Research Update – Alternative Feedstuffs

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▪ Introduction

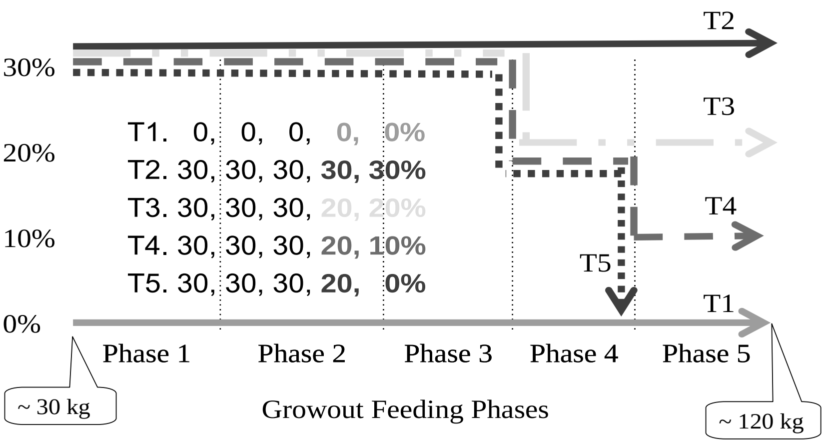
Yearly, we come to Banff Pork Seminar to discuss what a hard year Prairie pork producers have had and discuss what the coming year might bring. Production of grains and oilseed in 2009 will be 59.5 vs. 72.6 Mt last year because some areas of the Prairies received not enough rain and heat (Ag Canada 2009). Feed prices were not as high in 2009 relative to 2007 – 2008, but remained high relative to 5 – 10 years ago. Similar feed commodity pricing trends are expected for 2010 (Ag Canada 2009). Crude oil prices remain low, while the Canadian:US dollar exchange rate continues narrowing. The latter suggests cheaper ethanol supported by mandates of ethanol inclusion, implying greater upcoming opportunities to reduce feed cost by feeding distillers' dried grains with solubles (DDGS). This paper summarizes our latest research findings regarding feeding corn, wheat and triticale DDGS to pigs.

▪ Feeding High Levels of Corn DDGS

At writing, there was a $2 benefit per hog for feeding corn DDGS in Alberta. The currency exchange keeps narrowing, so we expect to see more American corn DDGS in western Canada. We also have an outstanding Alberta dataset to share with you. Corn DDGS is high in unsaturated oil that may soften the pork fat if fed at high levels to finishing hogs, potentially affecting pork quality. In a commercial trial, we fed corn DDGS, no corn DDGS or implemented three strategies to remove or withdraw corn DDGS out of the finishing diets. The goal was to optimize the use of DDGS in hog diets to reduce feed costs for producers while mitigating possible pork quality concerns for packers.

One-fifth of the barrows or gilts were fed a control diet over 5 growth phases until market weight (**Figure 1**). We implemented 3 corn DDGS withdrawal strategies during the last 2 finisher phases. Four-fifths of the barrows or gilts were offered diets containing 30% corn DDGS replacing soybean meal for the first 3 grower phases. These hogs were then fed 20 and 20%, 20 and 10% or 20 and 0% corn DDGS in the last 2 finisher phases, respectively, until reaching market weight. Our results showed that feeding 30% corn DDGS or implementing a withdrawal strategy did not affect hog growth performance, feed cost per hog, income over feed cost, or cost per kg gained. However, the rate of withdrawal of corn DDGS out of the finishing diets improved carcass dressing percent and estimated carcass pork yield (Beltranena et al. 2009a).

Figure 1. Withdrawal strategies tested for corn DDGS.

