

The Monogastric Feed Research Group at Alberta Agriculture and Forestry

Who we are

We are a small group of researchers within the Livestock Research and Extension Branch of Alberta Agriculture and Forestry (AF) in Edmonton. The Monogastric Feed Research Group conducts research with both pigs and poultry. The Group consists of Eduardo Beltranena (lead) and Miranda Smit (technical writer/research assistant) on the pig side, and Matt Oryschak (research associate) and Zahra Dehghani (research assistant) on the poultry side.

Bio of Eduardo Beltranena



Eduardo Beltranena works for Alberta Agriculture and Forestry as Monogastric Feed Research Scientist, as part of the Livestock Research Sector. He was born and raised in Guatemala, then moved to Mexico to study Agricultural Engineering. He finished his B.Sc. degree in 1982, after which he joined ALDABI in Mexico for two years, where he managed a farm.

As part of this job, he conducted many field trials including early research feeding imported Canadian canola meal to broilers and pigs. He also developed key relationships with Alberta swine breeders and Canadian researchers. He then moved to Canada to pursue a PhD in swine nutrition and reproduction at the University of Alberta under supervision of Frank Aherne and George Foxcroft. He studied follicular hormonal feedback of the pituitary/hypothalamic function, which is to this date his favorite research project he has worked on. After finishing his PhD degree in 1992, Eduardo joined Calmar Feed Mill as nutritionist for two years. After that he moved to Kansas to start as postdoctoral fellow at Kansas State University. Within a year, he secured a position as researcher at the Prairie Swine Centre in Saskatoon, where he spent 10 years (1994-2004). In 2004,

Eduardo accepted a position at Alberta Agriculture, where he is currently still working as the principal investigator of the Monogastric Feed Research Group.

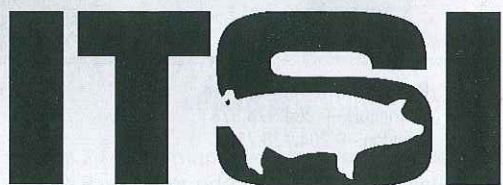
In his current position, Eduardo manages many research trials feeding co-products and/or underutilized ingredients to nursery pigs, grow-finish pigs, laying hens and broilers. He is still deeply involved in canola research. His areas of greatest interest include barn space utilization, dietary energy, feed as it affects carcass and pork quality, and enrichment of meat and eggs with omega-3s from camelina. This is reflected in the projects that he is currently involved in; 1) feeding of oilseed cakes to increase dietary energy, and 2) the interaction of dietary energy, crowding, feeder space and gender on growth performance, carcass and pork quality. Most recently, he has been reading a lot on reducing carbon and nitrogenous emissions to reduce the footprint of animal agriculture.



Eduardo's favorite part of the job is troubleshooting and modeling poultry and pig operations (barns and feed mills) to maximize their profitability, and he is inspired by the resilience and ingenuity of western swine producers who readily compete in a global market economy. If he could change one thing in the pork industry, it would be the funding and financing situation – too many resources are wasted begging for funding to conduct swine research. Moreover, bank financing limits industry expansion, which, if better backed up by government, could avidly increase exports to diversity GDP.

Eduardo considers some of his teachers his greatest mentors: Enrique Hernandez (Mexico), Alfredo Newell (Mexico), Frank

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Aherne (Alberta), and George Foxcroft (Alberta). His career highlight was moving to seek new opportunities. He was able to recognize when it was time to move on. Every move brought great rewards later on. His advice for new researchers: "Developing and maintaining relations with industry is as important as seeking innovation!"

Eduardo's interests outside of work include renovating old houses, long distance running and cross-country skiing. He is also a private pilot with multiple ratings, and is always seeking to embrace new technologies (solar panels, fuel cells, H2 etc.).

Bio of Miranda Smit

Miranda Smit is technical writer/research assistant at Alberta Agriculture and Forestry and works in the Livestock Research Sector for the Monogastric Feed Research Group. She was born and raised in the Netherlands, where she studied Animal Science (B.Sc. and M.Sc.) at the Wageningen University. She also spent a year in France, where she obtained a second M.Sc. degree in Agriculture.



Miranda's story of how she ended up in Canada and in the pork industry are connected to each other.

