# Nutrient digestibility in canola meal for broilers: **Effects of oil extraction method and fractionation by air classification**

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**Government of Alberta**
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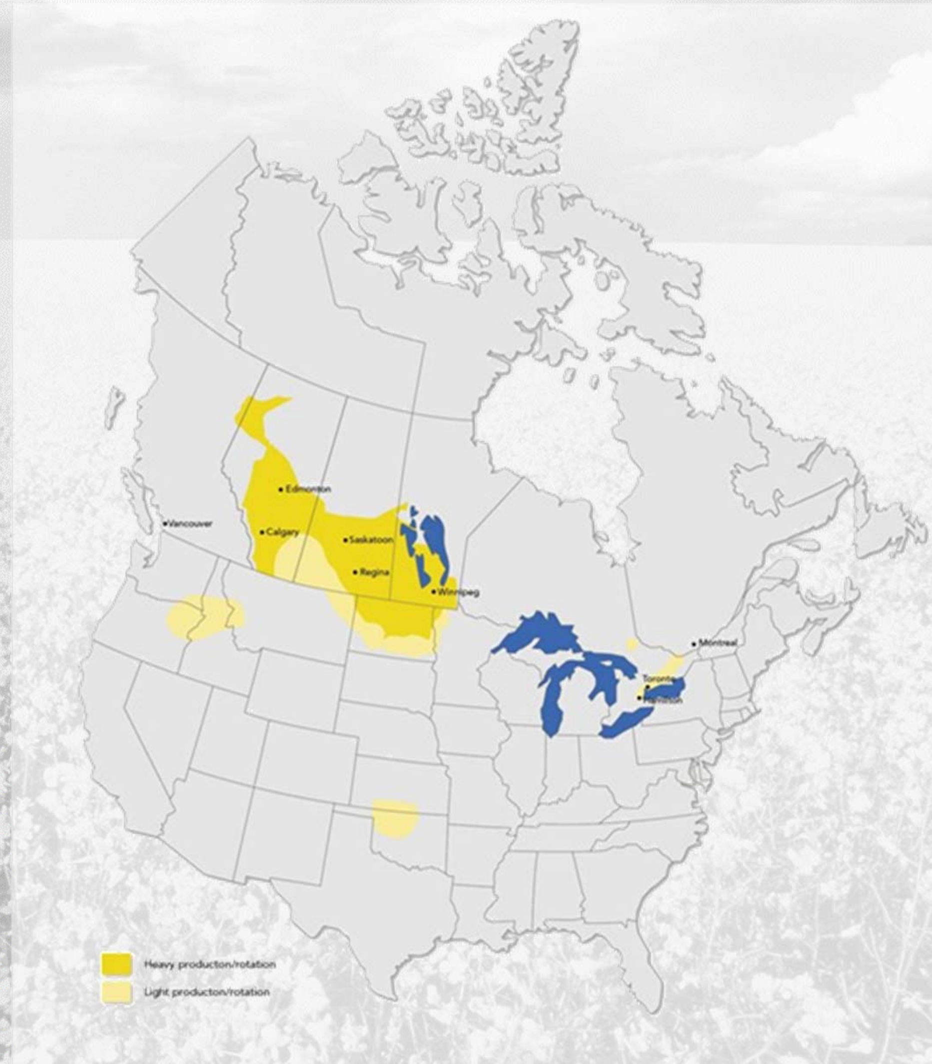
**Abstract 211**

# Background

- **Canada is cold!**
  - **i.e., we can't grow soybeans in Western Canada**
- **Canola is our dominant oilseed**
  - **Low erucic acid, low glucosinolate version of rapeseed**