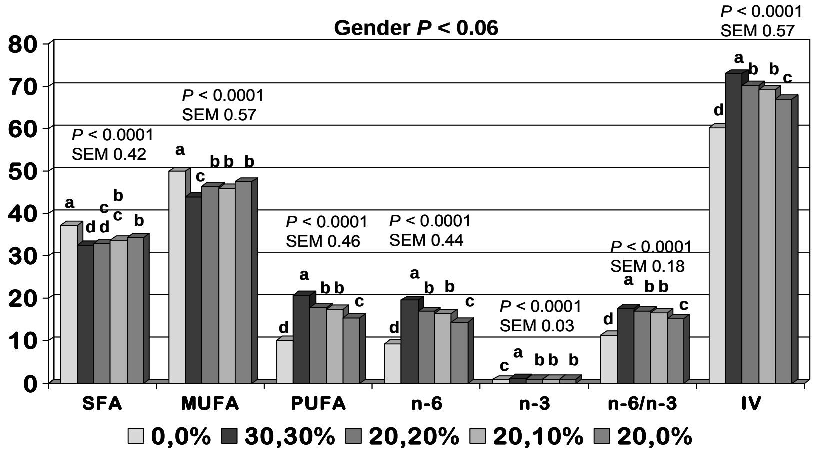


Agriculture and Agri-Food Canada – Lacombe Research Centre conducted the primal cut outs and extensive pork quality work. We found that feeding 30% corn DDGS or implementing a DDGS withdrawal strategy reduced the dissectible intermuscular fat in the picnic, butt, loin and ham. Implementing the DDGS withdrawal strategies also increased the weight of the squared and trimmed belly, proportionally reducing the weight of the spare ribs. Retail appearance, marbling scores and objective colour measurements were diminished by feeding 30% vs. 0% DDGS, but were enhanced by implementing the 3 DDGS withdrawal strategies. Most importantly, sensory panellists were unable to practically detect differences in texture and flavour attributes in cooked chops and burger patties from hogs fed 30% or no corn DDGS. So, in contrast to a minor impact on retail appearance, there were benefits of feeding 30% vs. no corn DDGS on primal cuts tissue composition, loin quality and no effects on sensory results (Beltranena et al. 2009b).

We determined that feeding 30 vs. 0% corn DDGS to market weight reduced backfat hardness. Reducing to 20%, followed by entirely removing corn DDGS from the last finisher diet, 2 weeks prior to hogs reaching market weight improved, but did not entirely restore backfat hardness. When bellies were draped over a bar to rate belly fat hardness, feeding 30% corn DDGS to market weight or reducing the dietary inclusion from 30 to 20% over the last 2 finisher phases prior to market weight, reduced the distance between the two hanging ends and the angle formed at the bar compared to bellies of control pigs. Reducing corn DDGS in the diet to 20%, followed by complete removal two weeks prior to hogs reaching market weight (i.e., 20, 0% strategy) increased belly thickness, the distance between ends and improved (increased) the angle, but did not entirely restore belly fat hardness to that of the 0% DDGS control hogs (Beltranena et al. 2009c).

Feeding 30% corn DDGS to market weight increased polyunsaturated fatty acids, omega-6, omega-3, and reduced saturated and monounsaturated fatty acids in belly fat compared to control hogs (**Figure 2**). From a human health perspective, this would have mixed implications because increases in the omega 6:omega 3 ratio and reductions in monounsaturated would be viewed as negative, while decreases in saturated fats would be positive. Implementing the three corn DDGS dietary withdrawal strategies for the last two finisher phases prior to market weight resulted in mostly intermediate content (between the 30 and 0% DDGS) of these fatty acids; the 20, 0% strategy was mostly different from the 20, 20 or 20, 10% corn DDGS feeding strategies, closer to controls (Beltranena et al. 2009c). Reducing to 20%, followed by entirely removing corn DDGS from the last finisher diet lowered the iodine value to 67 (Beltranena et al. 2009c).

Figure 2. Feeding 30% corn DDGS increased polyunsaturated fatty acids, n-6, n-3, and reduced saturated and monounsaturated fatty acids in belly fat compared to controls.

