EFFECTS OF PROCESSING AND FAT REMOVAL ON THE VALUE OF COTTONSEED IN DIETS FOR LACTATING DAIRY COWS

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Summary

Eighteen Holstein cows were used in six simultaneous 3×3 Latin squares to determine the value of extruded-expelled cottonseed meal with lint as a replacement for whole cottonseed in diets for lactating dairy cows. Diets were: 1) WCS=whole cottonseed; 2) EC+T=extruded-expelled cottonseed meal with tallow; and 3) EC=extruded-expelled cottonseed meal. Diets were formulated to contain 17.5% CP and 40% RUP. Tallow or shelled corn was used to balance energy across diets. No differences were observed in dry matter intake, milk production, or feed efficiency among diets. Cows fed EC produced milk with a slightly higher protein percentage. Feed costs per cwt of milk were $4.17, $4.19, and $4.11 for WCS, EC+T, and EC, respectively. Extruded-expelled cottonseed meal with lint can replace whole cottonseed in diets for lactating dairy cows, if the diet is balanced for energy with either corn grain or tallow.

(Key Words: Extruded Cottonseed, Tallow, Cottonseed, Lactating Cows.)

Introduction

Extruded-expelled cottonseed meal was compared to whole cottonseed in diets for lactating cows under heat stress conditions during the summer of 1998. Cows fed extruded-expelled cottonseed performed as well as those fed whole cottonseed, even though dietary fat was not equalized as dietary amounts of extruded-expelled cottonseed were increased and amounts of whole cottonseed decreased. The amount of soybean meal was adjusted to maintain dietary crude protein (CP) between 17.5 and 18%, but the fat content of the diets decreased from 5.1% to 4.2%, and the ruminally undegradable protein (RUP) increased from 36% to 40% as extruded-expelled cottonseed was added. The lack of differences in response indicated that the additional fat supplied by whole cottonseed did not improve performance. However, milk production in this study was relatively low (approximately 55 lb per cow per day), and dry mater intake was depressed by the heat stress conditions. Thus, the advantage of increased dietary fat in whole cottonseed may not have been realized under the conditions of the study. The purpose of this study is to further evaluate the value of extruded-expelled cottonseed meal as a replacement for whole cottonseed in diets for high-producing dairy cows.

Procedures

Eighteen Holstein cows were used in six 3×3 Latin squares. Cows were individually fed diets typical of those used by commercial dairies with all the cereal grain supplied as corn. The following diets were compared: 1) whole cottonseed (17.5% CP:40% RUP); 2) extruded-expelled cottonseed meal plus tallow (17.5% CP:40% RUP); and 3) extruded-expelled cottonseed meal (17.5% CP:40% RUP).

All diets were fed as a total mixed ration. Cows were fed each diet for 28 days, and feed intake and milk production were measured daily. Milk samples were analyzed weekly for milk composition; milk protein, fat, lactose, solids-not-fat, MUN and somatic cells being measured by the Heart of America DHI Laboratory, Manhattan, KS. Cows were weighed on 2 consecutive days at the beginning of period 1 and on the last 2 days

of each period thereafter. Body condition was scored on one of each of the dates when body weights were obtained.

Results and Discussion

Diet components and the chemical composition of the experimental diets are shown in Tables 1 and 2, respectively. Diets were formulated to be isocaloric with the sources of calories being tallow in EC+T and corn grain in EC to equal the caloric value of whole cottonseed. Diets also were formulated to contain 17.5% CP with 40% of the protein being RUP. Because RUP and CP were balanced, responses should provide a meaningful evaluation of the nutritional value of the cottonseed oil removed during the extrusion-expeller process. The actual CP contents of the diets (Table 2) differed as did the RUPs as a percentage of CP. However, the NE_L values were similar between WCS and EC, whereas NE_L in EC+T was greater because solvent soybean meal had a higher NFC content than did the expeller soybean used in the WCS diet as a source of RUP. The NFC contents of diets WCS and EC were consistent with expectations, whereas the content was higher than expected for EC+T.

Responses of the cows to the experimental diets are shown in Table 3. Dry matter consumption was similar across diets, whereas milk production was numerically higher from cows fed diets containing EC+T and EC. Cows fed EC produced milk with higher ($P<.05$) percentages of protein and solids-not-fat. Cows fed WCS had less ($P<.05$) milk-urea nitrogen than cows fed EC+T. These results are consistent with the RUP content of the diets. The diets yielded similar efficiencies (lb of milk produced per lb of dry matter consumed). An economic analysis (Table 4) of the diets shows that feed cost per cwt of milk produced was less for cows fed EC than for cows fed WCS or EC+T.

