5 lb of starter per day for 3 consecutive days. Soybeans roasted at 295 °F resulted in improved overall calf performance. Roasted corn enhanced performance of calves fed soybean meal but did not alter performance of those fed soybeans roasted at 280 °F and depressed performance of calves fed soybeans roasted at 295 °F. These effects were more pronounced during the postweaning period (6 to 8 wk). These results demonstrate the importance of nutrient interactions in young dairy calves, especially when processed grains are fed.; Dairy Day, 1993, Kansas State University, Manhattan, KS, 1993;

Keywords

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EFFECT OF ROASTING SOYBEANS AND CORN ON DAIRY CALF PERFORMANCE

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Summary

To evaluate the effect of roasting soybeans and corn on performance of young dairy calves, newborn Holstein calves (n= 132) were blocked by sex and birth date and randomly assigned to one of six isonitrogenous calf starters. The starters were formulated using soybean meal or soybeans roasted at 280 or 295 °F. Each of these protein sources was used with either raw corn or corn roasted at 280°F. Diets were offered ad libitum from .5 to 8 wk of age. Calves were fed milk at 4% of birth weight twice daily and weaned when they consumed 1.5 lb of starter per day for 3 consecutive days. Soybeans roasted at 295 °F resulted in improved overall calf performance. Roasted corn enhanced performance of calves fed soybean meal but did not alter performance of those fed soybeans roasted at 280 °F and depressed performance of calves fed soybeans roasted at 295 °F. These effects were more pronounced during the postweaning period (6 to 8 wk). These results demonstrate the importance of nutrient interactions in young dairy calves, especially when processed grains are fed.

(Key Words: Dairy Calves, Starters, Soybeans, Corn, Roasting.)

Introduction

Previous research at Kansas State University has shown superior performance when young dairy calves were fed whole soybeans processed at optimum conditions. Other research has demonstrated the beneficial effect of roasting corn for finishing beef cattle. Little information about the value of roasted corn as a major ingredient in calf starters is available. Information about how protein and carbohydrate sources interact when fed to the young dairy calf is also lacking. The objectives of this study were to evaluate the effects of roasting soybeans and corn and to study possible interactions between the two feed sources when fed to young dairy calves.

Procedures

Newborn Holstein calves (n= 132) were fed colostrum as soon as possible after birth and moved to 4 x 4 ft wood hutches bedded with straw. They were blocked by sex and birth date, and calves within each block were randomly assigned to one of six pelleted isonitrogenous starters made by using either soybean meal (SBM) or soybeans roasted using a Jet-Pro Roaster® (Jet-Pro Co., Atchison, Ks) to an exit temperature of 280°F (SB280) or 295°F (SB295). Each of these protein sources was used with either raw corn or corn roasted to an exit temperature of 280°F to make the six dietary treatments (Table 1). Whole milk was fed at 4% of birth weight twice daily, and starter and water were available free choice until the end of the trial at wk 8. Calves were weaned when they daily consumed 1.5 lb of starter for 3 consecutive days, provided that they were not less than 3 wk of age

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and had gained ≥ 10 lb body weight since birth. They were observed daily for general appearance and consistency of their feces. Starter consumption and body weight were recorded weekly. Heart girth and wither height were recorded at the start and end of the experiment. Body condition score (1, thin to 5, fat) was recorded at the end of the trial.

Results and Discussion

Total weight gain and feed consumption, height increase, and weaning age are shown in Table 2. Overall performance of calves on SB295 starter was superior to those on the SBM starter. Similar results were reported by Reddy et. al., using soybeans processed with the same method (Dairy Day 1992, Report of Progress 666, Kansas Agricultural Experiment Station). Increasing the roasting temperature from 280 to 295 °F improved feed consumption, weight gain, and height increase and reduced weaning age. Heifer calves consumed more feed than bull calves, 114 vs 101 lb for the entire trial ($P < .05$), but bull calves gained more height, 3.4 vs 2.9 in ($P<.05$).

Performance of those calves weaned at ≤ 37 days of age (n= 122) from wk 6 to wk 8 is shown in Table 3. An interaction ($P< .05$) occurred between the protein source (SBM, SB280, or SB295) and type of corn. Considering most variables measured in this experiment, the starter containing SB295 and raw corn would be considered the superior diet. Average daily gain was superior when roasted corn was used with SBM, not different when it was used with SB280, and lower when it was used with SB295. Feed intake was not different. The same pattern was observed for gain:feed ratio and energetic efficiency expressed as Mcal ME/lb of gain. Roasted corn did not affect body condition score when used with SBM, whereas a significant improvement was observed when it was used with SB280. Roasted corn depressed the body condition score when used with SB295. Over this postweaning period, performance of calves on SBM and roasted corn was similar to performance on SB295 and raw corn, but they tended to have a better energetic efficiency because of the former's lower energy content compared to the SB295 and raw corn starter. A benefit of the SB295 and raw corn starter was that calves were weaned earliest.

