

# Plant Protein Feedstuffs

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# Expanding the utilization of sustainable plant products in aquafeeds: a review

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Gatlin and Barrows are Chair and Vice-chair, respectively, of the Plant Products in Aquafeeds Working Group, and coordinated the development of this document; all other authors are listed in alphabetical order.

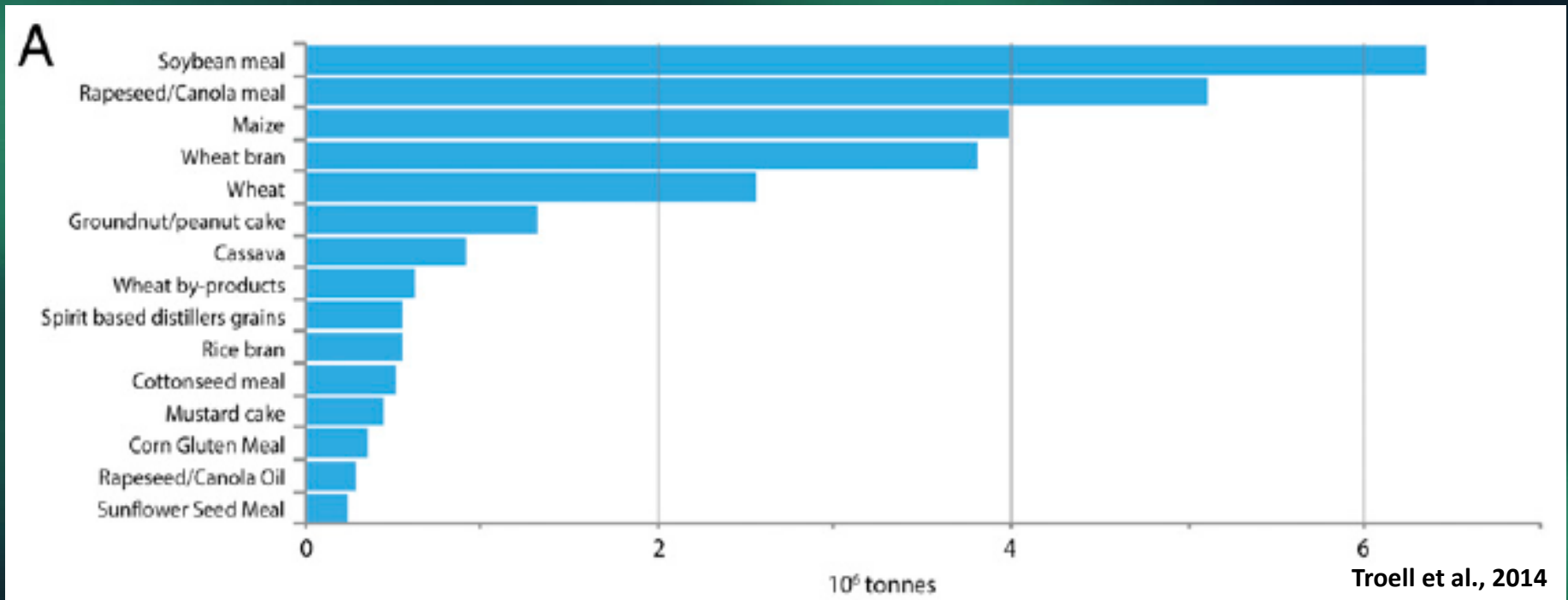
# Terrestrial Plant Meals



Several by-products of oil seed or grain processing for human consumption are available as protein feedstuffs

- Their costs can be relatively low to other protein feedstuffs given the quantities processed
- Crude protein (CP) varies considerably
- Most have limiting amounts of one or more amino acids
- Anti-nutritional factors also may be present
- Phosphorus is primarily as phytate

# Major Plant Feedstuffs Used In Aquafeeds





# Ingredient Database

The screenshot shows a web browser window displaying the 'Feed Composition Database' on the website [animalnutrition.org/feed-composition-database?check\\_logged\\_in=1](https://animalnutrition.org/feed-composition-database?check_logged_in=1). The page features a navigation sidebar on the left with the following menu items: NATIONAL ANIMAL NUTRITION PROGRAM, FEED COMPOSITION, MODELING, PUBLICATIONS / EVENTS, RESOURCES, ABOUT, FEEDBACK / QUESTIONS, and a LOGOUT button. Below the menu is a search bar labeled 'SEARCH SITE' and social media icons for Facebook, Twitter, LinkedIn, and YouTube. The main content area is a grid of six categories, each with a representative image and a title: 1. Animal proteins (image of meat), 2. By-products and Others (image of feed pellets), 3. Forages, Grain Crops (image of green grass), 4. Forages, Legumes and Grasses (image of green leafy plants), 5. Grain Products (image of yellow corn kernels), and 6. Oilseeds and Plant Proteins (image of soybeans). At the bottom of the page, there is a green footer containing the text: 'A National Research Support Project (NRSP-9) Supported by the Experiment Station Committee on Organization and Policy, The State Agricultural Experiment Stations, and Hatch Funds provided by the National Institute of Food and Agriculture, U.S. Department of Agriculture. Website by SURFACE 51'. The USDA United States Department of Agriculture logo is also present in the footer. The browser's taskbar at the bottom shows several open tabs, including 'José Luiz Pedreira...', 'AQUACULTURE-D...', 'meeting-30214172...', 'Asian Shrimp Prod...', 'J World Aquacultu...', and 'The economics of...pdf'. The system tray on the right shows the date and time as 2:56 PM on 5/25/2022, and the weather as 73°F Sunny.

