ABSTRACT #: T185

Assessment of dairy cow performance fed soybean meal or canola meal through a meta-analysis

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INTRODUCTION

- Soybean meal (SBM) is traditionally used as a protein source in lactating dairy cow diets; however, when commodity prices are high, SBM can be replaced with canola meal (CM; Broderick et al., 2015).
- Canola meal has recently become more competitive as a protein source for dairy rations as its availability has improved considerably. The large expansion of the canola crushing industry that occurred in North America since 2010 has increased the supply of CM for the animal feed industry. According to the Canadian Oilseed Processors Association (2019), 5.15 million tons of CM were produced in Canada in the 2017/18 crop year (2.6 times greater than 20 years ago). Similarly, the USDA Economic Research Service (2019) reported CM production in 2017/18 crop year in the USA was 0.8 million tons, increasing around three times during the last two decades.
- Methionine and lysine are usually the first and second, respectively, limiting amino acids in lactating dairy cow diets. Comparing with SBM protein, lysine concentration is lightly lower in CM protein (6.1 vs. 5.5%) but 61% greater in methionine (1.3 vs. 2.1%; CNCPS Library, 2019).

OBJECTIVE

To evaluate dry matter intake (DMI), milk yield, and milk composition of cows fed diets containing either SBM or CM.

MATERIALS & METHODS

- Peer-review articles were selected by searching Web of Science, PubMed, and cited papers.
- Ten published articles from 1998 to 2019 were included in the meta-analysis.
- Evaluated variables: DMI, milk production, and milk composition (included mean, SD, and # of cows).
- Statistics in R (Metafor; Viechtbauer, 2010):
  - Fixed effect of effect size (CI and significance).
  - Q-test for a random model (heterogeneity; P<0.05).
  - I^2 to evaluate heterogeneity of effect size.
  - Effect displayed in forest plots.
  - Funnel plot and Egger's test to evaluate publication bias.
  - Meta regression to identify any other source of heterogeneity (DIM, inclusion rate of forage, concentrate, SBM, and CM, and CP and NDF content of the diet).

RESULTS

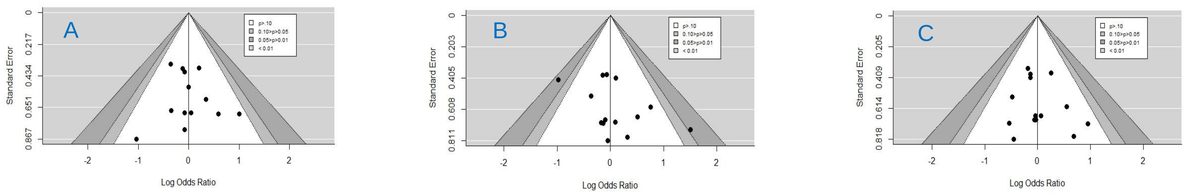


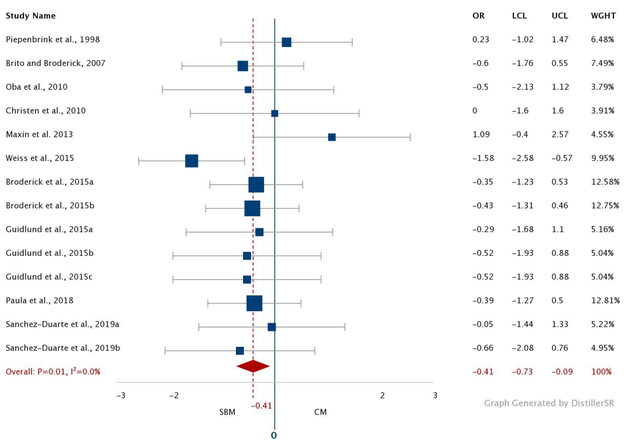
Figure 1. Funnel plots of DMI(A), milk yield (B), and ECM (C).

Table 1. Estimated effect size derived from meta-analysis in dairy cows fed diets containing SBM and CM.