The results of this study indicated the importance of interaction between protein and carbohydrate sources, especially when processed ingredients are used in calf starters. These interactions are more evident during the postweaning period, when the young calf is starting to become a functional ruminant. The results also demonstrate the need for a more precise characterization of nutrient requirements of ruminants including the weaned dairy calf.

Table 1. **Ingredient and Chemical Composition of Calf Starters**

	Starters[1]					
	Soybean meal		SB280[2]		SB295[2]	
Ingredient	Raw corn	Roasted corn	Raw corn	Roasted corn	Raw corn	Roasted corn
	%					
Corn, raw	40.53	-	37.28	-	37.34	-
Corn, roasted	-	39.20	-	36.00	-	36.08
Soybean meal	-	-	15.22	15.56	-	-
SB280[2]	-	-	18.06	18.44	-	-
SB295[2]	-	-	-	-	17.90	18.26
Alfalfa, ground	19.64	20.08	19.62	20.23	19.85	20.29
Oats, rolled	14.88	15.24	15.24	15.36	15.06	15.38
Molasses	7.00	7.20	7.12	7.28	7.16	7.30
Trace mineralized salt	.18	.18	.18	.18	.18	.18
Limestone	.72	.72	.68	.68	.68	.68
Vitamin mix[3]	.15	.15	.15	.15	.15	.15
Coccidiostat[4]	1.32	1.32	1.32	1.32	1.32	1.32
Dicalcium phosphate	.36	.36	.36	.36	.36	.36
Chemical analyses, %						
DM	83.9	84.6	83.6	84.00	81.4	82.8
CP[5]	17.0	17.4	16.6	16.8	16.4	17.1
ADF[5]	12.8	12.0	11.7	12.0	10.9	11.0
NDF[5]	24.5	29.1	30.7	28.0	24.0	34.5
Ether extract[5]	3.9	3.7	6.3	5.8	5.2	5.2

[1]As fed basis.
[2]Soybeans identified by roasting temperature.
[3]Provided 1000 IU vitamin A, 140 IU vitamin D, and 32 IU vitamin E per lb feed.
[4]Deccox (0.5%), provided 30 mg per lb feed.
[5]Dry matter basis.

Table 2. Effect of Protein Source on Total Weight Gain, Total Feed Intake, Height Increase, and Weaning Age

Item	Protein source			
	SBM[1]	SB280[2]	SB295[2]	SEM
Total wt gain, lb	58.4^{b}	63.4^{a}	66.4^{a}	2.2
Total feed intake, lb	101.5	107.5	114.5	4.7
Height increase, in	2.9^{b}	3.0^{b}	3.5^{a}	.5
Weaning age, days	32.5^{b}	31.5^{ab}	29.4^{a}	.9

^{a,b}Means within a row with different superscripts differ ($P<.05$).
[1]Soybean meal.
[2]Soybeans identified by roasting temperature.

Table 3. Average Daily Gain (ADG), Average Feed Intake (AFI), Gain:Feed Ratio, Energetic Efficiency, and Body Condition Score (BCS) of Calves from 6 to 8 wk

Item	Soybean Meal		SB280[1]		SB295[1]		SEM
	Raw corn	Roasted corn	Raw corn	Roasted corn	Raw corn	Roasted corn	
ADG, lb	1.8^{ab}	2.1^{a}	1.9^{ab}	1.9^{ab}	2.1^{a}	1.7^{b}	.1
AFI, lb	4.6	4.6	4.3	4.5	4.6	4.2	.2
Lb gain:lb feed	.39^{b}	.46^{a}	.44^{ab}	.43^{ab}	.46^{a}	.41^{ab}	.02
Mcal ME/lb gain	3.64^{ab}	2.99^{a}	3.32^{ab}	3.49^{ab}	3.18^{a}	3.81^{b}	.25
BCS	2.8^{ab}	2.9^{ab}	2.5^{b}	3.1^{a}	3.3^{a}	2.6^{b}	.2

^{a,b}Means within a row with different superscripts differ ($P<.05$).
[1]Soybeans identified by roasting temperature.