

# Effects of feeding two levels of a pelleted 30 percent pea starch and 70 percent dry distillers grain feed in feedlot finishing diets on animal performance and carcass characteristics

Chanda L. Engel<sup>1</sup>

---

*A feed pellet made with 30 percent pea starch and 70 percent dry distillers grains with solubles (DDGS) fed at 15 or 30 percent of the diet dry matter was an effective feed ingredient that can be used to replace DDGS and some corn in feedlot finishing diets. The 30 percent inclusion level may result in a slight improvement in animal performance and feed efficiency vs. the 15 percent inclusion level. Pelleting pea starch with DDGS may allow for greater transportability of DDGS across the country and in export markets. Additional work to improve the manufacturing process would be warranted and valuable.*

---

## Summary

One hundred seven Angus and Angus-cross steers (1,006-pound initial body weight) were weighed individually, blocked by body weight and sorted into four weight blocks. Within block, cattle were assigned randomly and sorted into one of 12 pens. Pens were assigned randomly to one of three dietary treatments. Air-fractionated pea starch (PS) and corn dry distillers grains plus solubles (DDGS) were combined at a rate of 30 percent PS and 70 percent DDGS into a small diameter feed pellet (PS-DDGS). The three treatment diets were: control (Con), 15 percent PS-DDGS pellet and 30 percent PS-DDGS pellet (15PS-DDGS and 30PS-DDGS). The Con diet included 20 percent DDGS (no PS). The two PS-DDGS diets included the 30 percent PS-70 percent DDGS pellet at 15 or 30 percent of the diet. Steers were weighed approximately every 28 days and at

the time of marketing, for a total of four weight periods. Steers were fed an average of 101 days. Hot carcass weights were recorded on the day of harvest. Carcass 12th rib fat thickness (BF), longissimus muscle area (LMA), and U.S. Department of Agriculture marbling score and yield grades (YG) were recorded following a 24-hour chill. Initial and final body weights were similar for Con, 15 and 30PS-DDGS treatments. Overall, we found a tendency for the 30PS-DDGS-fed cattle to have a lower feed to gain than cattle fed the 15PS-DDGS, and greater average daily gain (ADG) than for cattle on the 15PS-DDGS and Con treatments ( $P = 0.10$ ). All additional performance parameters were similar among the three treatments ( $P \geq 0.33$ ). Hot carcass weight, YG, LMA and marbling score were similar for Con, 15 and 30PS-DDGS treatments. Final BF was similar for 30PS-DDGS and Con, but both were greater than 15PS-DDGS ( $P = 0.02$ ; Table 3).

## Introduction

North Dakota has a large and expanding pea production and processing industry. Developments in field pea processing have made pea fiber, protein and flour fractions available as individual ingredients for use in human, pet food and livestock markets.

Pea starch flour is a fine-powdered material made from dehulled seeds of field peas. Pea starch flour is created without any processing aids or chemical compounds. It has a nutritional profile of approximately 90 percent dry matter, 13 percent crude protein and 87 percent total digestible nutrients (TDN).

Dry distillers grains with solubles (DDGS) is a widely used and valuable feed ingredient in feedlot diets. However, it tends to bridge and bind during transportation, reducing flowability and increasing unloading challenges. Pelleting distillers grain can improve the flowability and transportability of DDGS. However, DDGS alone does not pellet well.

Adding other feed ingredients such as pea flour, a byproduct of the dry-air-fractionation process of field peas, may improve pellet quality (Anderson and Koch, 2014). Small-scale milling has showed promising results with pelleting pea starch and DDGS, creating a durable, high-quality pellet.

The pelleting has not been tested in a commercial facility. Additionally, the true feeding value of pea starch for beef cattle has not

---

<sup>1</sup>Carrington Research Extension Center, NDSU

been quantified. Several studies have evaluated whole field peas in ruminant diets (Anderson et al., 2007; Gilbery et al., 2007; Pesta et al., 2012; Soto-Navarro et al., 2012).