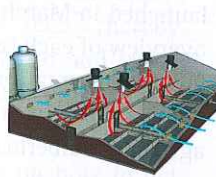
While working on her Masters degree in The Netherlands, she asked her supervisor to find an exchange student opportunity for her in Canada, as she had been interested in Canada since she was a kid. Her supervisor, being a pig researcher himself, got her in touch with Egbert Knol from the Institute for Pig Genetics (IPG) and George Foxcroft at the University of Alberta and in 2006 she spent four months in Edmonton studying fetal programming in a dataset provided by IPG. After finishing her Masters degree, she returned in 2007 to the U of A to work as research technician at the Swine Research and Technology Centre (SRTC) for five months. This is when Miranda fell in love with pigs and Canada. She returned in 2008 to start her PhD in pig reproduction at the U of A under supervision of George Foxcroft. Her thesis 'Litter birth weight and maternal n-3 LCPUFA supplementation in pigs' looked at two things; 1). Effects of feeding marine oil rich in omega-3 fatty acids to sows on reproductive performance and offspring growth and health. 2) Effects of low litter birth weight as measure of prenatal programming on postnatal growth performance (how things in the uterus impact growth after birth). After 4.5 years, she defended her thesis in March 2013 and shortly after managed to secure a job at Alberta Agriculture under supervision of Eduardo Beltranena. She is currently still enjoying her work there.

In the past three years, Miranda has published magazine and journal papers relating to feeding canola meal and low-oil corn DDGS to grow-finish pigs. Currently, a paper is under review to be published in Canadian Journal of Animal Science titled 'Feeding diets with reduced, constant net energy to growing-finishing barrows and gilts'. Miranda was also largely involved in two research trials feeding camelina cake to nursery and

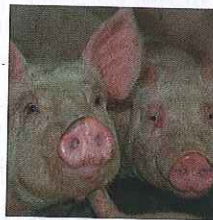
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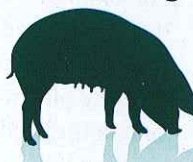
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grow-finish pigs that took place at the SRTC in the past two years. She is currently working on writing up the papers for these projects. Miranda is most proud of the Livestock Research website that she has developed with help from others. It launched in March 2015 and gives a great overview of each research group's research goals, presentations, posters, factsheets, publications etc. It can be found at www.agriculture.alberta.ca/livestockresearch.

In her off-time, Miranda enjoys hiking/backpacking in the mountains, training horses, several kinds of dancing (Argentine tango, salsa, ballroom), traveling near and far, and learning new languages (currently working on Spanish).

What we do

We conduct applied monogastric feed research mostly involving nursery and growing-finishing pigs. Our activities focus on three objectives:

1. Increase utilization of novel and under-used cereal grains, legumes, oilseeds, their fractions and bio-industrial co-products.
2. Implement processing methods that improve feeding value and reduce the effects of anti-nutritional factors in feedstuffs.
3. Reduce the adverse effects of feedstuffs and co-products on growth performance, dressing, carcass characteristics, and pork quality.

'Fractions' mostly include starch, protein and fibre, which are the main components of cereals, legumes and oilseeds. For example, from canola meal we produce low- and high-fibre fractions; the low-fibre fraction is targeted to feeding nursery pigs whereas the high-fibre fraction is targeted to feeding sows.

'Co-products' are what's left from large-scale bio-industrial or human food processing. Co-products are not useless by-products to trash, but instead have economic value. For example, the main co-product of crushing canola seed for human food oil consumption is canola meal. The main co-product of fermenting wheat grain to produce ethanol for gasoline in-

clusion is wheat distiller's grains and solubles (DDGS). Both of these co-products are high in protein and phosphorus that pigs can readily convert into pork.

Our low-cost processing methods aim to increase digestibility and absorption of nutrients from individual feedstuffs. We utilize processing also to reduce the effects of naturally-occurring compounds in feedstuffs that interfere with the digestion and absorption of nutrients, like glucosinolates, phytate, trypsin inhibitors, insoluble fibre, etc.

Feeding bio-industrial or food industry co-products and even some grains reduce the feed intake of pigs, decreasing their weight gain, and the efficiency in which pigs convert feed into pork. Yet feeding co-products can be very cost-effective. Our research thus targets establishing both maximum and optimum feed inclusions of these feedstuffs and issuing recommendations to maximize profit margin after feed cost.

Feeding certain feedstuffs for example enhances fat colour whereas feeding others reduce pork firmness. We identify opportunities to enhance pork attributes and address threats to pork quality that result from high feed inclusions or prolonged feeding of feedstuffs that are cost effective. We therefore find the best compromise between pork quality and profitability for both producers and packers.

