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Robert M. Kerr Food & Agricultural Products Center

FOOD TECHNOLOGY FACT SHEET

Adding Value to OKLAHOMA

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Canola Oil Properties

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Canola was developed from rapeseed using traditional plant-breeding techniques. The original rapeseed cultivars contained high amount of a fatty acid called "erucic acid" and a compound named "glucosinolates." Rapeseed oil feeding trials carried out with rodents indicated high levels of erucic acid in oil led to fatty deposits in heart and skeletal muscles and impaired growth of the animals. Glucosinolate in rapeseed meal (seed residue after oil extraction) was detrimental to poultry, swine and ruminants. Hydrolysis of glucosinolates produced isothiocyanates and other sulphur-containing compounds, which interfere with iodine uptake by the thyroid gland, contribute to liver disease and reduce animal growth and weight gain.

The economic viability of oilseed processing operations depends on the utilization of oilseed meal as animal feed. Erucic acid and glucosinolate content of the seeds had to be reduced for rapeseed meal to be used as animal feed. In the 1970s, breeding efforts resulted in world's first low erucic acid and low glucosinolate cultivar of Brasicca napus, often called double-zero rapeseed. The term "canola" was registered by the Western Canadian Oilseed Crushers in 1978 and then transferred to the Canola Council of Canada in 1980. The name canola refers to those cultivars containing less than 5 percent erucic acid in the oil and 3 mg/g aliphatic glucosinolates in the meal. In 1986, the definition of canola was amended to Brasicca *napus* and Brasicca *rapa* lines with less than 2 percent erucic acid in the oil and less than 30 micromol/g glucosinolates in the air-dried, oil-free meal. Today, the name "canola" is mainly used in the American continent and Australia. In Europe "rapeseed" is the term commonly used for both original high and low erucic acid rapeseed cultivars.

Brasicca species contain both spring and winter forms that are distinguished by vernalization (exposure of plants or seeds to low temperatures to stimulate flowering or to enhance seed production) requirement. Winter type B. *napus* is the main rapeseed crop grown in most of Europe and in parts of China. Spring type B. *napus* is produced in Canada, northern Europe and China. In Australia and the southeastern United States, where winters are mild enough, spring type B. *napus* can be grown as a fall-planted winter crop. Spring B. *rapa* is the main crop grown in most of Canada, northern Europe, China, and India. Spring types of B. *juncea* are dominant in India and also are grown to a limited extent in Canada and Europe for condiment use.

In 2004, Okanola project was initiated to introduce winter canola as a rotation crop for wheat in Oklahoma. It was believed winter canola may not only be a good rotation crop to improve crop yields but it also may be more profitable crop than winter wheat. Since then, canola acreages increased significantly and many Oklahoma wheat producers have cleaned up their weedy wheat fields, improved wheat quality and increased wheat forage and grain yields by incorporating canola into their crop rotation.

Depending on the variety, agronomic practices used and region they are grown, canola seeds contain 35 to 45 percent (by seed weight) and even higher oil. Just like other oilseeds, canola seeds go through a physical

cleaning (Fact Sheet - FAPC 158) followed by oil extraction (Fact Sheet - FAPC 159) to obtain crude oil and then refined to edible grade (Fact Sheet - FAPC 160). A typical composition for crude and refined canola oil is shown in Table 1. Edible oils are primarily composed of triacylglycerides (TAG), which are esters of one molecule of glycerol and three molecules of fatty acids (Fact Sheet - FAPC 196). Phospholipids are removed from crude oil during the degumming process. Main components of unsaponifiable fraction of oils are tocopherols and phytosterols. Tocopherols are recognized as natural antioxidants. Crude canola oil contains relatively high amounts of tocopherols, 500-1000 mg/kg. There are a number of clinical studies indicating that phytosterols may lower cholesterol levels in blood. The total amount of phytosterols in canola oil ranges between 0.7 percent and 1 percent. Unfortunately, tocopherols and phytosterols are lost during conventional edible oil refining and they end up in byproducts. Quality of edible oils is assessed by measuring its free fatty acid (FFA) content or acidity and determining presence or absence of oxidation products in the oil by measuring peroxide and anisidine values (Fact Sheet - FAPC 197).