A few studies in swine (Gunawardena et al., 2010) have examined the use of pea starch as a feed ingredient, but no studies in beef cattle could be found. Thus, a feedlot finishing study was conducted to evaluate the feeding value of a 30 percent pea starch/70 percent DDGS commercially produced feed pellet in finishing diets for feedlot steers.

## Experimental Procedures

All procedures were approved by the NDSU Animal Care and Use Committee. One hundred seven Angus and Angus-cross steers (1,006-pound initial body weight) consigned to the North Dakota Angus University feedout program were received at the NDSU Carrington Research Extension Center Livestock Unit.

Cattle were weighed individually, vaccinated, given an identification tag, treated for internal and external parasites, and implanted (Revalor-S; 24 mg estradiol 17beta, 120 mg trenbolone acetate). Cattle were blocked by body weight and sorted into four weight blocks. Within block, cattle were assigned randomly and sorted into one of 12 pens. Pens were assigned randomly to one of three dietary treatments.

Air-fractionated pea starch (PS) was obtained from the manufacturer (AGT Foods, Minot, N.D.) and shipped to a commercial feed mill. At the commercial feed mill, DDGS (no fat removal) and PS were combined at a rate of 30 percent PS and 70 percent DDGS into a small-diameter feed pellet (PS/DDGS).

The three treatment diets included control (Con), 15 percent PS-DDGS pellet and 30 percent PS-DDGS pellet (15PS-DDGS and 30PS-DDGS; Table 1). All diets included 13 percent barley straw as the forage base and 2 percent of a vitamin and mineral supplement containing an ionophore (Rumensin). The Con diet included 20 percent DDGS (no PS).

The two PS-DDGS diets included the 30 percent PS/70 percent DDGS pellet at 15 or 30 percent of the diet. The 30 percent treatment had the equivalent of 20 percent DDGS in the diet (similar to control).

The DDGS for the Con diet was received in one batch and was from the same source as the DDGS used to make the PS-DDGS pellet. The amount of dry-rolled corn in the diets was adjusted so each treatment diet had a similar energy value (Net energy for gain = 0.59 megacalorie per pound [Mcal/lb]). The 15PS-DDGS diet was lower in crude protein than the other two treatment diets, but no additional nitrogen was added.

Steers were weighed approximately every 28 days and at the time of marketing, for a total of four weight periods. Steers were fed an

average of 101 days (97 days for the three heavy blocks and 116 days for the light block).

All pens within a replication block were marketed on the same day at a commercial abattoir (Tyson Foods, Dakota City, Neb.). Hot carcass weights were recorded on the day of harvest. Carcass 12th rib fat thickness (BF), longissimus muscle area (LMA), and USDA marbling score and yield grades (YG) were recorded following a 24-hour chill.

Animal performance and carcass data were analyzed using the GLM procedures of SAS for a randomized complete block design, with pen as the experimental unit. Least square means were separated using the PDIFF statement of SAS.

## Results and Discussion

The 15PS-DDGS treatment included 10.5 percent DDGS from the PS-DDGS pellet. The 30PS-DDGS treatment included 21 percent DDGS from the PS-DDGS pellet, which was similar to the DDGS level in the control diet.

While the pellet durability was not measured, we observed that when loaded, transported in bulk (live-bottom, rear-dump semitrailer)

**Table 1. Formulation and nutrient composition of diets for yearling steers fed with 20 percent DDGS or 15 or 30 percent of a pellet containing 30 percent pea starch (PS) and 70 percent dry distillers grains with solubles DDGS.**

Feedstuffs, dry-mater basis	Control	15% Pea Starch Pellet	30% Pea Starch Pellet
Dry-rolled corn, %	63.7	69.2	54.6
DDGS, %	20.45	–	–
PS-DDGS, %	–	14.9	29.5
Straw, %	13.7	13.8	13.7
Supplement, %	2.18	2.08	2.18
<b>Nutrient Composition</b>			
Crude protein, %	13.7	11.8	14.2
NEm, Mcal/lb.	0.89	0.89	0.89
NEg, Mcal/lb.	0.59	0.59	0.59
NDF, %	23.0	20.7	21.8
Fat, %	4.9	3.9	4.8

and unloaded, the pellets were more brittle and had more fines than expected. Previous work by Anderson and Koch (2014) indicated a pellet durability index (PDI) of 89.7 and 94 for PS-DDGS pellets containing 25 and 75 percent PS and DDGS and 35 and 65 percent PS and DDGS, respectively.