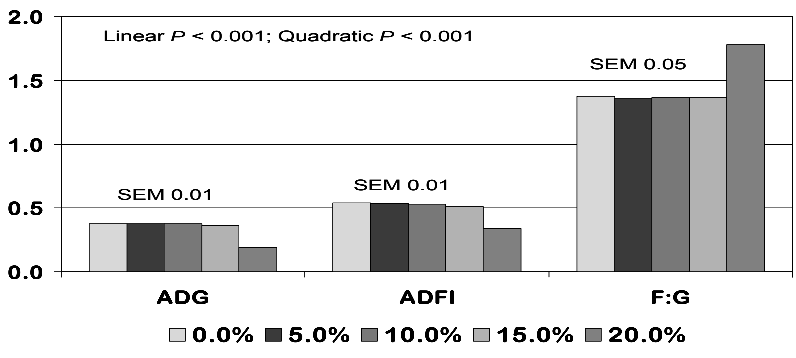


Our recommendation, therefore, is to maximize inclusion of corn DDGS in grower diets when the high oil content of corn DDGS will return the most by contributing extra dietary energy. If bellies are the MOST important cut to packers, corn DDGS should be withdrawn sooner (e.g., 4 weeks prior to market weight) if hogs were previously fed diets with ≥30% DDGS compared to hogs previously fed up to 20% DDGS, where withdrawing DDGS 2 weeks prior to market weight would be sufficient. Although the 3 corn DDGS withdrawal strategies tested improved fat hardness, not even the most aggressive withdrawal strategy (20, 0%) restored fat hardness to that of controls. But is there a need to reach 'zero' impact on fat hardness by withdrawing corn DDGS? The extent and length of withdrawal should therefore be a compromise between impact on fat hardness and benefits on pork quality. The effects of feeding corn DDGS were more pronounced in gilts compared to barrows.

▪ Feeding Increasing Levels of Wheat DDGS

Wheat DDGS is locally produced in the Prairies, and there are more Saskatchewan plants in operation now than previously (Terra Grain Fuels in Belle Plains, Norwest Terminals in Unity). The quality of wheat DDGS from the new ethanol plants might be superior to that of older plants, but wheat DDGS is as variable a co-product as American corn DDGS. Co-fermenting of wheat and corn continues (Husky Energy, Lloydminster) without the buyer being advised in what proportions or when these change. Therefore, assigning nutrient values for formulation is a moving target. We have recently conducted two studies, one with weaner pigs; the other with growout hogs.

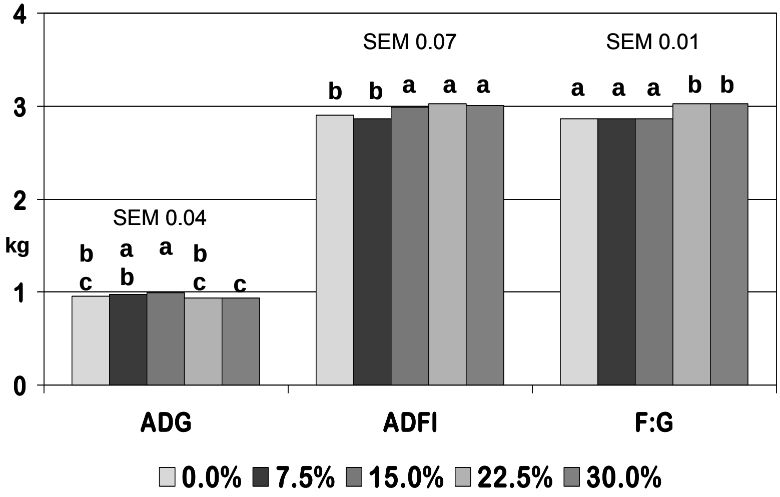
Figure 3. Growth performance of weaned pigs fed diets with increasing levels of wheat DDGS in substitution for soybean meal (Avelar et al. 2009, submitted)



We evaluated increasing levels of wheat DDGS (0, 5, 10, 15, or 20%) substituting soybean meal and wheat in the diet fed to weaner pigs starting one week post-weaning for four weeks. The diets were formulated to provide 2.39 Mcal net energy (NE) per kg and 4.80 g standardized ileal digestible lysine per Mcal NE. Increasing the levels of wheat DDGS in the nursery diet quadratically reduced feed intake, weight gain and feed efficiency (**Figure 3**). At d 28, weaner pigs fed 10 and 20% wheat DDGS were 0.15 and 5.6 kg lighter than controls. We concluded that weaned pigs can be fed up to 15% wheat DDGS without reducing performance (Avelar et al. 2009).