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WHY DIDN'T NOAH
SWAT THE TWO
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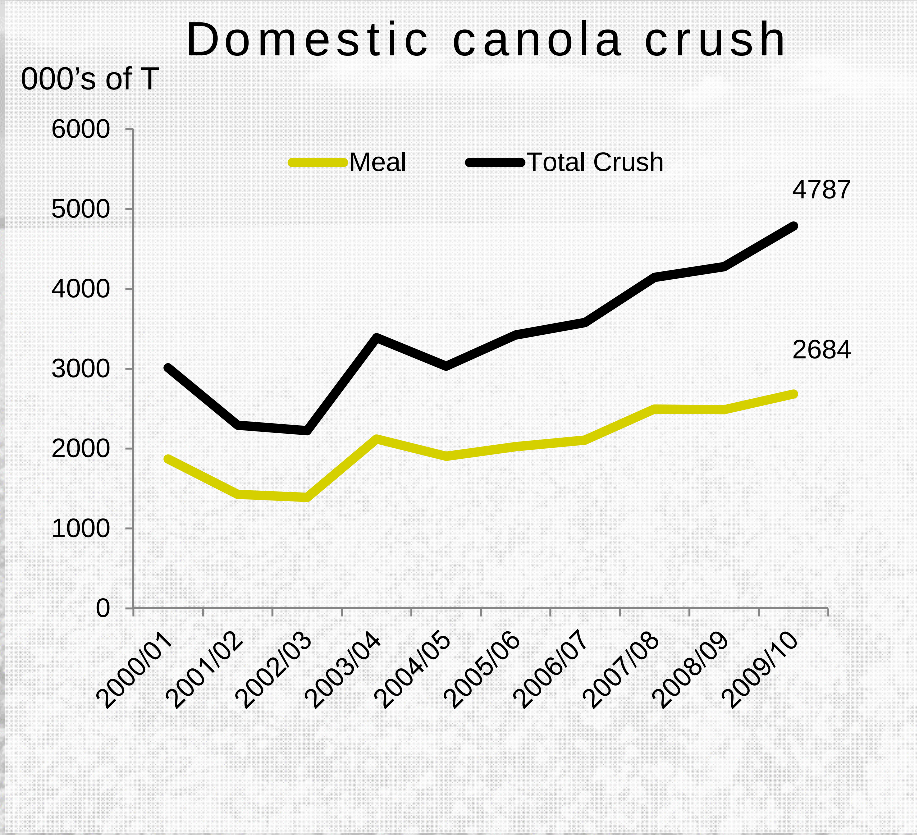
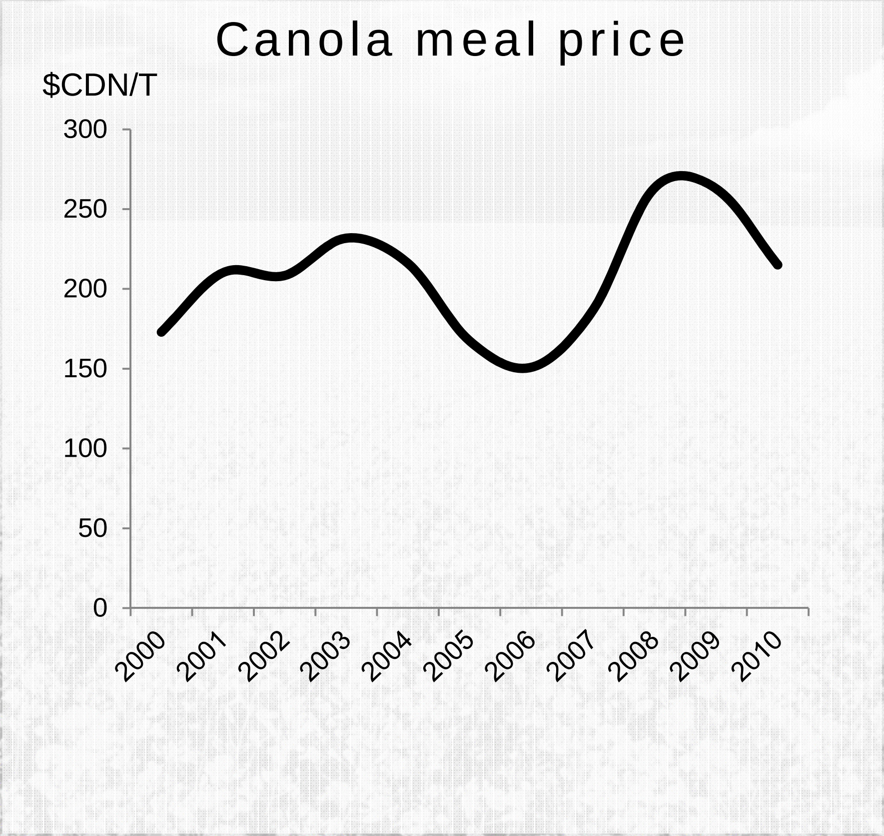
# Key canola industry trends