The graphical overview of AF's pork program shows examples of feedstuffs and variables we consider in our research.

Why we do it

- Feed represents 65 - 75 per cent of the cost of pork production. Reducing feed cost is central to all our research projects. It is the main determinant of profit margin for pig producers.
- Research into the feeding value of locally-grown pulses allows western Canadian pork producers to reduce their reliance on imported ingredients like soybean meal. This effort increases market demand for rotational crops (e.g., field pea, faba bean) and assures that lentil, chickpea, field pea that do



not meet export grade (e.g. splits) are utilized for feeding.

- Canada exports 2 out of 3 pigs either as pork or as live animals. Thus, our carcass traits and pork quality research is critical to assuring quality attributes to preserve consumer confidence and expand Canada's pork export markets.
- Expanded production of ethanol and bio-diesel in Western Canada generates large quantities of distillers dried grains and solubles and canola cake. Feeding these not only highlights the pig as convertor of bio-industrial co-products into pork, but also creates

local markets to sell the co-products to, which reduces distribution costs.

- Our research into the feeding value of fractions and co-products permits a single crop to be utilized for human food, bio-industrial applications and animal feed, thereby creating opportunities to add value to raw, undifferentiated agricultural commodities.
- Our research focuses on how to get more out of feedstuffs by increasing digestibility and thus largely reducing nutrient excretion in manure. Domestic and foreign pork consumers must have confidence that Alberta is an environmental steward and leader in farm animal food products. Our research directly benefits pork producers and packers, and indirectly benefits crop growers, bio-processors, rural economic development, and entices exports. We thus facilitate the growth of rural Alberta

communities, enabling producers, processors, and agri-businesses to succeed and be self-reliant in a highly competitive global economy.

Description of previous, current and future projects

At any point in time, we have several research projects going on, in different stages of completion. We will give a short overview of current and planned research trials, followed by a look at results from research we've done in the past two years feeding camelina cake to hogs.

- **Canola meal vs. soy expeller at two dietary energy levels**

In collaboration with Gowans Feed Consulting, we run commercial scale field trials. We are currently feeding either canola meal or soy expeller at two different dietary net energy levels to grow-finish hogs. We have previously shown that feeding low energy diets (2.1 vs 2.4 Mcal) is possible and

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even beneficial for the bottom line, but diets did not include canola meal or soy expeller. Both feedstuffs are locally (within Canada) produced and provide opportunities to either reduce or increase dietary energy level at low cost. We also need to confirm the response of hogs to low and high dietary net energy levels to endorse our previous feeding recommendations.

• **Effects of crowding, feeder space, dietary net energy level and gender on grow-finish pig performance and carcass traits**

In the fall of 2016, we will start a trial looking at the interactions between crowding, feeder space and dietary net energy level in grow-finish barrows and gilts. Hogs that are crowded don't grow as well as pigs that have space, but is this due to less feeder space per pig, or are other factors involved? Hogs fed lower net energy diets eat more to keep their caloric intake up, but is this still feasible in a more crowded environment? Do barrows and gilts react differently to changes in crowding, feeder space and dietary net energy value? These and other questions will be answered in this trial.

• **Feeding camelina cake to sows during gestation and lactation**

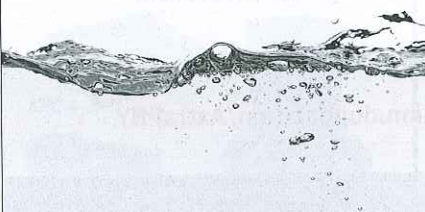
Previous research in our group has looked at feeding camelina cake to grow-finish pigs (see more information be-

low). Camelina cake does not seem to be toxic when fed to pigs. As the oil in camelina cake is high in omega-3 fatty acids, it could potentially be fed to sows to boost their piglets' health status. We have applied for funding for a research trial where we will feed different levels of camelina cake to sows to find maximum and optimum inclusion levels, and to look at piglet growth, scour scores, mortality and other parameters.

What two trials feeding camelina cake to nursery and grow-finish hogs has taught us

Before talking about our results feeding camelina cake to pigs, let's first answer the question why we care about this feedstuff in the first place. Camelina sativa, also known as false flax or gold-of-pleasure, is an oilseed crop (~42% oil) related to canola. Camelina possesses oil rich in poly-unsaturated fatty acids which makes it particularly well suited for biofuel for jet planes, cosmetics and human nutrition. Therefore, there is renewed interest in growing camelina in Europe, North America and Australia. Camelina also has favorable agronomic characteristics – it is early maturing, more resistant to diseases and drought than any of the canola species and the yield is competitive with that of canola. Camelina can be grown on marginal farmland, with relatively low inputs and no irrigation. Research has shown that camelina can be grown successfully in sev-

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eral different regions in Western Canada. The processing of the seed provides oil for biofuel production and a by-product in the form of camelina cake. In order to make industrial exploitation of camelina seeds for biofuel a reality, sustainable markets must be developed for the oil and cake before camelina will be accepted as a new oilseed crop.

