Improving the pellet quality of dried distillers grains with solubles by the addition of pea flour

V.L. Anderson[1] and K. Koch[2]

The objective of this study was to explore whether incorporating field pea flour with dried distillers grains with solubles improves the quality of DDGS pellets. The research indicates that adding field pea flour to distillers grains would improve pellet quality and nutritional value.

Summary

Pelleting distillers grains can improve flow properties and transportation efficiency while reducing waste during feeding, but distillers grains do not pellet well as a single ingredient. Adding field pea flour to distillers grains improves pellet quality and nutritional value. Economics and market potential are yet to be explored.

Introduction

Dried distillers grains with solubles (DDGS) is widely accepted as a valuable feed ingredient for many types of livestock. However, efficient and economical transportation and potential waste during storage and feeding are concerns with distribution and marketing. Flow properties of DDGS, for example, have been a concern, with problems experienced during offloading of long-distance trucks or rail cars.

Pelleting DDGS has been explored as an approach to improving bulk density and flow properties, while minimizing waste, but DDGS does not pellet well as a stand-alone ingredient, based on experience in the Northern Crops Institute Feed Production Center. The incorporation of additional grains or co-products to DDGS before pelleting has been evaluated in pilot-scale studies using wheat middlings, barley, barley malt sprouts, beet pulp and field peas with varying degrees of success, respective to energy consumption, pellet quality (durability) and nutrient density. Field peas pelleted with DDGS improved pellet quality, with nutrient density similar to DDGS alone. Anecdotal information from livestock producers is very positive regarding a DDGS/field pea pellet product.

Recent developments in fractionation technology have made pea fiber, protein and flour available as separate ingredients. Pea fiber and protein fractions are in high demand for human and pet food markets, while the pea flour market still requires development and marketing.

A pelleting study with pea flour added to DDGS at increasing levels was conducted at the Northern Crops Institute to evaluate pellet quality in addition to the manufacturing process and the nutritional value of the combined products.

Experimental Procedures

Corn distillers dried grains with solubles was provided by the Blue Flint Ethanol plant in Washburn, N.D., with pea flour provided by United Pulse Trading, Minot, N.D. Mixing and pelleting was done at the Northern Crops Institute Feed Production Center on the NDSU campus in Fargo, N.D. The test batches were:

- 1 = 150 pounds of pea flour and 850 pounds of DDGS – 15 percent pea flour by weight
- 2 = 250 pounds of pea flour and 750 pounds of DDGS – 25 percent pea flour by weight
- 3 = 350 pounds of pea flour and 650 pounds of DDGS – 35 percent pea flour by weight

All test mixtures were pelleted using a California Pellet Mill (CPM) Hy-flo pellet press with a 37.5-kilowatt (50 horsepower) main drive motor and a peripheral die speed of 365.8 meters/minute (1,200 feet/

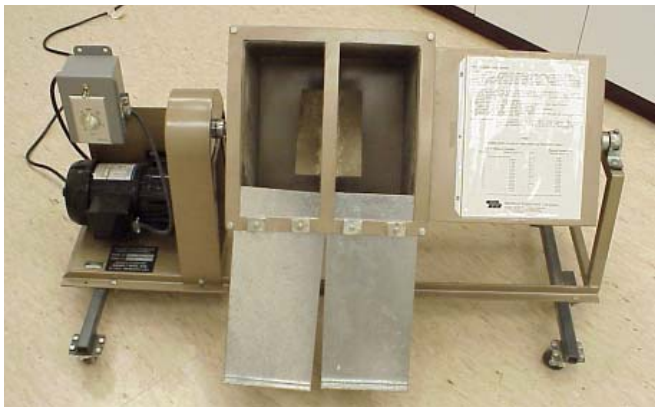

Figure 1. Tumbler used to test pellet durability.
Photo by Kim Koch, Northern Crops Institute

[1]Carrington Research Extension Center, NDSU
[2]Northern Crops Institute, NDSU

minute). Amps, volts and power factor were recorded. Die size was 6.4 millimeters (1/4 inch), with a performance ratio of 10-to-1. Steam addition to the conditioning chamber was at a pressure of 1.87 kilograms/centimeter^2 (30 pounds per square inch gauge), resulting in a temperature increase of the mash feed from 14 to 65 Celsius (57 to 149 F), yielding an approximate 3.2 percent moisture increase. All pelleting was conducted on the same day.

Pellets were cooled in a CPM vertical cross-flow cooler for 10 minutes before storage in fabric tote bags. Subsamples were obtained from the stored pellets after they were cooled totally. Samples were evaluated with the standard pellet durability index (PDI; ASAE S269.4). Pelleted feed samples from the totes were sifted on a U.S. 3.5 screen to remove fines, and 500 grams were placed into one of four test chambers of the rotating tumbler and tumbled for 10 minutes. Samples were reweighed after sifting out the fines generated in the tumbling process. The weight of the intact pellets was compared with the total amount of fines to determine the PDI as a percent of total initial pellet sample weight.