# Our group's research interests relating to canola meal

1. **Adding value to domestic feeds through further processing**
   - **Particular interest in fractionation technologies**

# Creating value-added products from canola meal

- **Fractionation technology may offer opportunity to create several products from a single commodity**
  - **e.g., could produce separate canola meal fractions geared toward monogastics (⇩fiber, ⇧CP) and ruminants (⇧fiber, ⇩CP)**
- **After trying several fractionation strategies, air classification permitted best separation of fiber between CM fractions**

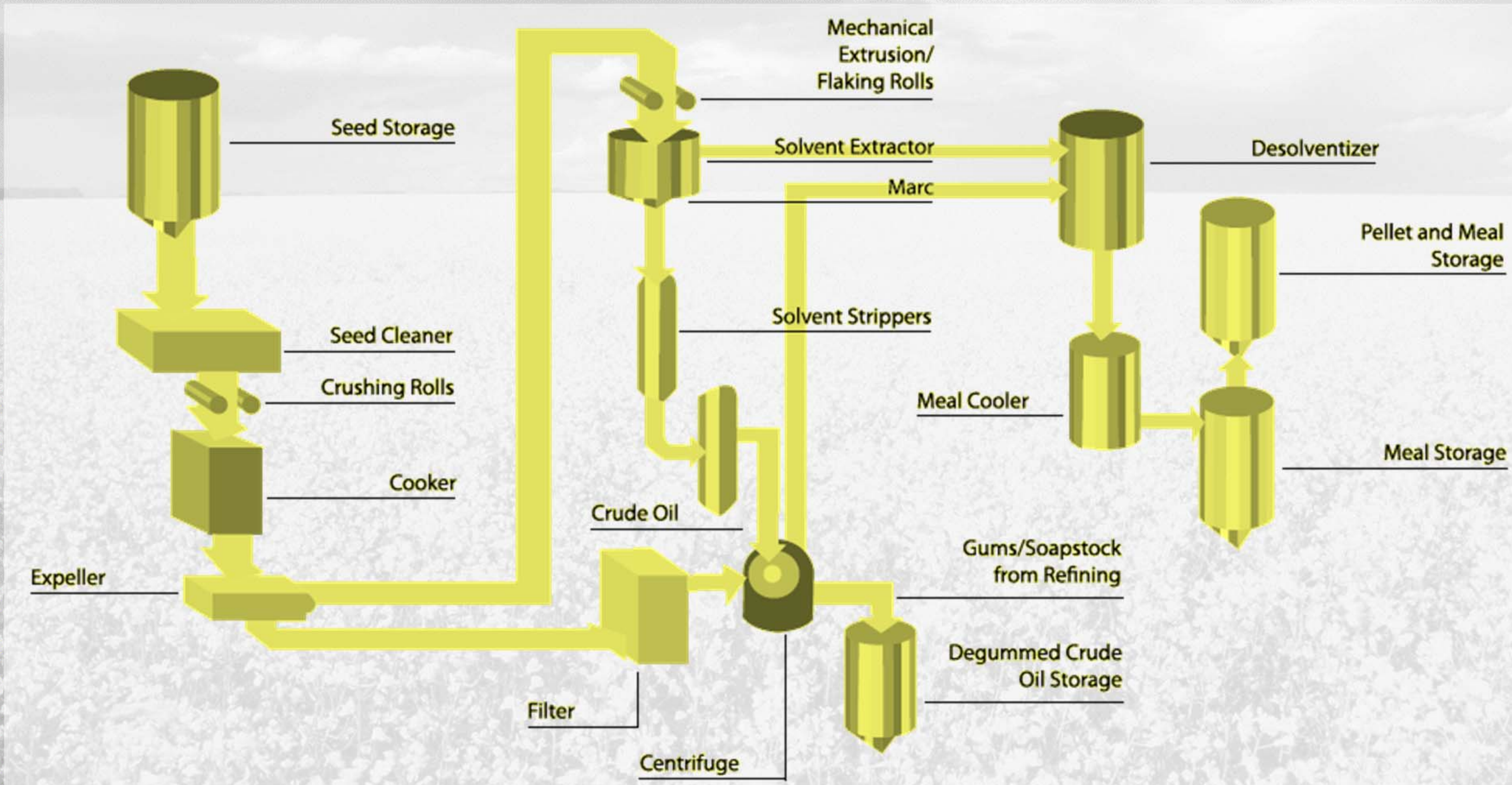
# Our group's research interests relating to canola meal