A PDI of 90 percent is considered satisfactory for commercial trade. Based on this data, a ratio of 30 percent PS-to-70 percent DDGS was chosen for the current study. The work by Anderson and Koch (2014) was done on a smaller scale and utilized a DDGS product with 10 percent fat, while the DDGS used in this study had 12 percent fat. Pellet die size was slightly smaller for the current study than in the work of Anderson and Koch (2014; visual observation by authors).

Initial, interim and final body weights, average daily gain (ADG), dry-matter intake and feed to gain were similar for the Con, 15PS-DDGS and 30PS-DDGS treatments, with the exception of the initial 28-day period and days 57 to 84 (Table 2). From day 0 to 28, steers on the 30PS-DDGS treatment had greater BW and ADG, resulting in a lower feed-to-gain ratio than for steers on the Con and 15PS-DDGS treatments.

We found a tendency ( $P = 0.07$ ) for the two PS-DDGS treatments to be similar but have a greater DMI than Con cattle days 57 to 84. Overall, we observed a tendency for the 30PS-DDGS-fed cattle to have a lower feed-to-gain ratio than cattle on the 15PS-DDGS and greater ADG than for cattle on the 15PS-DDGS and Con treatments ( $P = 0.10$ ).

The 15PS-DDGS diet had less total DDGS and thus lower protein than the 30PS-DDGS and Control diets, which may have affected performance. All additional performance parameters were similar among the three treatments ( $P \geq 0.33$ ).

Hot carcass weight, YG, LMA and marbling score were similar for the Con, 15 and 30PS-DDGS treatments. Final BF was similar for 30PS-DDGS and Con, but both were

greater than for the 15PS-DDGS ( $P = 0.02$ ; Table 3).

In conclusion, a pellet with 30 percent PS and 70 percent DDGS fed at 15 or 30 percent of the diet

**Table 2. Performance of yearling steers fed with 20 percent DDGS or 15 or 30 percent of a pellet containing 30 percent pea starch and 70 percent DDGS.**

	Control	15% Pea Pea Starch Pellet	30% Pea Pea Starch Pellet	SEM	P-Value
Weight, day 0	1,009	1,011	1,002	4.7	0.46
Weight, day 28	1,152 <sup>b</sup>	1,146 <sup>b</sup>	1,168 <sup>a</sup>	4.8	0.04
Weight, day 56	1,281	1,275	1,309	10.4	0.12
Weight, day 84	1,395	1,394	1,413	12.6	0.53
Final weight	1,481	1,493	1,510	13.4	0.35
ADG, d0-28	5.12 <sup>b</sup>	4.83 <sup>b</sup>	5.92 <sup>a</sup>	0.12	0.002
ADG, d29-56	4.60	4.62	5.04	0.28	0.49
ADG, d57-84	4.07	4.26	3.70	0.29	0.44
ADG, d85-final	4.78	5.87	5.43	0.43	0.27
ADG overall	4.86	4.97	5.24	0.10	0.10
DMI, days 0-28	26.2	25.6	26.0	0.22	0.22
DMI, days 29-56	26.8	28.3	28.3	0.71	0.33
DMI, days 57-84	26.9	30.3	28.3	0.83	0.07
DMI, day 85-final	30.0	32.0	29.9	1.15	0.39
Overall DMI	27.5	29.0	28.1	0.67	0.33
Feed:gain, days 0-28	5.13 <sup>b</sup>	5.33 <sup>b</sup>	4.41 <sup>a</sup>	0.13	0.01
Feed:gain, days 29-56	5.93	6.15	5.64	0.41	0.68
Feed:gain, days 57-84	6.62	7.35	7.67	0.44	0.30
Feed:gain, day 85-final	6.27	5.68	5.53	0.51	0.58
Feed:gain, overall	5.54 <sup>ab</sup>	5.68 <sup>a</sup>	5.32 <sup>b</sup>	0.10	0.10

