Feeding Lactating Holstein Dairy Cows Reduced-Fat Dried Distillers Grains with Solubles: Quality of Baby Swiss Cheese

A.S. Leaflet R3157

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Summary and Implications

In this experiment, feeding reduced-fat distillers grains (RF-DDGS) as 20% DM of a total mixed ration (TMR) supplemented with lysine did not negatively influence flavor attributes of baby Swiss cheese. Eye appearance in all cheeses was atypical, but was not related to diet. Any defects in appearance of Baby Swiss cheese appeared in both control and RF-DDGS fed cows and therefore the defects observed can be attributed to the make procedure itself rather than to of feeding RF-DDGS. The results indicate that lactating Holstein dairy cows can be fed RF-DDGS as 20% DM of a TMR without negatively affecting usability of milk for production of Baby Swiss cheese.

Introduction

Our group has previously investigated the impact of feeding full-fat DDGS to dairy cows on baby Swiss cheese quality and found that diet did not have any effect on the formation of ideal eyes. However, no work has been done to date to determine the effects of feeding RF-DDGS on the quality of milk produced and its usability for production of high-quality baby Swiss cheese. Regardless, it has been suggested that DDGS in general, or perhaps spore-forming thermoduric bacteria such as *Clostridium tyrobutyricum* originating from DDGS, could be to blame for late-blowing of eyes in Swiss cheese. Despite little evidence to support this claim, it has been brought to our attention that this claim exists in the agricultural community. Therefore, the objective of this study was to test the hypothesis that feeding 20% RF-DDGS (DM basis) would not influence milk quality negatively (i.e., usability for production of milk products) when compared with a standard corn/corn silage/hay ration and therefore would not influence quality of baby Swiss cheese.

Materials and Methods

For a detailed description of animal feeding and methodology refer to leaflet R3152.

For cheese making, milk from one complete milking of each treatment group (control or RF-DDGS) was collected, two to three times during weeks three and four, during each of the three 35-day periods. The milk was tested for fat, protein and lactose prior to further processing (within 60 min) by using a LactiCheck Milk Mini Analyzer (Page and Pederson Inc, Hopkinton, MA). Those who collected milk at the dairy farm showered and changed into clean clothes before participation in cheese making to minimize additional external contamination of milk to be used for cheese production.

Measured percentages of fat and protein were used to standardize milk to the target fat:protein ratio (0.88±0.05). If the fat:protein ratio was not 0.88±0.05, the milk was separated and standardized, and cream or skim from the milk collected from the same experimental cows were added to raise or lower the ratio, respectively. Milk was separated using a Type LWA 205 Westfalia Separator (219 rpm in 2.5 dial setting, Dusseldorf, Germany). Pooled standardized milk from each dietary treatment was poured into a labeled cheese vat and heat treated (63°C, 2 min) by delivering steam-heated water to the jacketed vat, with gentle agitation. After heat treatment, the milk was gradually cooled to 33°C by running cold water in the jacketed vat, and with gentle agitation of the milk.

Baby Swiss cheese was made by using CHOOZIT 60 (0.16 g/45 kg milk, DuPont ™ Danisco®, New Century, KS), and CHOOZIT eyes (0.06 g/ 45 kg milk, DuPont ™ Danisco®,). Coagulant (6 mL/45 kg of milk, DCI Supreme, Dairy Connection Inc., Madison, WI) was diluted with cold water to a ratio of 1:40 and added with slow agitation for one minute. The cheese curd was allowed to set for approximately 30 min, tested for firmness visually, and manually cut with 12-cm wire curd knives. About 25% of vat volume of whey was initially removed, followed by constant stirring and addition of water (3 to 5% of the vat volume) at 33°C; the forework proceeded for 35 min at 33°C. Gradually, the curds were cooked by increasing the temperature to 40°C over a 15-min period, and then to 46°C over a 10-min period by adding steam to the jacket of the vat. Warm water (~10 % of the vat volume) was added at 44°C to facilitate the rise in temperature of the cheese to 46°C(±1°C), where the curds were held for 42 min (postwork). After postwork, and at a target pH of 6.4, whey was removed.

Cheese curds were collected into perforated stainless steel Longhorn hoops. Towers were pressed under whey by using a 7 kg weight for 15 min. The whey was drained completely and the cheese block was pressed for 1 hr with 11 kg, 1 hr with 23 kg, and an additional 3 hr with 35 kg of weights. Curd pH was measured (Accumet® Basic AB15, Fisher Scientific Inc, Pittsburgh, PA), the press was removed, and cheese was fermented in an empty basin for an additional 5 to 8 hr at 28°C ± 3°C. The pressing time was based on the time required for the pH of the cheese to drop from 6.4 to 5.25 (±0.5). Brining was carried out in saturated brine containing 23% NaCl and 0.38% $CaCl_2$, for up to 7 to 9 hr (depending on block weight (approximately 30 min/kg cheese)). Cheese blocks were vacuum-packed in clear vacuum seal bags (Fisher Scientific Inc, Pittsburgh, PA) with a Koch vacuum packing machine (Koch Equipment LLC©, Kansas City, MO). Cheeses were stored at 10±1°C for 7 days (pre-cool), 22±3°C for 21 days (warm room), and 4±1°C for 60 days (cold room). Cheeses were analyzed for composition and sensory quality after at least 60 days aging. The cheeses were sliced systematically for analysis and photographs. Representative photographs are included in Figures 1 – 4.