<https://animalnutrition.org/>

# Oilseeds and Plant Proteins

The screenshot shows a web browser window displaying the National Animal Nutrition Program website. The page is titled "Oilseeds and plant protein" and features a list of items under the heading "NAME". The list includes various oilseeds and plant proteins such as Beans, Camelina meal, Canola meal, Cottonseed, and Flaxseed. The website has a navigation menu on the left with options like "FEED COMPOSITION", "MODELING", and "PUBLICATIONS / EVENTS". The browser's address bar shows the URL "animalnutrition.org/feed-composition-database".

**NATIONAL ANIMAL NUTRITION PROGRAM**

FEED COMPOSITION  
MODELING  
PUBLICATIONS / EVENTS  
RESOURCES  
ABOUT  
FEEDBACK / QUESTIONS

LOGOUT

SEARCH SITE

Connect with us

CHOOSE A DATABASE

FEED COMPOSITION

MODELING

### Oilseeds and plant protein

Back to Categories

NAME
Beans, Phaseolus spp
Camelina meal, mechanical extracted
Canola meal (Rapeseed meal), mechanical extracted
Canola meal (Rapeseed meal), solvent extracted
Canola seed (Rapeseed)
Cottonseed
Cottonseed meal, mechanical extracted
Cottonseed meal, solvent extracted
Faba beans
Field peas
Flaxseed
Flaxseed meal, mechanical extracted
Lentils
Lupin seeds

Taskbar: José Luiz Pedreir...html, AQUACULTURE-D-...pdf, meeting-30214172...ics, Asian Shrimp Prod..., J World Aquacultu..., J World Aquacultu..., The economics of..., 1-s2.0-500222011...pdf, Show all

System tray: Pollen high, 3:40 PM, 5/25/2022

<https://animalnutrition.org/>



# Soybean Meal

**Most widely available plant protein feedstuff**

- **Solvent-extracted, dehulled meals most readily used in aquafeeds (~48% CP)**
- **Methionine most limiting amino acid**
- **Protease inhibitors, oligosaccharides and lectins are primary antinutrients**
- **Variable degrees of sensitivity to enteritis among omnivorous and carnivorous fish**
- **Ethanol extraction to produce soy protein concentrate (~65% CP) greatly reduces negative effects – but increases costs considerably**
- **Fermentation can reduce oligosaccharides**



# Canola Meal

**Solvent extract meal contains ~40% CP**

- **Early rapeseed cultivars had lower CP and relatively high levels of erucic acid (22:1n-9) and glucosinolates**
- **Canola varieties have more desirable nutritional characteristics**
  - **Transgenic variety (Nuseed Omega-3 Canola) now available which produces high levels of DHA**





# Corn Protein Products

Various by-products from ethanol production consisting of mixtures of corn protein and yeast have been developed including:

- Distiller's dried grains with solubles (DDGS) - ~31% CP
- High-protein DDGS (54% CP)
- Corn gluten meal (63.2% CP)
- Corn protein concentrate (76.2% CP)
  - Lysine deficiency a concern
  - Elevated pigment levels of concern for some white-flesh fish



# Cottonseed Products

Regular cottonseed meal historically was limited in fish diets due to relatively low protein (41% CP) and lysine as well as high gossypol (~7,000 to 11,000 ppm) levels

Several different products have been developed from different cotton varieties

- Glandless meal (~200 ppm gossypol)
- Glanded meal with 97% reduction in seed gossypol through gene silencing
- Refined processing has resulted in products with relatively high protein (54%) and low gossypol

# Other Plant Protein Feedstuffs

## Safflower Meal

- Solvent extracted product contains 38.4% CP
- Very high in fiber (22.3%)

## Peas/Lupins

- Lower levels of CP (25 and 39%, respectively, for peas and lupins)
- Very high protein digestibility

# Wheat Products

Wheat gluten is high in protein (82.9%) but also quite expensive

- Other wheat products derived from flour production may be used for animal feeds but generally much lower in protein such as wheat middlings (17.7% CP)





# S.W.O.T. of Plant Meals



- **Strengths**
  - Production methods well established
  - Most are by-products of human foods
- **Weaknesses**
  - LCA for some crops are not good
  - Nutritional characteristics (protein, fiber or anti-nutrients) may limit their inclusion in aquafeeds
- **Opportunities**
  - Processing methods such as fermentation and air classification have improved nutritional value of some products
  - Genetic technology has allowed several crops to improve their nutritional value
- **Threats**
  - Climate change
  - Demands from a growing world population

**Thanks for your attention**