Currently, camelina cake can only be fed to pigs up to 2% in the USA and is not allowed to be fed to livestock, except broilers (12%), in Canada. Before a novel feedstuff can be approved for feeding to livestock in Canada, the Canadian Food Inspection Agency (CFIA) requires the evaluation of data relating to feeding safety and efficacy. In order to get camelina cake listed in Schedule IV of the Canada Feeds Act, we performed two trials in nursery and grow-finish hogs. In the first trial, we studied the effects of increasing dietary inclusions of camelina cake in pig nursery (0, 6, 12, 18%) and grow-finish (0, 5, 10, 15%) diets on growth performance and indicators of toxicity. In the second trial, we fed 12% camelina cake to pigs in the nursery, and then looked at different withdrawal regimens in the grow-finish phase, feeding a control diet (0% camelina) starting in the finisher phase, developer phase or grower phase until slaughter.

In the first trial, feed intake (ADFI), daily weight gain (ADG) and feed efficiency (G:F) linearly decreased with increasing camelina cake inclusion (Figure 1). ADFI was 21% lower, ADG 32% lower and G:F 11% lower in hogs fed 18/15% camelina cake compared with controls. Increasing cake inclusion resulted in lower BW throughout the trial, linearly reduced ship weight, and increased days to slaughter weight. It took hogs fed 18/15% camelina cake 28 days longer to reach slaughter weight than controls (146 vs. 118 days, respectively). Increasing dietary camelina cake level linearly decreased carcass weight, dressing %, backfat depth and revenue per hog, linearly increased lean yield, but did not affect loin depth and index (Table 1).

Gross pathological exams of necropsied hogs did not show any abnormalities. However, liver weight linearly increased and spleen weight linearly decreased, both as % of BW, suggesting a greater metabolic burden in hogs fed high camelina cake levels. Heart, thyroid, kidney and pancreas weights were not affected by camelina cake levels in the diet.

Figure 1. Effect of increasing dietary camelina cake inclusion on overall growth performance in nursery and grow-finish hogs

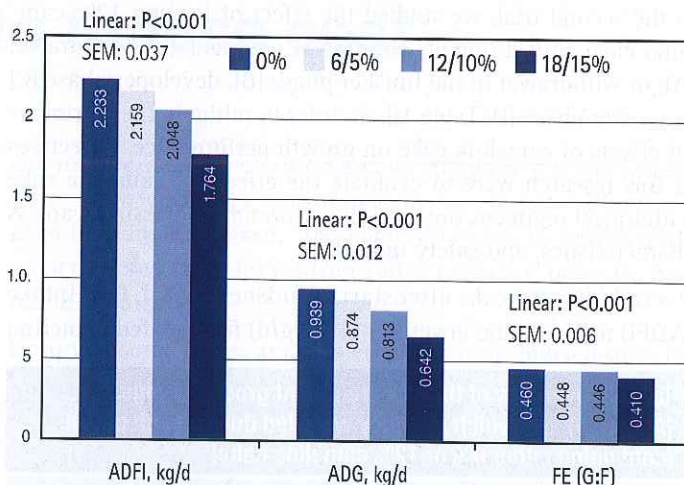


Table 1. Effect of dietary camelina cake on carcass traits

	0%	6/5%	12/10%	18/15%	SEM	Linear
Carcass weight, kg	99.8	96.1	93.8	95.7	0.8	<0.001
Dressing, %	79.7	78.6	78.3	78.3	0.6	<0.05
Backfat, mm	19.14	18.07	18.16	15.66	0.88	<0.01
Loin depth, mm	63.34	56.89	56.82	58.26	2.96	0.272
Lean yield, %	60.51	60.54	60.57	61.86	0.48	<0.05
Index	113.8	112.1	110.1	112.1	1.14	0.176
Calculated carcass revenue, \$	181.49	172.46	165.54	171.61	2.67	<0.05

We concluded from this first trial that feeding camelina cake to hogs up to 18% in nursery and 15% in grow-finish seemed

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safe, but hogs did not like to eat it resulting in impaired growth rate and severe delays in pigs reaching market weight.