**Table 3. Carcass composition for yearling steers fed with 20 percent DDGS or 15 or 30 percent of a pellet containing 30 percent pea starch and 70 percent DDGS.**

Item	Control	Pea Starch 15% Pellet	30% Pea Starch Pellet	SEM	P-Value
Hot carcass weight, lb.	890	891	901	8.3	0.63
Yield grade <sup>1</sup>	3.4	3.1	3.2	0.11	0.23
Longissimus muscle area, sq. in.	13.7	13.2	13.3	0.52	0.78
Marbling score <sup>2</sup>	493	467	454	18.8	0.39
Backfat, in.	0.58 <sup>a</sup>	0.48 <sup>b</sup>	0.55 <sup>a</sup>	0.02	0.02

<sup>1</sup>Yield grade is composite calculation of fat to lean yield in a carcass based on a relationship of hot carcass weight, rib-eye area, fat thickness and KPH; low values = lean carcasses.

<sup>2</sup>USDA Quality grades based on marbling scores of 300-399 = select, 400-499 = low choice, 500-599 = average choice, 600-699 = high choice, 700+ = prime.

dry matter appears to have been an effective feed ingredient that can be used to replace bulk DDGS and some corn in feedlot finishing diets. In finishing diets, the 30 percent inclusion level may provide a slight improvement in animal performance and feed efficiency, compared with the 15 percent inclusion level.

While pellet quality was not as expected, the pellets in the current study still flowed from the bin and were acceptable in visual quality. Pelleting PS with DDGS may allow for greater transportability of DDGS across the country and in export markets. Additional work to improve the manufacturing process would be warranted and valuable.

## Acknowledgments

The authors thank AGT Foods and Ingredients for donating the PulsePlus Flour V-6000 (pea starch feed ingredient) that was used in this trial. Also, thank you to Carrington Research Extension Center livestock technicians Dale Burr and Tim Schroeder for the care and feeding of the livestock used in this trial.

## Literature Cited

- Anderson, V., and K. Koch. 2014. Improving the pellet quality of dried distillers grains with solubles by the addition of pea flour. 2014. North Dakota Beef Report. pg. 7-9.
- Anderson, V., G. Lardy and B. Ilse. 2007. Field Pea Grain for Beef Cattle. NDSU Extension Service publication AS1301.
- Gilbery, T.C., G.P. Lardy, S.A. Soto-Navarro, M.L. Bauer and V.L. Anderson. 2007. Effect of field peas, chickpeas, and lentils on rumen fermentation, digestion, microbial protein synthesis, and feedlot performance in receiving diets for beef cattle. *J. Anim. Sci.* 85:3045–3053.
- Gunawardena, C.K., R.T. Zijlstra and E. Beltranena. 2010a. Characterization of the nutritional value of air-classified protein and starch fractions of field pea and zero-tannin faba bean in grower pigs. *J. Anim. Sci.* 88:660–670.
- Pesta, A.C., A.H. Titlow, J.A. Hansen, A.L. Berger, S.A. Furman, M.K. Lubbe, G.E. Erickson and K.H. Jenkins. 2012. Effects of feeding field peas in combination with distillers grains plus solubles in finishing and growing diets on cattle performance and carcass characteristics. *Prof. Anim. Sci.* 28:534–540. Available from: <http://digitalcommons.unl.edu/animalscifacpub>
- Soto-Navarro, S.A., A.M. Encinias, M.L. Bauer, G.P. Lardy and J.S. Caton. 2012. Feeding value of field pea as a protein source in forage-based diets fed to beef cattle. *J. Anim. Sci.* 90:585–591.