A descriptive sensory analysis panel, composed of 6 trained panelists, evaluated the quality of the cheeses. Panelists were recruited from students of the Department of Food Science and Human Nutrition. Panelists were trained to evaluate baby Swiss cheese in relation to set quality standards, which served as anchors during training sessions.

Baby Swiss cheese should have a mild nutty (roasted hazelnut) and propionic acid aroma and flavor character with little to no apparent sour/lactic acid taste. Other than a slight bitter aftertaste, baby Swiss should clean up, leaving no fruity, fermented, rancid yeasty or other foreign flavors on the palate. Eyes should be completely round, from 1/8 to 1/4 inch in diameter (hole punch size to smaller than a dime; Figure 5). Panelists were provided individual samples, cut to a standard size with a template, in zipper-lock bags, along with water and grapes for cleansing palate (Figure 6).

Results and Discussion

The flavor and body and texture of all baby Swiss cheeses produced in the study were typical, with no significant diet effects ($P > 0.05$). Cheeses from cows fed the control and DDGS diets were characterized by very low levels of acid, flat, or unclean flavors, with low bitterness (Tables 1, 2, and 3). Control and DDGS cheeses were neither weak nor pasty, but were moderately curdy and slightly mealy/grainy (Table 2). A moderate but significant negative ($P < 0.00005$) correlation was observed between weak and curdy (-0.52) and curdy and pasty (-0.45); a strong negative correlation was observed between amount of eyes and eye distribution (-0.74). A moderate but significant positive ($P < 0.0005$) correlation was demonstrated between mealy and curdy (0.47) and pasty and flat (0.53).

Regarding appearance, the baby Swiss cheeses were slightly atypical. Compared to the ideal, the cheeses were characterized by a high number (overset) of very small to small eyes (0.32 cm to 0.64 cm in size), many of which were irregular in shape (including frog mouth, collapsed, and rarely cabbage), and the distribution was slightly uneven. Eyes exhibited a typical glossy appearance, but some exhibited a wet (free whey) appearance. Although gas formation seemed normal in most cheeses, several cheeses exhibited checks, picks, and rarely, spilts or a blowhole. DDGS cheeses were not significantly different from control for any attribute except size of eyes (Table 3). Mean score for eye size of control cheeses were closer to ideal than DDGS cheeses ($P < 0.05$). Significant cheese by production day interaction effects were noted for most sensory attributes (Table 4), but very few trends stand out.

Overall Summary

In summary, these findings demonstrate that feeding of RF-DDGS had little effect on cheese quality. Instead, cheese make procedures (temperature control, moisture removal, brine incorporation into curd, aging conditions) had more of an impact on cheese quality attributes. Cheese producers should not worry about the appropriateness of milk from cows fed RF-DDGS for cheese applications.

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Table 1. Effect of RF-DDGS on flavor of Baby Swiss cheese.

Flavor	**Mean Control**	**Mean DDGS**	**SEM**	***P* - Value**
Acid	1.01	1.05	0.19	0.840
Bitter	3.82	3.47	0.46	0.450
Flat	1.35	1.61	0.31	0.411
Unclean	1.43	1.86	0.39	0.260

Table 2. Effect of RF-DDGS on body and texture of Baby Swiss Cheese

Body and Texture	**Mean Control**	**Mean DDGS**	**SEM**	***P* - Value**
Curdy	7.17	6.85	0.43	0.471
Mealy/Grainy	5.56	6.47	0.57	0.110
Pasty	0.75	0.98	0.29	0.445
Weak	1.03	1.24	0.25	0.409

Table 3. Effect of RF-DDGS on appearance of Baby Swiss of eyes

Appearance	**Mean Control**	**Mean DDGS**	**SEM**	***P* - Value**
Amount	7.77	7.98	0.48	0.664
Distribution	4.08	3.56	0.62	0.392
Gloss	6.77	6.86	0.31	0.793
Shape	8.39	8.23	0.15	0.722
Size	6.41	5.71	0.70	0.027
Gas Formation	3.71	4.57	0.86	0.318

Table 4. Cheese by production day summary for significant interaction effects for flavor and body and texture attributes.

