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## Extruded-expelled cottonseed meal (Express) as a source of protein and fat for lactating dairy cows

### Authors

A.F. Park, M.V. Sheffel, Evan C. Titgemeyer, and John E. Shirley

**EXTRUDED-EXPELLED COTTONSEED MEAL (EXPRESS™)  
AS A SOURCE OF PROTEIN AND FAT FOR  
LACTATING DAIRY COWS**

*J. E. Shirley, A. F. Park,  
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**Summary**

Twenty-four Holstein cows were used in six 4×4 Latin squares to evaluate the effects of substituting extruded-expelled cottonseed meal (Express™) for whole cottonseed and solvent soybean meal in diets for lactating cows. No differences were observed in milk and milk component yield among treatments. Percentages of fat, protein, solids-not-fat, and lactose in milk were similar among treatments. Replacing whole cottonseed with Express™ tended to reduce milk urea nitrogen but had no effect on milk protein percentage or yield. Cow acceptability of Express™ was excellent throughout the 84-day study conducted between late June and September when ambient temperature exceeded 100°F for 35 days. Long-term storage of Express™ in a commodity barn was not a problem. In vitro analysis of Express™ revealed that it contains approximately 75% rumen undegradable protein (RUP) with an intestinally absorbable dietary protein value of 53.4%. Express™ is an excellent source of RUP, and the protein fraction is highly digestible in the small intestine.

(Key Words: Lactating Cows, Extruder-Expelled Cottonseed Meal.)

**Introduction**

Whole cottonseed processed through an extruder followed by an expeller results in a product that contains approximately 27% crude protein and 7.5% fat. The extrusion process decreases the ruminal degradability of the protein fraction. The resultant product, extruded-expelled cottonseed meal, has the potential to be a source of high quality rumen undegradable protein (RUP) for dairy cows in addition to its inherent fat content and positive

contribution to neutral detergent fiber (NDF) and acid detergent fiber (ADF) in high energy diets.

Use of this product would reduce the number of ingredients needed to formulate diets for high-producing dairy cows and provide an economical source of RUP. Reluctance to switch from whole cottonseed to extruded-expelled cottonseed meal probably has occurred because of a lack of performance data available for the extruded-expelled product.

The objective of this study was to evaluate the effect of extruded-expelled cottonseed meal on milk yield and components when substituted for whole cottonseed and solvent soybean meal in diets for lactating cows.

**Procedures**

Twenty-four Holstein cows were used in six 4×4 Latin squares. Cows were fed individually diets typical of those used in commercial dairies with all of the cereal grain supplied as corn. The diets differed only in source of protein and amounts of fat. The following combinations were compared: 1) 6 lb of whole cottonseed and 2 lb distillers grains; 2) 3 lb of whole cottonseed, 3 lb Express™ meal, and 2 lb distillers grains; 3) 6 lb Express™ meal and 2 lb distillers grains; and 4) 8 lb Express™ meal.

All diets (Table 1) were fed as a total mixed ration. As Express™ replaced whole cottonseed, a portion of the SBM was replaced with corn in order to keep diets equal in nitrogen (protein) content. Cows were fed each diet for 21 days with feed intake and milk production measured daily. Milk samples were analyzed weekly for milk composition; milk protein, fat, lactose, solids-not-fat, MUN, and

somatic cells were measured by the DHIA Laboratory, Manhattan, KS. Cows were weighed and scored for body condition at the beginning and end of each 21-day period.

## Results and Discussion

The response of lactating dairy cows to an extruded-expelled cottonseed meal product with lint (Express™) is shown in Table 2. Substituting Express™ for 50% or 100% of the whole cottonseed in the diet did not affect milk yield or composition, even though the fat content of the diet was reduced from 5.1% of dry matter to 4.5% of dry matter when Express™ replaced 6 lbs. of whole cottonseed in the diet on an equal weight basis. Reduction of dietary fat without a change in milk yield indicates that the additional fat supplied by whole cottonseed was not efficiently utilized by the cows.

The protein fraction of Express™ is approximately 75% rumen undegradable (RUP; Table 3) based on Dr. Marshall Stern's (University of Minnesota) procedure and 55% RUP based on the values provided by Insta-Pro7 Extrusion Technology (Des Moines, IA). We used 55% RUP in our formulation, because that was the value available to us at the initiation of the study. Table 3 also shows that the RUP fraction of Express™ is quite digestible in the intestines,

which is critical to its success as an absorbable protein.

Express™ was fed with and without distillers dried grains (Table 2, diets ECSMD and ECSM) to determine if distillers dried grains were beneficial. No difference was observed in production performance between the two diets, suggesting that Express™ provided sufficient amino acids to support the production level observed. The dry matter intake across diets was lower than anticipated and reflected the effect of high ambient temperature and humidity during most of the study period.