1. **Adding value to domestic feeds through further processing**
   - **Particular interest in fractionation technologies**
2. **Gathering information about feeding value of domestically-produced crops and bio-energy co-products**
   - **All canola meals are <u>not</u> necessarily created equal**

# Variation in oil extraction processes = different CM??

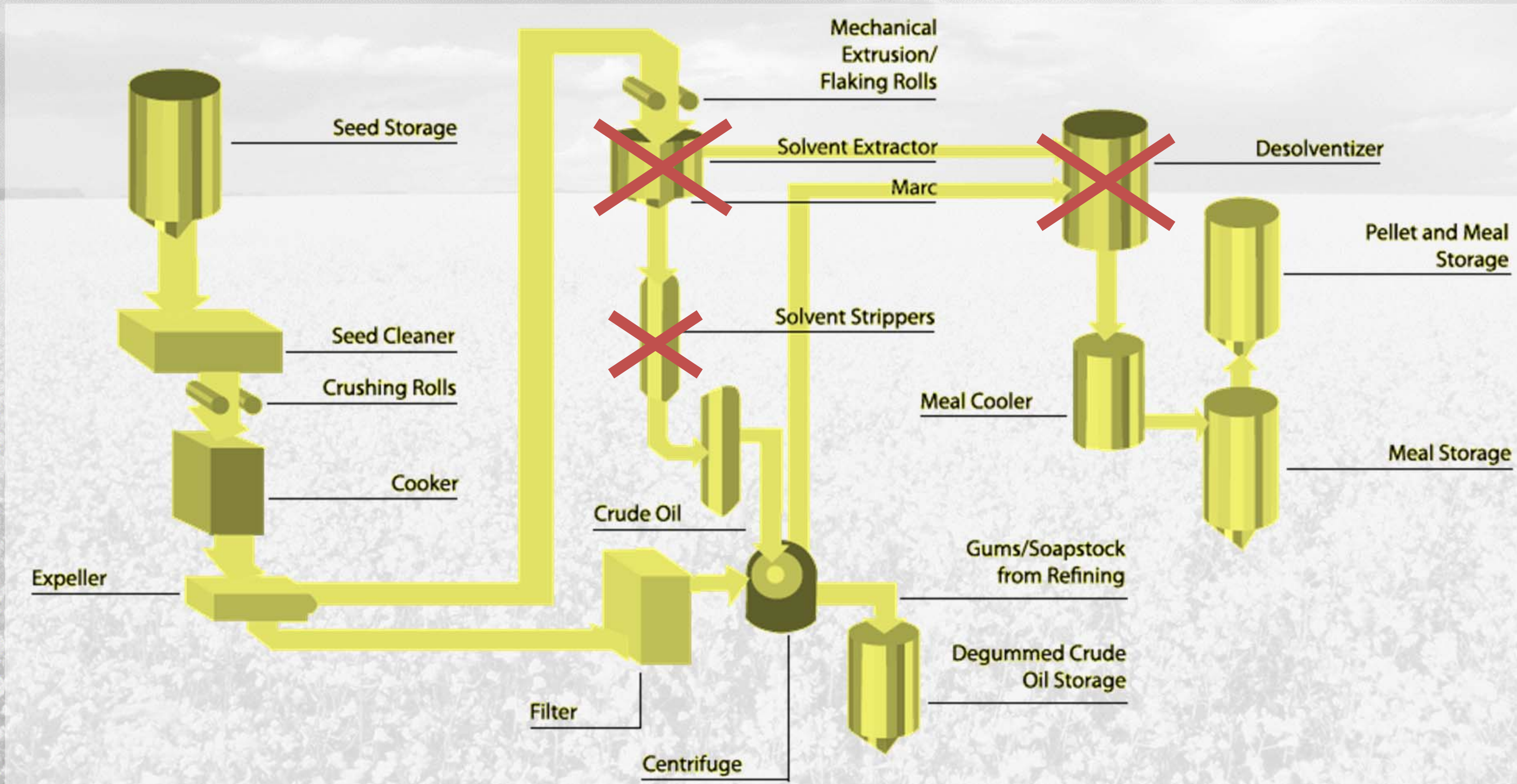
- **Traditional crushing plants maximize oil yield through a combination of pressing and solvent extraction**
- **Some recently-added crushing capacity employs less capital-intensive systems**
  - **double press**
  - **'homemade'**

