# Feeding straw to sows in late gestation.

## Benefits to processing?

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Feeding fiber-rich diets to gestating sows may reduce the behavioral problems associated with restricted feeding, and improve sow and litter performance during lactation. However, these beneficial responses are not consistently observed. This probably related to differences in dietary inclusion rates and composition of the fiber, specifically the proportion of soluble to insoluble fiber. For example, sows offered diets rich in soluble fiber had an extended feeding time, delayed glucose and nutrient absorption, spent less time standing (Ramonet et al., 2000; de Leeuw et al., 2004) and showed reduced aggression (Danielsen et al., 2001) compared to a diet based on a less soluble mixed fiber. However, many of the fiber-rich ingredients available for inclusion in the diet of a gestating sow are high in insoluble fiber. There is work indicating that severe hydrothermal processing of fiber sources increases the solubility and improves the utilization of insoluble of fiber in pigs (de Vries et al. 2012). The overall objective of this study was to determine if feeding heat-treated straw to sows in late gestation would provide beneficial effects. We were especially interested in potential benefits to the piglets.

### Experimental approach

This experiment was conducted at the Prairie Swine Centre, Saskatchewan, and utilized 150 sows (86 ± 2 d of gestation; 236.7 ± 32.4 kg BW; parity 0-5), 10 sows per week. Gestating sows were maintained in a free access stall system (Inn-O-Stall, Egebjerg International, Denmark) with 32 individual walk-in/lock-in stalls per group pen. Each stall (66 cm x 210 cm) is equipped with a feeder and nipple drinker. Sows were fed individually in stalls once per day, but were allowed to leave, with sows from various treatments mixed within the group. On d 110 of gestation, sows were moved from the gestation facility into a farrowing room containing 16 farrowing crates (183 x 244 cm each). Each crate was equipped with an individual bowl feeder and water nipple at the front.

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The experiment used 5 dietary treatments; a standard gestation diet (Control) or the Control supplemented with processed or unprocessed oat or wheat straw at 10% of the daily feed allowance. The straw was ground using a tub grinder followed by further grinding through ¼ inch screen using a hammer mill. The processed straws were produced by hydraulically compressing straw through a briquette maker (model BP-100; Biomass Briquette Systems, LLCTM, Chico, CA, USA) at a temperature of about 80$^{o}$C.

We intended to measure indicators of behavior, such as scratches and marks due to aggression, but this was terminated after the first couple of blocks because there was no indication of fighting with any of the sows. However, as an indicator of treatment effect on satiety, feeding rate was estimated at 1300 h on d 18 (about d 100 of gestation) by measuring the time required to consume 200 g of the standard gestation diet offered to each sow at 6 h post feeding. Blood samples were obtained on d 100 of gestation at -5 (preprandial) and at 30, 60, 90, 120, 180, 240, 300, and 360 min post feeding from a catheter that had been inserted into an ear vein the previous day. Upon weaning, 3 piglets per litter with the BW closest to the average were selected, placed on standard diets. and followed from weaning to market.

The statistical analysis used 2 models. The first model assumed a randomized complete block design (RCBD) with 5 treatments, while the second model also used the RCBD but with 4 treatments arranged as a 2 × 2 factorial.

## Results and discussion

Treatment had no effect on aggression; however, a non-competitive feeding system was used and the sows were grouped after receiving their morning feeding. This environment results in low overall aggression, making it difficult to detect treatment effects. There was also no effect of treatment on the time required to consume 200 grams of gestation diet provided to the sows 6 hours post-feeding. This test was used as an indicator of satiety, assuming that "hungrier sows" would consume the 200 grams more quickly. Six hours after the morning feeding may not be sufficient time to measure adequately this response.

As expected, dietary energy content was reduced with the addition of straw (Table 1, trt $P < 0.001$). Processing increased diet digestibility and thus energy content of the diet and this effect was greater with the oat straw than the wheat straw (S × P, $P < 0.01$).

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**Table 1. Total tract dry matter and energy digestibility and calculated dietary DE of the diets determined on approximately day 100 of gestation.**

| | | Oat | | Wheat | | | | P value[1] | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Item | Control | Unproc | Proc | Unproc | Proc | SEM | Trt | S | P | S × P |
| N sows | 10 | 9 | 10 | 9 | 9 | - | - | - | - | - |
| Digestibility,% | | | | | | | | | | |
| Dry matter | 72.4$^a$ | 60.0$^d$ | 70.9$^b$ | 68.8$^c$ | 71.1$^{ab}$ | 0.63 | 0.001 | 0.001 | 0.001 | 0.001 |
| Energy | 72.9$^a$ | 58.7$^d$ | 69.2$^b$ | 67.3$^c$ | 69.9$^b$ | 0.80 | 0.001 | 0.001 | 0.001 | 0.001 |
| DE, Kcal/kg | 2,777$^a$ | 2,234$^d$ | 2,648$^b$ | 2,576$^c$ | 2,673$^b$ | 30.5 | 0.001 | 0.001 | 0.001 | 0.001 |

a-d Means in a row within variables with different superscripts differ ($P < 0.05$). Values are means with pooled SEM for overall dietary treatments.
1 P-values: Trt = overall dietary treatment effect; S = effect of straw type; P = effect of straw processing; S × P = effect of interaction between straw and processing

