

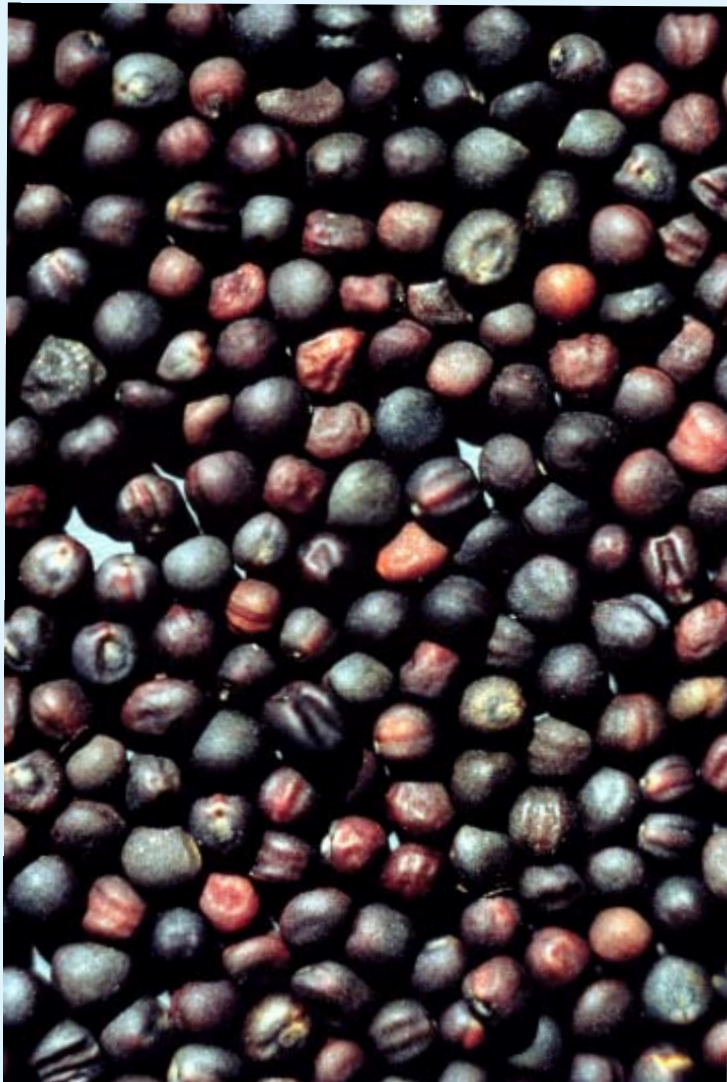
oils & fats

*Science behind Technology*

desmet ballestra

## Rapeseed Processing

Desmet Ballestra Processing Application Expertise



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# Introduction to rapeseed

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Historians have their doubts when it comes to mentioning precise dates and places, but generally agree to say that the seed has been cultivated in India for some 3,000 years at least.

The turn of the Christian era must have witnessed its introduction to the Far East, mainly to Japan and China. In those days, rapeseed oil was used for illumination, and so had it been for six centuries already around the Mediterranean basin, brought back from India by Alexander the Great.

The seed was to remain there, until much later, when it was discovered that rapeseed oil had particularly interesting lubricating properties. Mechanization had found a new friend, and steam engines a faithful ally.



The Second World War, with all its blockades, prohibitions and difficulties then prompted an immediate reaction in oil-short Canada. Introduced by a Pole in 1936, it was planted on serious scale in 1942 and used as a lubricant for the Navy, inland transportation and the industry.

Studied in depth, object of true dedication at all levels, from the field to the most advanced industrial research centres, rapeseed was - at last - considered as a

potential source of edible oil and meal. The first plant ever to do this started operation in 1956, in Canada.

But here, another story begins : that of a dedicated genetic work on a seed that evolves from an ancestral agricultural commodity to a brand new concept, known for a part and even registered in 1978 as *Canola* - for "Canadian Oil - Low acid" - by the Western Canadian Oilseed Crushers' Association.



Today, rapeseed ranks as third oilseed crop in the world, just behind soyabean and cotton seed, and before sunflower, with a production of some 32,000,000 tons a year.