# Conventional canola crushing
## (pre-press solvent extraction)




Source: *Canola Council of Canada*

# Double press process
## (omits solvent extraction)




Source: ***Canola Council of Canada***

# Alternative extraction processes
## (small scale, low capital)

**Table 1.** Analyzed nutrient content of canola meal samples and fractions test compared in the present study.

| Nutrient | Extruder Press CM | Expeller Press CM | Conventional Canola Meal | ACCM ‘Fines' fraction | ACCM ‘Coarse' fraction |
|---|---|---|---|---|---|
| Moisture | 7.51 | 5.63 | 7.65 | 6.21 | 6.14 |
| Crude Protein | 29.54 | 35.60 | 37.92 | 38.77 | 36.52 |
| Total Amino Acids | 23.93 | 32.39 | 34.57 | 33.71 | 32.69 |
| Crude Fat | 17.12 | 12.75 | 4.76 | 4.28 | 3.23 |
| Crude Fiber | 10.04 | 6.01 | 7.24 | 0.40 | 2.04 |
| ADF | 22.34 | 16.08 | 15.49 | 15.85 | 21.31 |
| NDF | 27.79 | 20.17 | 24.39 | 23.21 | 36.60 |
| Calcium | 0.60 | 0.60 | 1.33 | 0.83 | 1.27 |
| Phosphorus | 0.82 | 1.04 | 1.13 | 1.09 | 1.08 |
| Lysine | 1.20 | 2.11 | 2.15 | 2.08 | 2.03 |
| Methionine | 0.54 | 0.69 | 0.74 | 0.73 | 0.69 |
| TSAA | 1.24 | 1.55 | 1.63 | 1.60 | 1.51 |
| Threonine | 1.16 | 1.52 | 1.58 | 1.54 | 1.48 |
| Tryptophan | 0.39 | 0.52 | 0.59 | 0.55 | 0.49 |
| Arginine | 1.54 | 2.19 | 2.31 | 2.17 | 2.13 |

# Objectives

1. To compare nutrient digestibility among a sample of conventional canola meal and two fractions produced by air classification
2. To compare nutrient digestibility among samples of conventional, double-pressed and extruder pressed canola meals

# METHODS AND MATERIALS

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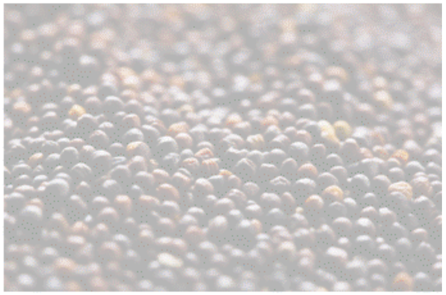