In summary, extruded-expelled cottonseed meal with lint can replace whole cottonseed in diets for high-producing dairy cows if the diets are balanced for energy with either tallow or corn grain.

Table 1. Compositions of Experimental Diets as Percent of Dry Matter

	Diets[1]		
Ingredient	WCS	EC+T	EC
	---------- % of dry matter ----------		
Alfalfa hay	27.1	26.8	23.8
Corn silage	20.0	19.9	16.9
Whole cottonseed	9.7	-	-
Extruded cottonseed	-	9.8	9.9
Ground corn	28.5	28.0	32.4
Soybean meal, 48%	1.0	8.0	8.0
Expeller soybean meal	9.1	1.5	2.0
Soy hulls	-	-	3.0
Wet molasses	1.0	1.0	1.0
Tallow	-	1.5	-
Vitamins/minerals premix	3.6	3.6	3.0

[1]WCS = 5.4 lb of whole cottonseed; EC+T = 5.5 lb of extruded-expelled cottonseed meal, 0.8 lb of tallow; and EC = 5.5 lb of extruded-expelled cottonseed meal.

Table 2. Chemical Compositions of Experimental Diets

	Diets[1]		
Ingredient	WCS	EC+T	EC
Crude protein, %	17.7	16.2	17.0
RUP, % of CP	42.2	39.8	38.0
NE_L, Mcal/lb	0.75	0.78	0.74
Fat, %	5.56	5.73	4.27
NDF, %	31.5	30.7	30.7
ADF, %	21.7	21.4	21.5
NFC, %	36.7	40.1	40.6

[1]WCS = 5.4 lb of whole cottonseed; EC+T = 5.5 lb of extruded-expelled cottonseed meal, 0.8 lb of tallow; and EC = 5.5 lb of extruded-expelled cottonseed meal.

Table 3. Responses of Lactating Cows to Experimental Diets

	Diets[1]			
Ingredient	WCS	EC+T	EC	SE[2]
DMI, lb/day	59.0	59.7	59.1	1.01
Milk, lb/day	77.5	80.7	78.6	2.18
ECM[3], lb/day	77.4	79.4	78.3	2.35
Efficiency, milk/feed	1.32	1.32	1.33	0.03
Milk fat, %	3.56	3.61	3.50	0.06
Milk protein, %	2.98[a]	3.01[a]	3.06[b]	0.01
SNF, %	8.53[a]	8.56[a]	8.63[b]	0.02
MUN, mg/dL	15.17[a]	16.12[b]	15.96[ab]	0.28
Change in body wt., lb	-12.85	-18.39	-15.82	7.50

[1]WCS = 5.4 lb of whole cottonseed; EC+T = 5.5 lb of extruded-expelled cottonseed meal, 0.8 lb of tallow; EC = 5.5 lb of extruded-expelled cottonseed meal.
[2]Standard error of the mean.
[3]Energy corrected milk.
[a, b]Means not bearing a common superscript differ ($P<0.05$) within row.

Table 4. Production Costs Associated with Experimental Diets

	Diets[1]		
Item	WCS	EC+T	EC
DMI, lb/day	59.0	59.7	59.1
Cost/lb dry matter[2], $	.0547	.0567	.0547
Feed cost/head/day, $	3.23	3.38	3.23
Milk yield, lb/day	77.5	80.7	78.6
Feed cost/cwt milk[3], $	4.17	4.19	4.11

[1]WCS = 5.4 lb of whole cottonseed; EC+T = 5.5 lb of extruded-expelled cottonseed meal, 0.8 lb of tallow; EC = 5.5 lb of extruded-expelled cottonseed meal.
[2]Based on NE Kansas prices. Shelled #2 corn, $78.6/ton; 48% SBM, $148/ton; Tallow, $360/ton; Linted whole cottonseed, $160/ton; Alfalfa hay (170 RFV), $80/ton; Extruded-expelled cottonseed meal, $148/ton; Vitamin/Mineral premix, $280/ton; Soy hulls, $90/ton; Corn silage, $24.5/ton; Wet molasses, $138/ton; SoyBest expeller soybean meal, $186.00/ton.
[3]Feed cost to produce of 100 lb of milk.