**Table 2. Lactation performance of sows who had received a control diet or diets supplemented with processed (Proc) or unprocessed (Unproc) oat and wheat straws during late gestation.**

| | | Oat | | Wheat | | | | P value[1] | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Item | Control | Unproc | Proc | Unproc | Proc | SEM | Trt | S | P | S × P |
| N sows | 10 | 9 | 10 | 9 | 9 | - | - | - | - | - |
| Parity | 2.1 | 1.9 | 1.7 | 2.1 | 1.6 | 0.33 | NS | NS | NS | NS |
| Sow, Lactation | | | | | | | | | | |
| ADFI $^d$ 1-7, kg/d | 4.26 | 4.71 | 4.71 | 4.13 | 4.37 | 0.23 | 0.053 | 0.010 | NS | NS |
| Piglets, n[2] | 57 | 70 | 67 | 72 | 67 | | | | | |
| Body weight, kg | | | | | | | | | | |
| Weaning | 7.03$^b$ | 7.16$^b$ | 7.51$^a$ | 7.03$^b$ | 6.93$^b$ | 0.17 | 0.05 | 0.002 | NS | 0.056 |
| Nursery exit | 25.6$^a$ | 24.1$^c$ | 25.2$^{ab}$ | 24.7$^{bc}$ | 25.0$^{ab}$ | 0.41 | 0.02 | NS | 0.03 | NS |

a-d Means in a row within variables with different superscripts differ ($P < 0.05$). Values are means with pooled SEM for overall dietary treatments.
1 P-values: Trt = overall dietary treatment effect; S = effect of straw type; P = effect of straw processing; S × P = effect of interaction between straw and processing
2 The number of piglets selected from each treatment and followed through to market

hypothesis just isn't supported by data. How many people are successful with sustained weight loss through counting calories or exercise programs? How many billions of dollars are spent unsuccessfully on these types of weight loss programs? How many billions more on treatments for metabolic disorders like diabetes. If you want to know more details, have a look at Gary's 2012 presentation titled "Why We Get Fat: Adiposity 101 and the Alternative Hypothesis of Obesity". It can be found at https://meatscience.org/publications-resources/rmc-proceedings/2012. My simple understanding of the alternative hypothesis is that eating carbohydrates stimulates insulin release; insulin results in energy moving from our blood into fat reserves; sustained high levels of insulin may also increase risk of diabetes; eating fat does not stimulate insulin release; and eating fat rather than carbohydrates appears to avoid the undesirable effects we get from excessive carbohydrates. What does all this have to do with pork quality? Well, what if it turns out that Gary and Nina are absolutely correct? What if a healthy diet really is low in carbohydrates, moderate in protein and high in fats? If so, then we should be thinking about fat when we think about high quality pork. We need to get past the idea that lean is healthy, and that pork is simply a good source of protein. Pigs are very good at turning carbohydrates into healthy fats for human consumption. Imagine the possibilities of what we can do with pork cuts if fat goes from villain to hero.

If you are attending Banff Pork Seminar in January, there will be a break out session on "Meat Quality". I'll talk about pork as more than a good source of protein and some related opportunities that may lie ahead for the Canadian pork industry. I'll also share the rest of the story on my journey with eating more fat in place of carbohydrates over the past 18 months. As a teaser, I'm quite happy to be a guinea pig experimenting on this different way of eating. The other speaker in the session will be Michael Young from Canada Pork International. Michael will talk about what customers around the world look for in Canadian pork, followed by a pork cutting demonstration. It's worth noting that some of the customers who pay the most for Canadian pork require a healthy balance of protein and fat in the product, and they would like even more fat. There is opportunity to learn from these markets and learn from Michael how to work with a variety of pork cuts, especially those higher in fat. The result could lead you to a more enjoyable and healthier pork eating experience and increased market value for Canadian hogs. Hope to see you in Banff!

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Pre- and post-prandial plasma glucose tended to decrease with processing in the wheat, but not the oat straw ($P \times S$, $P < 0.10$, data not shown) and this effect was more apparent in the preprandial samples. This, combined with the effects on digestibility, indicates that processing had a greater effect on the solubility of fiber in the oat, relative to the wheat straw.

Supplementing the gestation diet with processed straw during late gestation had no effect on litter size or piglet birth weight (Table 2). However, piglet weaning weights were improved with the oat straw supplementation (S, $P < 0.01$) and there tended to be a further improvement when the oat straw was processed ($S \times P$, $P = 0.06$). This observation could be a reflection of the improved feed intake for the sows during the initial 7 days post-farrowing that was observed with the oat straw supplementation (S, $P < 0.01$; Table 2). The improvements observed with straw processing were still evident at nursery exit ($P < 0.03$); however, piglets on the control treatment had similar nursery exit weights as piglets from sows receiving processed oat or wheat straws. Finally, treatment had no effect ($P > 0.10$) on market weight or yield, dressing or carcass yield %, mm back fat or loin depth.

### Summary and Conclusions

Although data on aggression and/or satiety was not conclusive, processing the oat straw increased plasma glucose, whereas the opposite effect was observed with the wheat straw. Moreover, gestating sows fed oat straw from day 86 of gestation to farrowing had increased feed intake post-farrowing and higher average piglet weaning weights. In our study, oat but not wheat straw provided benefits for gestating sows and there was some indication that further benefits could be obtained through processing.

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