Cheese and production day[1]	Bitter	Curdy	Mealy/ grainy	Pasty	Weak	Amount	Distribution	Gas Formation
A1.day1	4.27^{abc}	11.05^{a}	10.52^{a}	0.28b	0.30b	8.88a	3.16abc	1.78a
C1.day1	3.52^{abc}	8.63^{abc}	5.90^{bcd}	0.50b	0.57b	9.23a	3.20abc	3.58a
A3.day2	5.71^{c}	7.40^{bc}	4.64^{bcd}	0.42b	1.04b	9.77a	1.93c	4.23a
C2.day2	5.64^{c}	5.86^{cd}	2.13^{d}	1.34b	1.85ab	7.65ab	3.89abc	6.44a
A2.day3	4.24^{abc}	9.22^{ab}	5.18^{bcd}	0.33b	0.40b	8.98a	1.63c	7.86a
C3.day3	3.13^{ab}	8.48^{abc}	5.89^{bcd}	0.36b	1.39b	5.13b	6.73a	5.19a
A1.day4	3.85^{abc}	7.30^{bc}	6.85^{abc}	0.29b	0.39b	7.02ab	4.28abc	6.74a
C1.day4	3.45^{abc}	8.09^{abc}	6.64^{abc}	0.36b	0.52b	7.55ab	2.33bc	1.59a
A2.day5	3.22^{ab}	3.08^{d}	4.11^{cd}	3.94a	3.36a	5.45b	6.62ab	7.76a
C2.day5	4.55^{b}	8.92^{abc}	8.36^{ab}	1.00b	0.43b	8.78a	3.89abc	3.22a
A3.day6	2.19^{a}	6.43^{bcd}	6.13^{bcd}	1.03b	1.70b	6.58ab	4.03abc	3.58a
C3.day6	2.32^{a}	7.28^{bc}	4.69^{bcd}	0.41b	0.58b	8.10ab	2.68abc	2.88a
A1.day7	2.36^{a}	8.10^{abc}	7.61^{abc}	0.45b	0.64b	7.68ab	2.87abc	2.81a
A2.day7	2.12^{a}	7.08^{bc}	6.50^{abc}	0.57b	1.21b	8.26ab	2.13c	2.78a
P - value	0.01	<0.0001	<0.0001	<0.0001	<0.0001	0.001	0.005	0.03

[1]A = Control, C = Control [not clear to reader what days are—change to rep (replicate)?]

[a, b, c] Items in a row not sharing a common superscript differ, $P < 0.05$

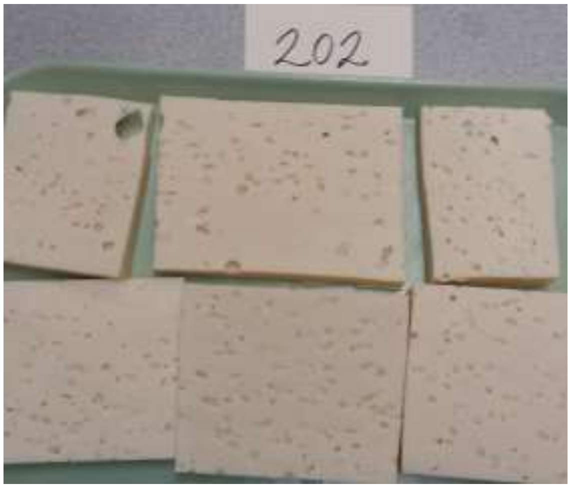

Figure 1. Representative photograph of baby Swiss cheese from milk of cows fed control diet in period 1.

Figure 2. Representative photograph of baby Swiss cheese from milk of cows fed DDGS diet in period 1.

Figure 3. Representative photograph of baby Swiss cheese from milk of cows fed control diet in period 2.

Figure 4. Representative photograph of baby Swiss cheese from milk of cows fed DDGS diet in period 2.

Figure 5. Evaluation of eye size conducted by trained panelist using hole-punched washable plastic square and penny.

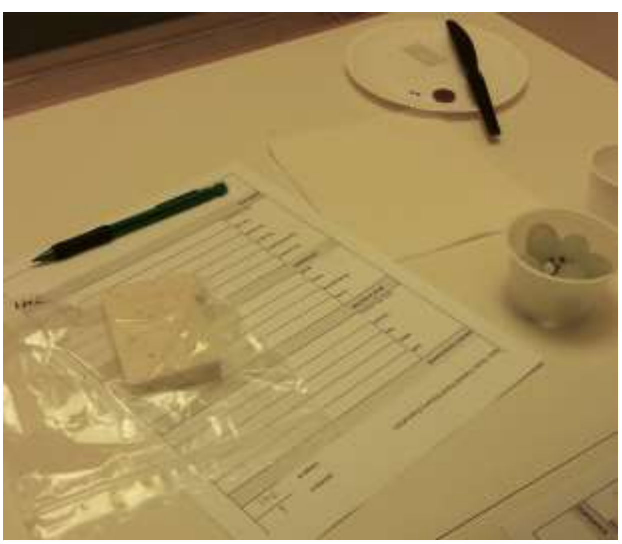

Figure 6. Set up of cheese as presented to trained panelists for evaluation.