Brown Midrib Corn Silage for Lactating Dairy Cows: A Contemporary Review

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Introduction

Brown midrib (bm_3) corn silages are characterized by their lower lignin content and higher fiber digestibility than conventional corn silages (Oba and Allen, 1999b). Early feeding trials with bm_3 corn silages date back to the 1970's (Frenchick et al., 1976; Keith et al., 1979; Sommerfeldt et al., 1979). However, commercial application was delayed until advancements in the agronomic performance of bm_3 corn hybrids occurred in the 1990's. Since then there has been considerable research activity as well as commercial application with bm_3 corn silages. The purpose of this paper is to present a contemporary review of published research regarding the use of bm_3 corn silages in diets fed to lactating dairy cows.

Data Set and Statistical Analysis

Eleven bm_3 vs. conventional corn silage comparisons in feeding trials with lactating dairy cows published in the Journal of Dairy Science (JDS) since 1999 are referenced and summarized briefly in Table 1. Trials were generally switchback type designs with short-term feeding periods. Forage comprised 55% of diet DM on average across the trials ranging from 44% to 63%. Corn silage comprised 81% of forage DM on average across the trials ranging from 62% to 100%. The MIXED procedure of SAS was used to evaluate the effect of bm_3 corn silage in diets fed to dairy cows on dry matter intake (DMI) and milk yield, composition and component yields using data from 17 treatment comparisons within the 11 trials. The model included the fixed effect of corn silage treatment and the random effect of trial (St. Pierre, 2001). Each response was weighted according to the number of animals used to test for it using the WEIGHT statement (St. Pierre, 2001).

Results and Discussion

Control and bm_3 corn silage dry matter (DM), starch neutral detergent fiber (NDF), and in vitro NDF digestibility (ivNDFD) concentrations from the 11 trials are presented in Table 2. Dry matter and NDF concentrations were similar for control than bm_3 corn silages. While the starch content of control and bm_3 corn silages was similar on average, greater variation was observed for the bm_3 corn silages (Coefficients of Variation = 14.1% vs. 9.5%). The ivNDFD content (% of NDF) of the bm_3 corn silages was 11.5%-units greater on average than

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observed for the control corn silages. Eastridge (1999) reported that on average, bm_3 corn silages, contained 34% less lignin and had in situ or in vitro NDF digestibilities that were 19% higher than non-bm_3 corn silages.

Least square means for DMI and milk yield, composition and component yields for cows fed control and bm_3 corn silages in the 11 trials are presented in Table 3.

Dry matter intake was 1.2 kg/d greater ($P < 0.01$) for cows fed bm_3 corn silage, which is consistent with the reported increase in DMI with increased ivNDFD (Oba and Allen, 1999b). Oba and Allen (2000) suggested that reducing physical fill in the rumen by feeding more highly digestible NDF allows for increased DMI in high producing dairy cows.

Milk yield was 1.7 kg/d greater ($P < 0.0001$) for cows fed bm_3 corn silage. Tine et al. (2001) and Oba and Allen (1999a) reported that at production levels of intake, increased ivNDFD has minimal impact on diet net energy of lactation (NE_{L-3x}) content but increases NE_L intake primarily through increased DMI. Therefore, the increased milk yield by cows fed bm_3 corn silages can be explained on the basis of increased DMI related to their greater ivNDFD.

Milk fat % tended to be reduced ($P < 0.10$) by 0.08%-units for cows fed bm_3 corn silages. Oba and Allen (2000) reported a trend for an interaction ($P < 0.06$) between diet NDF concentration and corn silage hybrid for milk fat %; milk fat % was reduced when bm_3 silage was included in diets with 28% NDF but was not affected when diets contained 38% NDF. Also, Qiu et al. (2003) reported an interaction ($P < 0.05$) between bm_3 corn silage and content of forage NDF in the diet for milk fat %; increasing concentration of forage NDF in the diet with bm_3 corn silage increased milk fat %. Yield of fat (1.40 vs. 1.36 kg/d) was greater ($P < 0.05$) for cows fed bm_3 corn silages and related to the greater milk yield for these cows. Milk protein % was unaffected by treatment. Milk protein yield (1.20 vs. 1.15 kg/d) was greater ($P < 0.001$) for cows fed bm_3 corn silages and related to the greater milk yield for these cows.

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Table 1. List of references for intake and milk production data used in the meta-analysis.

Reference	Trial Design[1]	n	Period Length wk	% Forage in Diet DM	% Corn Silage in Forage DM
Bal et al. (2000)	CRO	26	8	60	67
Ballard et al. (2001)	RB	75	4	50	62
Ebling & Kung (2004)	CR	24	6	60	70
Gehman et al. (2008)	LS	20	4	58	93
Kung et al. (2008)	LS	27	3	55	82
Oba & Allen (1999)	CRO	32	4	56	80
Oba & Allen (2000)	LS	8	3	44, 63	81
Qiu et al. (2003)	LS	8	4	52	75
Taylor & Allen (2005)	LS	8	3	49	80
Tine et al. (2001)	LS	6	4	60	100
Weiss & Wyatt (2006)	LS	8	3	55	100

[1]CRO=Crossover; RB=Randomized Block; CR=Completely Randomized; LS=Latin Square.

Table 2. Corn silage DM, starch, NDF and ivNDFD concentrations from the trials used for the meta-analysis as referenced in Table 1.

	Control		**bm3**	
	Average	Std. Dev.	Average	Std. Dev.
DM, % of as fed	33.5	3.3	32.5	3.9
Starch, % of DM	30.5	2.9	29.9	4.2
NDF, % of DM	42.0	1.7	40.9	2.1
ivNDFD[2], % of NDF	46.1	9.2	57.6	7.7

[1]In vitro NDF digestibility measured after in vitro fermentation for 30 h except for trial of Weiss and Wyatt, 2006 where a 48 h determination was performed.

Table 3. Effect of brown midrib (bm_3) corn silage in diets fed to dairy cows on dry matter intake (DMI) and milk yield, composition and component yields[1].

	Control	**Bm_3**	**SE**	**(P <)**
DMI, kg/d	24.2	25.4	0.7	0.001
Milk, kg/d	37.7	39.4	1.5	0.0001
Fat, %	3.67	3.59	0.1	0.10
kg/d	1.36	1.40	0.04	0.02
Protein, %	3.08	3.07	0.05	NS
kg/d	1.15	1.20	0.04	0.001

[1]Results are least-square means from meta-analysis (St. Pierre, 2001) performed on data from 11 trials with 17 treatment comparisons published in the Journal of Dairy Science since 1999; trial referenced in Table 1.