In a commercial-scale study, 550 gilts and 550 barrows (30 kg) penned separately were fed diets with increasing levels (0, 7.5, 15, 22.5 or 30%) of wheat dried distillers's grain with solubles (DDGS) to market weight (118 kg). The 5 growth phase study diets were formulated to provide 2.4, 2.4, 2.35, 2.35 and 2.30 Mcal/kg NE and 4.0, 3.7, 3.3, 3.0 and 2.8 g SID Lys/Mcal NE. Overall, feed intake increased (130 g/d) to 22.5% DDGS, but declined 20 g/d at 30% inclusion (**Figure 4**).

Figure 4. Growth performance of grower-finisher pigs fed diets with increasing levels of wheat DDGS (Beltranena et al. 2009, unpublished)

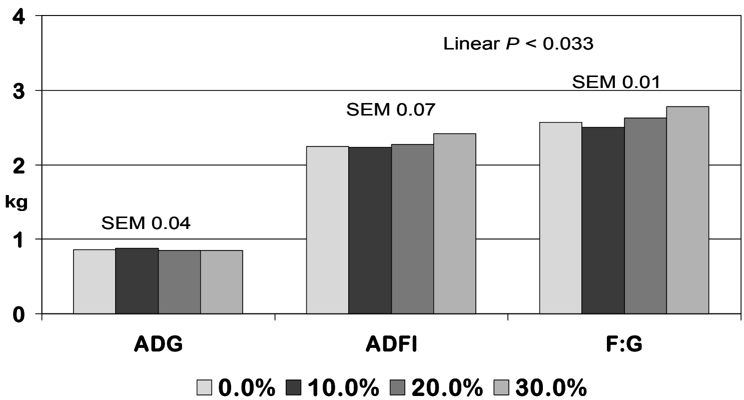


Weight gain increased 40 g/d at 15% DDGS, but decreased 10 g/d at 22.5 and 30% inclusion. Pigs consumed 42 g/d more feed per kilo gained for every 7.5% increase in dietary wheat DDGS inclusion. Dressing percentage decreased 0.45 %-unit and backfat thickness decreased 0.23 mm for each 7.5% increase in wheat DDGS inclusion. Estimated pork yield increased 0.13 %-units and index increased 0.25 units for each 7.5% increase in dietary wheat DDGS inclusion. Due to increased feed intake, reduced weight gain and days to market, income over feed cost decreased linearly with increased wheat DDGS inclusion. The results of this study indicate that the NE content of wheat DDGS was overestimated. It appears that 20% inclusion rate should be the maximum commercial inclusion rate of wheat DDGS for grower-finisher pigs after which reduced performance should be expected.

▪ Feeding Increasing Levels of Triticale DDGS

The Canadian Triticale Biorefinery Initiative has the goal of promoting triticale as a bioindustrial crop, including production of ethanol for gasoline and DDGS for livestock feeding. To validate the effect of feeding increasing dietary inclusion levels of triticale DDGS on growth performance and carcass characteristics, 48 barrows and 48 gilts were fed 0, 10, 20 or 30% triticale DDGS in the grower, developer and finisher diets from 25 to 125 kg. Pigs were weighed and feed intake established every 14d and for the entire trial. Real time ultrasound was conducted at the grading site at market weight (125 kg) to measure backfat thickness and loin depth instead of the planned carcass grading. Over the entire trial, feed intake increased 60g/d and pigs required 72 g more feed per kg gained for every 10% inclusion of triticale DDGS in the diet, but daily weight gain was not affected (**Figure 5**).