All durability samples were run in triplicate. Nutrient analyses also were conducted on each treatment for common feed quality components (Table 2).

Results and Discussion

A pellet durability index (PDI) of 90 percent is considered satisfactory for commercial trade. At 15 percent pea flour (Table 1), the PDI was 87.4 percent. At 25 percent pea flour, the PDI was 89.7 percent. At 35 percent pea flour, the PDI was 94 percent. Interpolating these results suggests that 26 or 27 percent pea flour added to DDGS may be the optimum level for durable pellets (90 PDI) for commercial markets.

Throughput increased from 2.42 tons per hour for 15 percent pea flour to 2.64 tons/hour for 25 and 35 percent pea flour pelleting. Power consumption increased from 9.4 to 10.75 kilowatt-hours per 1.1 tons for 25 and 35 percent pea flour, respectively. Further replications of this research with other combinations of ingredients will provide valuable information on appropriate inclusions of pea flour for the commercial market.

Nutrients in the three combinations (dry-matter basis) appear to differ slightly (Table 2), with somewhat less fiber, fat and ash with increasing pea flour amounts. Protein decreased only slightly as pea flour increased. At 15, 25 and 35 percent pea flour, crude protein was 32.56, 31.12 and 29.12 percent, respectively. Nonfiber carbohydrates (NFC) increased from 31.93 to 36.21 and 39.61 percent for 15, 25 and 35 percent pea flour, respectively, as starch in the flour replaced fiber from DDGS in the formulation. This is a 13 percent increase from 15 to 25 percent pea flour and a 24 percent increase from 15 to 35 percent pea flour.

Table 1. Effects of adding pea flour to distillers grain on the pellet manufacturing and durability.

	Treatment		
Pellet Production Data	15% Pea Flour 85% Dist. Grain	25% Pea Flour 75% Dist. Grain	35% Pea Flour 65% Dist. Grain
Tons/hr	2.42	2.64	2.64
Energy consumed, Kw/ton	9.63	9.40	10.75
Pellet durability index, %	87.4	89.7	94.0

Table 2. Effects of adding pea flour to distillers grain on nutrient content of pelleted mixture.

	Treatment		
Nutrient Analysis*	15% Pea Flour 85% Dist. Grain	25% Pea Flour 75% Dist. Grain	35% Pea Flour 65% Dist. Grain
Dry matter, %	89.6	89.9	90.3
		Dry-matter basis	
Crude protein, %	32.56	31.12	29.12
ADF, %	11.51	11.48	11.23
eNDF, %	24.59	22.12	20.43
Fat, %	6.93	6.64	6.26
Ash, %	4.99	4.91	4.58
Calcium, %	0.27	0.21	0.16
Phosphorus, %	0.81	0.74	0.65
Magnesium, %	0.36	0.34	0.29
Potassium, %	1.24	1.16	1.09
Sulfur, %	0.76	0.68	0.62
Calculations			
TDN, %	76.07	76.75	77.29
NFC, %**	31.93	36.21	39.61
NEg, Mcal/lb.	0.623	0.625	0.627
NEm, Mcal/lb.	0.922	0.924	0.926

* Dairyland Laboratories Inc., St. Cloud, Minn.
** Nonfiber carbohydrates

Acid detergent fiber decreased negligibly in the analysis from 11.51 to 11.48 to 11.23 percent for 15, 25 and 35 percent pea flour, respectively. Calculated total digestible nutrients only increased from 76.07 to 76.75 to 77.29 percent for 15, 25 and 35 percent pea flour, respectively. Minimal differences occurred in net energy gain (NEg) from 15 to 25 to 35 percent pea flour at 0.623, 0.625 and 0.627 megacalories per pound, respectively.

The addition of pea flour to DDGS may increase the marketing potential for producers of monogastric livestock, avian species and possibly even aquaculture production. However, consideration must be given to the cost of the pea flour and the logistics of moving ingredients to a processing site, as well as the cost of processing and transporting products to markets for end use.

While a pelleted formulation may increase feed costs slightly, the advantages of durable pellets are gained through reduced losses when granular feeds are stored in the open. Transportation efficiency is improved with greater bulk density and more desirable flow properties of pelleted feeds. Ultimately, flexibility in end use may create more demand for such a product.

Formulations containing other ingredients may provide products with specific nutrient profiles. Nutrient-dense ingredients such as oilseed meals may increase demand by reducing the cost per unit of nutrient while maintaining desirable pellet quality and durability. Additional investigations with feeding studies and metabolism trials may be warranted to determine economic value and digestibility.

Acknowledgments

The authors express their appreciation to the Northern Pulse Growers Association for partial funding for this study, United Pulse LLC for providing the pea flour and Blue Flint Ethanol for supplying the dried distillers grains with solubles.