# Our approach

| Ingredient | Basal diet | Test diets |
|---|---|---|
| Wheat | 87.75 | 61.42 |
| Canola oil | 5.00 | 3.50 |
| Test ingredient | - | 30.00 |
| Dicalcium phosphate | 2.75 | 1.92 |
| Limestone | 1.72 | 1.20 |
| Vitamin/mineral premix | 0.71 | 0.50 |
| Choline chloride premix | 0.71 | 0.50 |
| Salt | 0.57 | 0.40 |
| Antibiotic | 0.07 | 0.05 |
| Chromic oxide | 0.71 | 0.50 |

# Our approach (*cont'd*)

Commercial starter diet → Test diets

d0 | d14 | d21

# Experimental design

- **Cage (13 birds/pen) = experimental unit**
  - **Digesta and excreta were pooled to produce one sample of each per pen**
- **Randomized complete block design**
  - **Each treatment appeared once in each of 6 blocks for 6 replicate cages per treatment**

# Measurements

- **Feed disappearance measured over the experimental period**
- **Body weight on d 14 and d 21**
- **Diets, ingredients, digesta and excreta assayed for DM, Cr, CP and GE, P and Ca**
  - **Full AA profile also developed for diets and digesta**
  - **ADF, NDF, CF and EE for diets**

# Statistical analysis

- **Nutrient digestibility coefficients compared using PROC MIXED of SAS (v 9.2)**
  - **Main effect = test ingredients**
  - **Random term = block**
  - **Covariates tested = ADFI; intake of ADF, NDF, CF and respective nutrient**
  - **Preplanned contrasts:**
    - ***Between oil extraction processes***
    - ***Fractions vs. parent stock***

# RESULTS

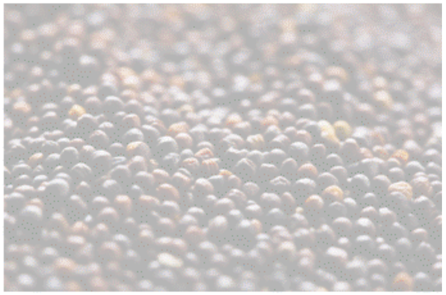

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**Table 2.** Nutrient digestibility of conventional canola meal compared to 'fine' and 'coarse' air classified fractions

| | Conv. CM | AC 'fine' fraction | AC 'coarse' fraction | SEM | *P* - value |
|---|---|---|---|---|---|
| **AME, kcal/kg** | 76.87[a] | 45.51[b] | 48.93[b] | 3.58 | **< *0.0001*** |
| **Dig Lysine** | 88.66 | 85.89 | 87.35 | 1.35 | *0.2280* |
| **Dig Methionine** | 98.34[a] | 92.53[b] | 95.48[ab] | 1.35 | ***0.0166*** |
| **Dig TSAA** | 93.59[a] | 85.33[b] | 87.53[b] | 1.84 | ***0.0047*** |
| **Dig Threonine** | 82.74[a] | 74.41[b] | 79.11[ab] | 2.10 | ***0.0311*** |
| **Dig Tryptophan** | 85.07 | 81.40 | 82.43 | 1.28 | *0.0577* |
| **Dig Arginine** | 94.91 | 94.48 | 96.37 | 0.76 | *0.5907* |
| **Dig Total AA** | 92.56[a] | 86.22[b] | 89.66[ab] | 1.32 | ***0.0098*** |

