Processing and Industrial Uses of Castor beans and Oil

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by

Levente L. Diosady
Professor of Food Engineering
University of Toronto
Department of Chemical Engineering and Applied Chemistry

Castor beans contain some 30% oil and up to 40% protein

The bean is grown typically for the oil, which has many industrial, and some medicinal uses

Castor beans can be extracted using traditional pre-press, solvent extraction

The meal has a high protein content, and good amino acid distribution, but it is highly toxic.

It is primarily used as organic fertilizer

The meal can be detoxified by high-temperature cooking or steaming, preferably in conjunction with treatment with an oxidizing agent such as chlorine.

Broken seeds and their dust are highly toxic, and require precautions during harvesting, transport and processing.

Valuable products can be formed from triglycerides by sequential hydrolysis:

diacylglycerols (diglycerides)
monoacylglycerols (monoglycerides)
(free)fatty acids

plus glycerol

The basic industrial oleochemical compounds derived from triglycerides are used directly or as intermediates. These include

- fatty acids
- fatty acid methyl esters (FAME)
- fatty alcohols
- fatty amines; and
- glycerols

Further reactions yield a series alcohols and their derivatives:

- alcohol ethoxylates
- alcohol sulfates
- alcohol ether sulfates
- aliphatic linear chain hydrocarbons
- quarternary ammonium substances

Uses of fatty alcohols and their derivatives:

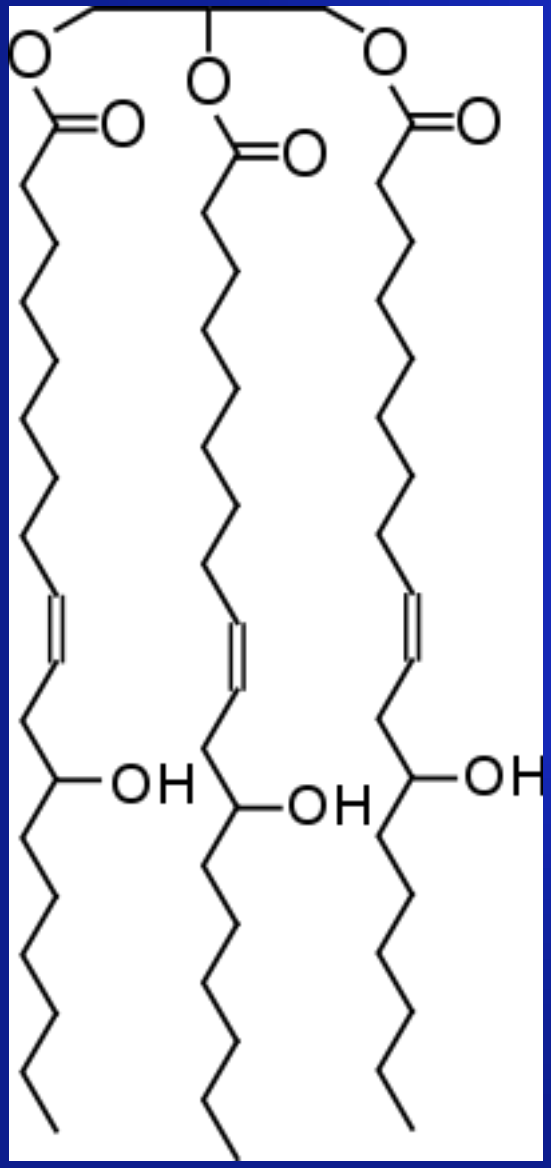
- surfactants
- emulsifyers
- detergents
- cosmetics
- lubricants
- fire-extinguishing foams
- plasticisers
- heat stabilizers
- uv absorbers

Castor oil competes with most typical temperate climate edible oils - such as soy, canola, cottonseed oils - and to a lesser extent with tropical oils - such as coconut and palm oil - for industrial applications.

Castor oil is unique in having high concentrations of ricinoleic acid

Fatty acid composition of Brazilian castor oil

Palmitic; C16:0	0.7
Stearic; C18:0	0.9
Oleic; C18:1 ω 9c	2.8
Linoleic; C18:2	4.4
ω6Linolenic; C18:3 ω3	0.2
ricinoleic; C18:1ω OH	90.2



Castor oil – triricinoleate

High ricinoleic oil has many of the same industrial uses as mineral oils but it is readily bio-degradable.

Its high ricinoleic acid content allows its ready derivatization through th OH group

Castor oil uses include:

Lubricants

Hydraulic and brake fluids

Dielectric fluids

Feedstock for industrial processes:

Nylon 11

Adhesives

Detergents

Fuels: biodiesel

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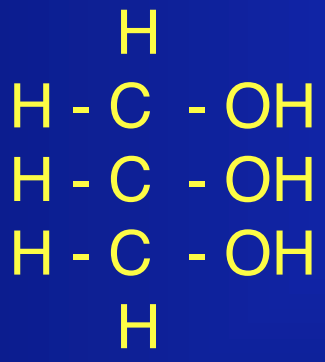
Oleochemical production from any fat/oil results in glycerol.

Glycerol is a tribasic alcohol, also commonly called glycerin or glycerine, it is a sugar alcohol, and is sweet-tasting and of low toxicity.



It is a colorless, odorless, viscous liquid

Glycerol is one of the major raw materials for the manufacture of polyols for flexible foams, and to a lesser extent rigid polyurethane foams.

Glycerol is used to produce nitroglycerin, an essential heart medication, but also an essential ingredient of dynamite, smokeless gunpowder and other explosives -

Medical uses are relatively small in volume requiring high purity glycerol.

Biodiesel production will result in huge volumes of glycerol, that will have to be used to add value to the process.

Potential uses for glycerol :

Glycerine acetate (as fuel additive)

Citric acid production

Ethylene and propylene glycol production

Conversion to acrolein

Conversion to epichlorohydrin as a raw material for epoxy resins.

Potential uses for glycerol in fuel:

Hydrogen gas production

Conversion to ethanol

Compost additive

With the high price of crude oil, and legislative support, tryglyceride oils and therefore castor oil-based biodiesel could be competitive and economically lucrative

The castor industry needs to develop and demonstrate processes and products that use the unique attributes that derive from ricinoleic acid.

To achieve these objectives much research and development is required, over an extended period:

Short term R&D objectives

1. Determine the physical, chemical and engineering properties of the oil, fatty acid fractions and derived chemical feed stocks

2. Demonstrate the applications on a pilot and full plant scale

In the medium term

1. Develop novel products and processes based on ricinoleicacid

2. develop appropriate technology for recovering and purifying fatty acids

Membrane technologies, supercritical processes and absorption technologies - alone and in combination - promise to produce high quality fuel and oleochemical feedstocks.

Long term R&D objectives:

The biggest challenge facing all castor oil utilization is the recovery of the value of glycerol, the by-product of both biodiesel and oleochemical feedstock production. For the residual meal, toxicity is the greatest challenge

Develop environmentally friendly, profitable uses for the large volumes of glycerine expected in the future.

Develop a coordinated approach, for complete utilization of castor

This requires the development application and integration of a range of chemical unit operations, encompassing separation techniques and reactions, resulting in a complete set of products:

Feed ingredients, fuels and oleochemicals.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