The term 'rape' covers a whole series of varieties of vegetables, and finds its origin in a Latin word, *rapum*, meaning "turnip". Rapeseed, as such, is a brother of mustardseed, also crushed widely in the Indian sub-continent. Rape belongs to the genus *Brassica*, in the family *Cruciferae*. The various species in this genus differ in the number of chromosomes, and wide variations in properties are known.

These varieties imply different cultivation techniques and may reveal impressive variations in yields. A 1 to 3 ratio is often mentioned according to the climatic conditions, fertilizers and herbicides used.

At various levels of intensity, most of the species identified as rape presented two major setbacks that prevented large-scale utilization in the initial years after 1956.

The first problem was in the oil, with a large percentage (up to 40%) of erucic acid composing the fatty acids in the oil. It was clearly demonstrated at the time that erucic acid causes heart damage and some other detrimental effects at growth, cholesterol and reproduction levels.

The other problem was in the meal, in which the presence of glucosinolates - sulphur compounds - has a highly detrimental effect when used to feed pigs, poultry and other monogastrics. The effect is on the thyroid and, consequently, the hormonal balance.

Heavy work was undertaken on both problems :

- reduction of erucic acid content by a step-by-step in-depth mutation of the carbon chain, removing those enzymes that are responsible for the elongation of the chain and, therefore, the production of erucic acid.
- glucosinolates were reduced on the basis of environmental factors, with a vital role played by temperature, as it was clearly noted that a low glucosinolate content followed high 22:1's and low 16:0 and 18:0's.

The above statements do not in the least mean that the "old" rapeseed varieties, known as HEAR (high erucic acid rapeseed) or LEAR (low erucic acid rapeseed) are no longer grown. There is still a large demand for non-edible purposes.

As a matter of fact, the name rapeseed applies to this “old” rapeseed, i.e. HEAR or LEAR (known as “O”-variety), whilst the term **canola** is reserved for the “OO” variety, i.e. cultivars containing less than 2% erucic acid in the oil and less than 3.9 mgr/gr of thioglucosinates in the extracted meal.



In 1985, *canola* received GRAS (Generally recognized as safe) status from the US Food and Drug Administration.

A typical illustration of the above definition is the tolerated incorporation in animal feed meal :

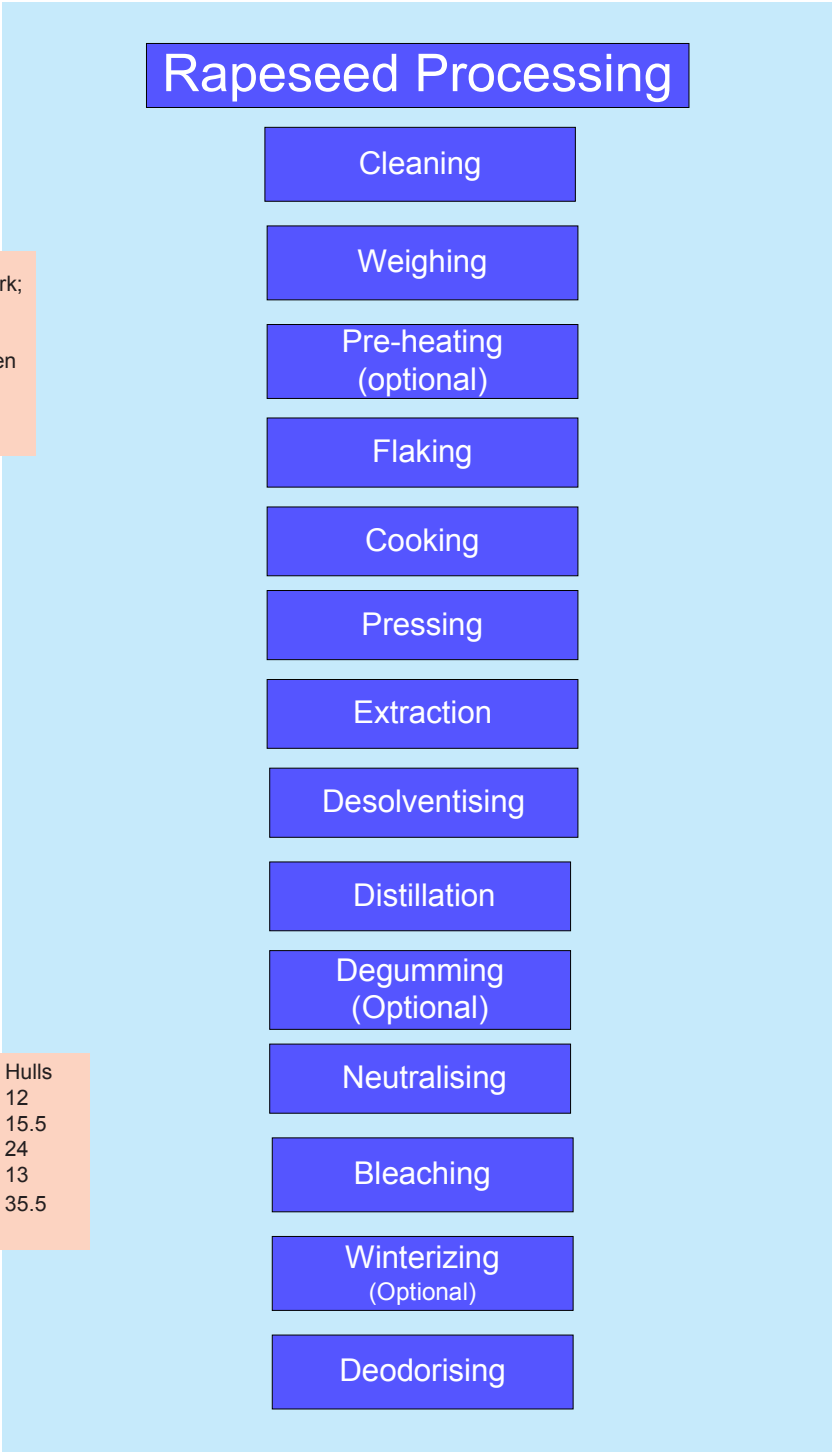
- HEAR : 0 to 5% for chicken and pork;
- LEAR : - 5 to 10% for chicken  
- 5 % for pork.
- “OO” : - 10% for breeding chicken  
- 10-15% for swine-pork  
- 20% for food chicken