**Table 3.** Digestible nutrient content of conventional canola meal compared to 'fine' and 'coarse' air classified fractions, as-fed basis

| | Conv. CM | AC 'fine' fraction | AC 'coarse' fraction | SEM | *P* - value |
|---|---|---|---|---|---|
| **AME, kcal** | 3338[a] | 2056[b] | 2136[b] | 161 | **< *0.0001*** |
| **Dig Lys, %** | 1.91[a] | 1.79[b] | 1.78[b] | 0.03 | ***0.0008*** |
| **Dig Met, %** | 0.73[a] | 0.68[b] | 0.66[b] | 0.01 | **< *0.0001*** |
| **Dig TSAA, %** | 1.53[a] | 1.37[b] | 1.32[b] | 0.03 | **< *0.0001*** |
| **Dig Thr, %** | 1.31[a] | 1.15[b] | 1.17[b] | 0.03 | ***0.001*** |
| **Dig Trp, %** | 0.50[a] | 0.45[b] | 0.40[c] | 0.01 | **< *0.0001*** |
| **Dig Arg, %** | 2.19[a] | 2.05[b] | 2.05[b] | 0.02 | **< *0.0001*** |
| **Dig Total AA,%** | 32.00[a] | 29.07[b] | 29.31[b] | 0.42 | **< *0.0001*** |

**Table 4.** Nutrient digestibility of samples of conventional, double-pressed and extruder pressed canola meal

| | Conv. CM | Double pressed CM | Extruder pressed CM | SEM | *P* - value |
|---|---|---|---|---|---|
| **ATTD GE** | 76.87[a] | 56.73[b] | 67.77[a] | 3.58 | ***0.0011*** |
| **AID Lysine** | 88.66[b] | 72.52[c] | 97.33[a] | 1.35 | ***0.0339*** |
| **AID Methionine** | 98.34[a] | 81.43[c] | 91.37[b] | 1.35 | ***<0.0001*** |
| **AID TSAA** | 93.59[a] | 75.79[c] | 84.92[b] | 1.84 | ***<0.0001*** |
| **AID Threonine** | 85.07[b] | 85.08[b] | 88.86[a] | 1.28 | ***0.0052*** |
| **AID Tryptophan** | 82.74[a] | 67.44[b] | 85.80[a] | 2.10 | ***0.0278*** |
| **AID Arginine** | 94.91[a] | 85.41[b] | 97.13[a] | 0.76 | ***0.0009*** |
| **AID Total AA** | 92.56[a] | 75.22[c] | 84.83[b] | 1.32 | ***<0.0001*** |

**Table 5.** Digestible nutrient content of samples of conventional double-pressed and extruder pressed canola meal

| | Conv. CM | Double-pressed CM | Extruder-pressed CM | SEM | *P* - value |
|---|---|---|---|---|---|
| **AME, kcal/kg** | $3338^{a}$ | $2837^{b}$ | $3344^{a}$ | 161 | ***<0.0001*** |
| **Dig Lys, %** | $1.91^{b}$ | $0.87^{c}$ | $2.05^{a}$ | 0.03 | ***<0.0001*** |
| **Dig Met, %** | $0.73^{a}$ | $0.44^{c}$ | $0.63^{b}$ | 0.01 | ***<0.0001*** |
| **Dig TSAA, %** | $1.53^{a}$ | $0.94^{c}$ | $1.32^{b}$ | 0.03 | ***<0.0001*** |
| **Dig Thr, %** | $1.31^{a}$ | $0.78^{b}$ | $1.30^{a}$ | 0.03 | ***<0.0001*** |
| **Dig Trp, %** | $0.50^{a}$ | $0.33^{c}$ | $0.46^{b}$ | 0.01 | ***<0.0001*** |
| **Dig Arg, %** | $2.19^{a}$ | $1.32^{c}$ | $2.13^{b}$ | 0.02 | ***<0.0001*** |
| **Dig Total AA,%** | $32.00^{a}$ | $18.00^{c}$ | $27.48^{b}$ | 0.42 | ***<0.0001*** |

# Conclusions

- **Despite successfully separating CM into two fractions differing in crude fiber, no real impact on digestible nutrient content**
  - **Value of AC fractionating CM??**
- **Extraction process has a large impact on digestible nutrient content of resulting meal**
  - **Importance of knowing origin of the CM**
  - **Meal from low-capital crushing facilities can still be of excellent feeding value**

# Acknowledgements

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