The use of diets with elevated RUP is important for cows producing at levels higher than those achieved in this study. Thus, we expect that the extruded-expelled cottonseed meal would improve the performance of cows producing over 70 lb of milk per day. This prediction is based on previous experience using other sources of RUP. The milk urea nitrogen (MUN) content was low across diets because of the low dry matter intakes, but the MUN values tended to decrease as the amount of Express™ in the diet increased.

In summary, extruded-expeller cottonseed meal can be substituted successfully for whole cottonseed and distillers grains in diets for lactating dairy cows. It is an effective source of rumen undegradable protein. Further studies during the cool seasons at higher milk production levels are needed.

**Table 1. Experimental Diets**

| Ingredient                  | WCS <sup>1</sup> | WCS-ECSM | ECSMD | ECSM |
|-----------------------------|------------------|----------|-------|------|
| ----- % of dry matter ----- |                  |          |       |      |
| Alfalfa hay                 | 27.0             | 27.0     | 27.0  | 27.0 |
| Corn silage                 | 20.0             | 20.0     | 20.0  | 20.0 |
| Shelled corn                | 31.0             | 31.9     | 32.8  | 32.8 |
| Soybean meal (48%)          | 6.0              | 5.1      | 4.2   | 4.2  |
| Whole cottonseed            | 9.0              | 4.5      | 0     | 0    |
| Extruded cottonseed         | 0                | 4.5      | 9.0   | 12.0 |
| Distiller grains            | 3.0              | 3.0      | 3.0   | 0    |
| Molasses                    | 1.0              | 1.0      | 1.0   | 1.0  |
| Min./vit. Premix            | 3.0              | 3.0      | 3.0   | 3.0  |

<sup>1</sup>WCS = 6 lb of whole cottonseed; WCS-ECSM = 3 lb WCS and 3 lb extruded-expelled cottonseed meal; ECSMD = 6 lb of extruded-expelled cottonseed meal with 2 lb of distillers grains; ECSM = 8 lb of extruded-expelled cottonseed meal.

**Table 2. Response of Lactating Dairy Cows to Whole Cottonseed and Extruded Cottonseed Meal during the Summer**

| Item                     | Diets <sup>1</sup> |          |       |      | SE <sup>2</sup> |
|--------------------------|--------------------|----------|-------|------|-----------------|
|                          | WCS                | WCS-ECSM | ECSMD | ECSM |                 |
| Milk, lb/day             | 55.5               | 57.0     | 53.0  | 54.7 | .99             |
| DMI, lb/day              | 43.3               | 44.8     | 40.4  | 44.0 | 1.41            |
| Efficiency, milk to feed | 1.28               | 1.27     | 1.31  | 1.24 |                 |
| Butter fat, %            | 3.60               | 3.77     | 3.61  | 3.58 | .075            |
| Protein, %               | 3.13               | 3.12     | 3.15  | 3.14 | .030            |
| Lactose, %               | 4.91               | 4.82     | 4.77  | 4.85 | .052            |
| SNF, %                   | 8.72               | 8.71     | 8.66  | 8.75 | .035            |
| Change in body wt, lb    | +28                | +15      | +12   | +10  | 7.2             |
| MUN <sup>2</sup>         | 14.1               | 13.8     | 13.5  | 13.4 | .24             |

<sup>1</sup>WCS = 6 lb of whole cottonseed; WCS-ECSM = 3 lb WCS and 3 lb extruded-expelled cottonseed meal; ECSMD = 6 lb of extruded-expelled cottonseed meal with 2 lb of distillers grains; ECSM = 8 lb of extruded-expelled cottonseed meal.

<sup>2</sup>MUN = milk urea nitrogen.

**Table 3. Protein Availability Estimates for Diet Ingredients**

| Sample                     | CP    | RDP <sup>1</sup> | Solubility | Rate of CP         | ID <sup>2</sup> | IADP <sup>3</sup> |
|----------------------------|-------|------------------|------------|--------------------|-----------------|-------------------|
|                            |       |                  |            | Degradation        |                 |                   |
|                            | (% as | (% of            | (% of      | (h <sup>-1</sup> ) | (% of RUP)      | (%)               |
| SBM standard               | 44.7  | 83.2             | 16.6       | -.26               | 85.8            | 14.4              |
| Extruded full-fat soybeans | 37.7  | 52.3             | 6.1        | -.051              | 74.7            | 35.6              |
| Express <sup>TM</sup>      | 23.6  | 25.7             | 11.8       | -.011              | 71.9            | 53.4              |
| Expeller SBM               | 42.4  | 48.7             | 7.5        | -.048              | 76.8            | 39.4              |

<sup>1</sup>RDP = rumen degradable protein.

<sup>2</sup>ID = intestinal digestion.

<sup>3</sup>IADP = intestinally absorbable dietary protein (RDP × intestinal digestion).