In the second trial, we studied the effect of feeding 12% camelina cake with different withdrawal regimens (no withdrawal [A], or withdrawal in the finisher phase [B], developer phase [C] or grower phase [D, Table 1]), in order to mitigate the detrimental effects of camelina cake on growth performance. Objectives of this research were to evaluate the effects of camelina cake withdrawal regimens on: growth performance, dressing, carcass characteristics, and safety indicators.

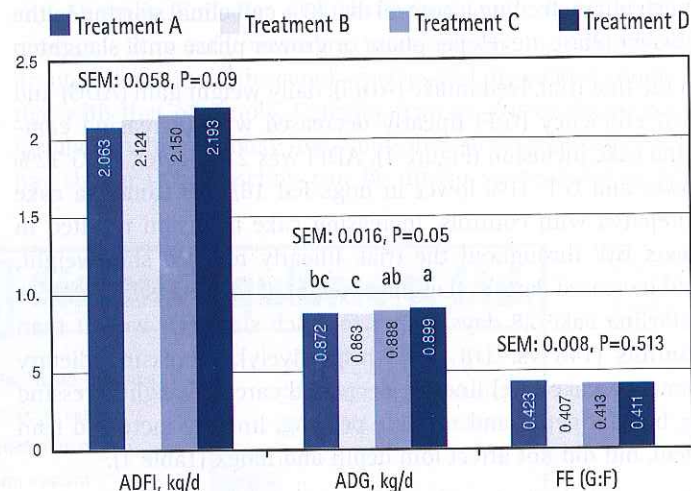
Overall (d0 - 3 weeks after start of finisher phase), feed intake (ADFI) tended to be lower (by 0.13 kg/d) for pigs fed camelina

Table 2. Overview of the four treatment groups of pigs (A, B, C, D) and which diet they were fed during each phase (containing either 0% or 12% camelina cake)

	A	B	C	D
Starter	12%	12%	12%	12%
Grower	12%	12%	12%	0%
Developer	12%	12%	0%	0%
Finisher	12%	0%	0%	0%

to slaughter (A) vs. pigs fed control diets from the grower period onwards (D). Daily gain was significantly lower for pigs on treatments A and B compared with D. Feed efficiency (G:F) was not affected by camelina withdrawal regimen (Figure 2). Days to shipping tended to be less for pigs on withdrawal regimen D (37.2 d) than B (43.0 d), but was not different from pigs on regimen A (38.7 d). Camelina withdrawal regimen did not affect ship BW, carcass weight, dressing, backfat, loin depth, lean yield, or index, but tended to have lower calculated carcass revenue for pigs on withdrawal regimen A (\$163.59) compared with D (\$172.98). At necropsy, no abnormalities were found in organ appearance or serum standard panel results. Liver weight was greater in pigs not withdrawn camelina (A; 23.4 g/kg BW) compared with pigs on withdrawal regimens B, C, or D (average 19.8 g/kg BW). None of the other organ weights were affected by camelina withdrawal regimen.

Figure 2. Effect of dietary camelina cake withdrawal regimen on overall growth performance in nursery and grow-finish hogs



In conclusion, as opposed to our previous trial, pigs fed camelina cake performed quite well, with only minor changes in ADFI and ADG. Withdrawing camelina at different phases did not affect carcass characteristics, or organ weights except liver. Together with the absence of abnormalities in organ appearance and serum samples, it can be concluded that feeding camelina cake to grow-finish hogs is safe and camelina cake withdrawal may not be needed to mitigate detrimental effects of feeding camelina cake. However, the performance of hogs fed camelina cake may strongly depend on the origin of the camelina seed. We used different seed for the first and second experiment; in the first trial hogs didn't like to eat the camelina cake, whereas in the second trial hogs had no problems with the taste. It is possible that seed in the first trial had more anti-nutritional factors that negatively affected the taste of the seed. We suggest to do more research on feeding camelina cake to grow-finish hogs and are currently trying to secure funding for this. ■

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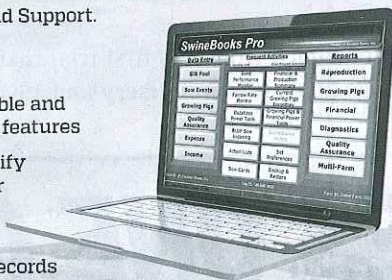
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