Outcome measured	Cows (n)[1] SBM	Cows (n)[1] CM	Weighted mean difference for SBM – CM[2] [95% CI[3]]	Effect size [95% CI]	I^2 (%)	P-value for effect size	Funnel plot asymmetry (Egger´s test)
DMI (kg/d)	81	81	-0.32 [-0.77, 0.13]	-0.18 [-0.49, 0.13]	0.0	0.16	0.75
Milk yield (kg/d)	**81**	**81**	**-0.41 [-0.73, -0.09]**	**-0.41 [-0.73, -0.09]**	**0.0**	**0.01**	**0.24**
ECM (kg/d)	81	81	0.25 [-0.72, 0.22]	-0.20 [-0.51, 0.11]	0.0	0.21	0.52
Milk fat (%)	81	81	0.14 [-0.32, 0.60]	0.09 [-0.23, 0.40]	0.0	0.59	0.36
Milk fat (kg/d)	81	81	0.009 [-0.44, 0.46]	0.0002 [-0.31, 0.31]	0.0	0.97	0.80
Milk protein (%)	81	81	-0.003 [-0.43, 0.42]	0.002 [-0.31, 0.31]	0.0	0.99	0.98
Milk protein (kg/d)	81	81	-0.02 [-0.45, 0.41]	-0.01 [-0.32, 0.30]	0.0	0.93	0.19
Milk lactose (%)	81	81	0.04 [-0.37, 0.45]	0.02 [-0.29, 0.33]	0.0	0.85	0.26
Milk lactose (kg/d)	81	81	-0.01 [-0.40, 0.38]	-0.01 [-0.32, 0.30]	0.0	0.95	0.57
FE (ECM/DMI)	81	81	0.02 [-0.07, 0.10]	0.03 [-0.28, 0.34]	0.0	0.73	0.86

[1]SBM = soybean meal die, CM = canola meal.
[2]Weighted mean difference is an estimate of actual effects for cows fed diets containing SBM and CM in units measured.
[3]CI = confidence interval.
I^2 is a measure of variation beyond chance among studies used in the meta-analysis.

Figure 2. Forest plot of the effect of SBM vs. CM for milk yield.



NOTE: Papers from Broderick et al., 2007, Guidlund et al., 2015, and Sanchez-Duarte et al., 2019 had multiple comparisons within the paper.

Table 2. Meta-regression analysis output for diet variables that influenced feeding SBM and CM.

Item	Coefficient [95% CI]	P-value
Milk yield (kg/d)		
Intercept	-6.34 [-11.505, -1.169]	0.02
Forage inclusion	**-0.09 [-0.139, -0.036]**	**0.0009**
Grain inclusion	**0.11 [0.041, 0.172]**	**0.001**
SBM inclusion	0.63 [-0.178, 1.437]	0.12
CM inclusion	-0.37 [-0.854, 0.110]	0.13
Dietary CP	-0.21 [-0.643, 0.228]	0.35
Dietary NDF	0.09 [-0.029, 0.220]	0.13
ECM (kg/d)		
Intercept	-0.88 [-6.065, 4.301]	0.74
Forage inclusion	-0.05 [-0.109, 0.009]	0.10
Grain inclusion	**0.09 [0.018, 0.159]**	**0.01**
SBM inclusion	0.43 [-0.342, 1.200]	0.28
CM inclusion	-0.26 [-0.723, 0.207]	0.28
Dietary CP	**-0.47 [-0.898, -0.034]**	**0.03**
Dietary NDF	0.11 [-0.013, 0.235]	0.08

SUMMARY

- Funnel plots and Egger's test showed no publication bias for the evaluated variables (Figure 1; Table 1).
- Low degree of heterogeneity (I^2=0.00) in all evaluated variables indicated that the response of those variables to the protein supplements were very consistent across studies.
- DMI, ECM, and FE were not affected by meal protein source.
- Milk components and milk component yields were not modified by meal protein source
- Cows fed diets with SBM produced 0.41 kg/d less milk than cows on diets with CM
- Meta-regression (Table 2):
  - DIM did not influence the heterogeneity.
  - Inclusion of forage and grain contributed to the heterogeneity of milk yield.
  - Inclusion of grain and dietary CP contributed to the heterogeneity of ECM.

CONCLUSIONS

- There was no difference in performance and feed efficiency between cows fed CM- or SBM-based diets.
- Feed price and inclusion rate of forages and grains, as well as, dietary CP must be considered when CM is used to replace SBM in lactating dairy cow diets.

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