Figure 5. Growth performance of grower-finisher pigs fed diets with increasing levels of triticale DDGS (Beltranena et al. 2009, unpublished)



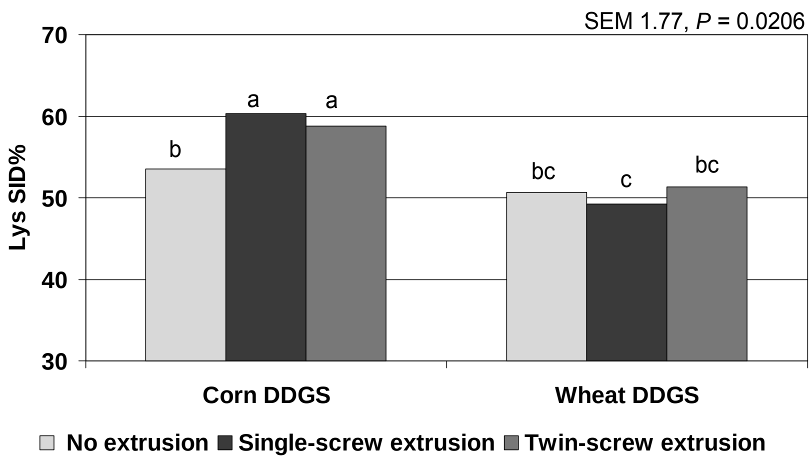
Live backfat thickness and loin depth at market weight were not affected by DDGS inclusion level either. We concluded that previous digestibility work likely overestimated the NE value of triticale DDGS; yet hogs can be fed up to 20% triticale DDGS in the growout diets.

■ Extrusion of DDGS to Enhance Nutrient Digestibility

To enhance the nutrient digestibility of DDGS and assess the feeding opportunity for growing pigs, 9 ileal-cannulated pigs (27.6 kg) were used to characterize the effect of extrusion processing on energy and amino acid digestibility of wheat and corn DDGS, and to compare single- vs. twin-screw extrusion. One wheat and 1 corn DDGS sample were processed using a single-screw InstaPro 2500 or a twin-screw Werner & Pfleiderer ZSK-57 extruder. In a 7 x 9 Youden square design, 7 diets (wheat DDGS, single-screw extrudate, twin-screw extrudate, corn DDGS, single-screw extrudate, twin-screw extrudate, N-free) were fed to 9 pigs at 2.8 x maintenance over 7 periods consisting of a 5-d diet adaptation, a 2-d collection of feces, and a 2-d collection of ileal digesta.

Single- and twin-screw extrusion increased the apparent total tract digestibility (ATTD) of gross energy by 5.0 and 4.5%, and the DE value of DDGS by 6.1 and 5.9%, respectively. There was a DDGS grain by extrusion interaction on the standardized ileal digestibility (SID) of 8 out of 10 and the mean of all 10 indispensable AA, glutamine and tyrosine. Single- and twin-screw extrusion processing increased the SID of the mean of all 10 indispensable AA in corn DDGS by 7 and 5%, respectively; twin- but not single-screw-extrusion did so by nearly 3% for wheat DDGS. Extrusion increased the SID of lysine by 11% (**Figure 6**), tryptophan by 8 %, valine and isoleucine by 7%, methionine, phenylalanine histidine, leucine, glutamine and tyrosine by 5% in corn DDGS.

Figure 6. Effect of extrusion on the standardized ileal digestibility of amino acids in corn and wheat DDGS for growing pigs (Beltranena et al. 2009d)



There was no effect of single- or twin-screw extrusion on wheat DDGS, except for twin-screw extrusion on the SID of methionine and tyrosine and both single- and twin-screw extrusion on the SID of leucine. The results of this study indicated that single- and twin-screw extrusion is an effective processing method to increase the dietary energy digestibility of DDGS. More so for corn than wheat DDGS, extrusion also increased the AA digestibility of the main co-product of ethanol production in diets for growing pigs (Beltranena et al. 2009d).

■ Conclusions

The results of these studies indicate that unless packers express concern regarding fat and belly quality, corn DDGS can be included in western Canadian hog diets up to 30%. A two week withdrawal was sufficient to reduce iodine value to 67, mitigating the impact in fat and belly quality. Until we have additional information, we suggest prudence limiting the inclusion of wheat and triticiale DDGS to 15% in late nursery diets and 20% in growout hog diets. Identifying the proper NE value for high protein and fibre wheat and triticale DDGS has been a challenge. Extrusion of corn and wheat DDGS increased the energy and amino acid digestibility for young pigs.

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