Finally, we must report the existence of a “triple O” variety of *canola*, with a low fibre content. This improvement is definitely the appropriate alternative to decortication - cellulose is mostly found in hulls -, which is a feasible and industrially proven, but very expensive process. This triple zero variety is known as “Candle”.

A typical seed would probably have the following characteristics, mentioned for easy reference only, as dehulling is very occasional.

	Seed	Meat	Hulls
Fats	41	45	12
Proteins	21	22	15.5
Cellulose	7	4.5	24
Water	7	6	13
Others	24	22.5	35.5

The apparent density of rapeseed is 0.6 to 0.68, for a real density of 1.25. Its natural slope angle ranges from 27 to 30° and the recommended slope in operation is 45°.



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# Crushing of rapeseed

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## Precleaning

Precleaning consists of high-capacity perforated drums inside which special aspiration channels remove undesirable by-products from the harvest, such as stems, straw, stalks, chaff, stones, loose hulls or other cereals and seeds.



## Seed drying

Drying is also essential, as the acidity of the oil increases when seed moisture exceeds the limits of stability, i.e. approx. 10% moisture. The heat released also leads to some hydrolyzation of the proteins, or of contamination by micro-organisms by high moisture.

## Pre-Cooking

Pre-cooking is recommended before flaking, mostly in case there is a risk of having frozen or cold rape seed.



## Flaking

The seeds must then be flaked to break the walls of the oil cells making it possible for the oil to be pressed out and/or solvent extracted.

The main points to watch are the steadiness of the feed to the unit, and the condition of the roll surfaces.



## Final Cooking

Cooking reduces the viscosity of the oil, which can then flow out of the cells, and the cake, during pressing.

Drying to 3.5-4% is done at the same time. Drying is necessary to make it possible for the press to apply pressure on the cake, for mechanical squeezing.



**Pressing**

STERLING®

In the case of pre-pressing prior to solvent extraction, the press delivers a cake with an oil content of 16-18 per cent.

For small capacities or special applications, full pressing may be applied.



**Solvent Extraction**

LM®  
REFLEX®

The main advantage of solvent extraction over the mechanical processes is that it improves the oil yield, since the residual oil content of the meal is around 1 per cent in industrial operation. Rapeseed cakes are quite corrosive and we foresee several components of the extraction in stainless steel.



**Desolventising-toasting**

DIMAX®

The desolventizer-toaster removes the solvent from the meal, again with several components made of corrosion-free stainless steel.

Heat and live steam stripping are both applied to bring the residual solvent in meal down to very low levels.



**Miscella distillation**

HYTECH®

The solvent is separated from the oil by evaporation under vacuum and recovered in water cooled condensers. The De Smet distillation is designed to preserve oil quality and at the same time maximizing heat recovery.



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# Refining of rapeseed oil

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## Degumming/ Neutralising

These unit operations reduces free fatty acids to below 0.08% and phosphorus to below 3 mg/kg. Iron and copper concentrations are reduced to below the detection limit. Coloured compounds (chlorophylls, carotenoids) are not affected significantly, although chlorophylls can be reduced by 30-70% of the original concentration under certain process conditions. The concentration of sulfur compounds is reduced slightly.



## Bleaching

The neutralized oil is usually golden yellow, which is not yet suitable for food purposes. It is necessary to bleach the oil so as to remove the various pigments not removed by neutralization. Sometimes processors are facing quite high chlorophyll contents, requiring specific treatments. This is done with adsorbents in the form of bleaching earth or activated charcoal. Rapeseed oil is bleached at a maximum temperature of 100°C-105°C. The bleaching earth must be used in concentrations of 0.3-0.5% of the oil weight in chemical refining.



## Winterizing

Winterizing normally does not apply to rapeseed oil, except in extremely cold climates like in North America or Northern Europe. The oil may contain a small and variable concentration of compounds (about 20-400 mg/kg) that may over time appear as a sediment. Winterizing will reduce the wax content to below 50 mg/kg, which no longer produces a visible haze.



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## Deodorising

Rapeseed oil has some objectionable odour and taste, like the other vegetable oils, because of the presence of foreign substances. It must therefore be deodorized. The deodorization of rapeseed oil is well mastered; the usual continuous or semi-continuous equipment is used. As the substances to be removed are volatile, it is sufficient to heat the oil to a high temperature and inject steam to carry off the impurities, which are then condensed and evacuated.

In Europe, the parameters are typically a temperature of 225-235°C, an absolute pressure of 2-3 mbar and a cycle time of under 1 hour.

In the United States, where much higher temperatures are used (240°-260°C), the cycle time can be reduced to 30-40 minutes.



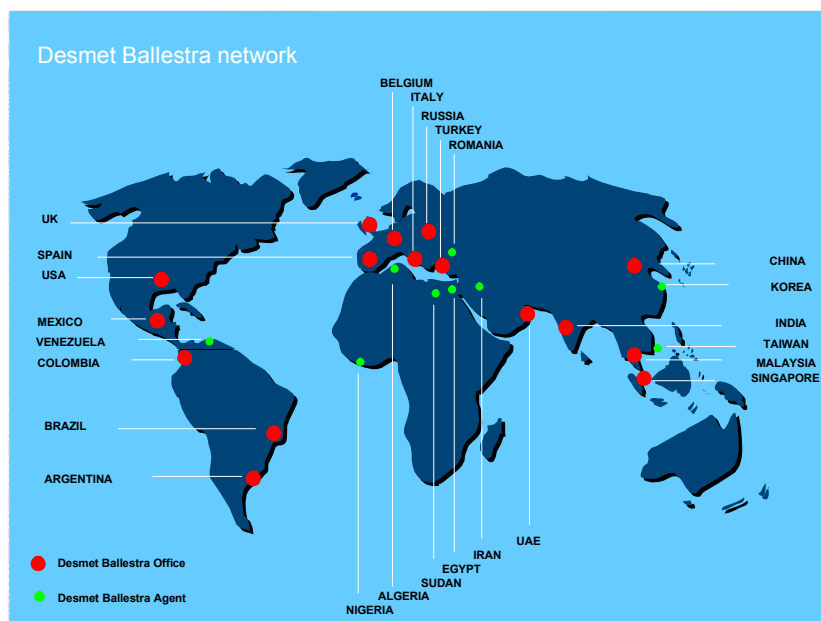
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## Hydrogenation

Hydrogenated fats from rapeseed oil are important as lightly hydrogenated oils, and are recognized for their improved stability in storage. This is due, in part, to the high content of monounsaturated fatty acids in rapeseed oil. These products are becoming very popular because of their good stability and pourability and their low saturated fatty acids content.



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