Physical properties of canola oil are determined by its composition (Table 2). Fatty acid composition of the oil has a significant effect on its density. Saturated fatty acids have higher density than monounsaturated fatty acids (MUFA) and polyunsaturated fatty acids (PUFA). Viscosity is the relative thickness or resistance of the oil to flow. Refined canola oil has a higher viscosity than that of soybean oil. The smoke point is the temperature at which oil produces a continuous stream of smoke during heating. This parameter is important for evaluating suitability of oil for frying applications. In general, regulations specify 200 degrees Celsius as the minimum. Smoke point of canola oil is higher than

Table 1: Composition of canola oil.*

Constituent	**Crude Oil**	**Refined, bleached and deodorized (RBD) oil**
Triacylglyceride (%)	94 – 99	> 98
Phospholipids (%)		
Crude oil	up to 2.5	
Water degummed	up to 0.6	-
Acid degummed	up to 0.1	-
Free fatty acids (%)	0.4 - 1.5	0.03
Unsaponifiables (%)	0.5 – 1.2	
Tocopherols (mg/kg)	700 - 1200	-
Chlorophylls (mg/kg)	5 - 50	< 0.025
Sulphur (mg/kg)	3 - 25	< 1
Iron (mg/kg)	< 2	< 0.2
Copper (mg/kg)	< 0.2	< 0.02
Nickel (mg/kg)	-	< 0.3
Peroxide value (meq/kg)	0.5 – 3.0	0 (freshly deodorized)
Anisidine value	1 - 3	< 2
Color, Lovibond	-	< 1.5 Red/10 Yellow
Moisture, %	< 0.3	-

*Adapted from Bailey's Industrial Oil and Fat Products, 6th Edition. Editor: F. Shahidi. John Wiley and Sons, N.J.

Table 2: Physical properties of canola oil.*

Parameter	**Range**
Relative density (g/cm^3, 20°C/water at 20°C)	0.914 - 0.920
Refractive index (40°C)	1.465 - 1.467
Viscosity (kinematic viscosity at 20°C, mm^2/sec)	78.2
Cold test (15 h at 4°C)	Pass
Smoke point (°C)	220 - 230
Flash point (open cup, °C)	275 - 290
Specific heat (J/g at 20°C)	1.910 - 1.916
Saponification number	182 - 193
Iodine value	91 - 126

*Adapted from Bailey's Industrial Oil and Fat Products, 6th Edition. Editor: F. Shahidi. John Wiley and Sons, N.J. See Fact Sheet – FAPC 196 for the definition of the parameters listed in the table.

200 degrees Celsius. Cold test measures the resistance of oil to sediment formation at 0 degree Celsius or 4 degrees Celsius. High saturated fatty acid content in the oil causes sedimentation at low temperatures. Cold test is helpful when choosing oil for salad dressings and biodiesel production.

The fatty acid composition of the oil is genetically controlled and has been successfully modified to produce products specifically tailored for end use. Commodity canola oil contains only traces of erucic acid, 5 to 8 percent saturated fatty acids, 60 to 65 percent MUFA, and 30 to 35 percent PUFA. Plant breeders have developed low linolenic (about 2 percent), high oleic (60 to 85 percent), high lauric (39 percent), high stearic (40 percent), high palmitic (10 percent) and high gamma linolenic acid content canola oils (Table 2). When linolenic acid content of the canola oil was reduced to less than 2 percent, storage stability and frying performance of the oil and storage stability of the fried products such as French fires were improved as compared to the regular canola oil. Fatty acid composition of high oleic acid canola oil resembles to that of olive oil. This oil exhibits better frying stability and produce higher quality fried foods than the regular canola oil. High lauric acid canola is developed for use in confectionary, coatings, coffee whiteners, whipped toppings and center filling applications. High stearic

Table 3: Fatty acid composition of canola, rapeseed and soybean oil (%).*

Fatty acid	Canola	HEAR	HOCAN	LLCAN	LTCAN	GLCO	Soybean
Capric (10:0)	-	-	-	-	0.1	-	-
Lauric (12:0)	-	-	-	-	38.8	-	-
Myristic (14:0)	0.1	-	0.1	0.1	4.1	0.1	0.1
Palmitic (16:0)	3.6	4.0	3.9	3.4	2.7	4.2	10.8
Stearic (18:0)	1.5	1.0	1.3	2.5	1.6	3.7	4.0
Arachidic (20:0)	0.6	1.0	0.6	0.9	0.4	1.0	-
Behenic (22:0)	0.3	0.8	0.4	0.5	0.2	0.5	-
Lignoceric (24:0)	0.2	0.3	0.30	0.3	0.2	0.2	-
Palmitoleic (16:1)	0.2	0.3	0.2	0.2	0.2	0.2	0.3
Oleic (18:1)	61.6	14.8	61.4	77.8	32.8	24.4	23.8
Gadoleic (20:1)	1.4	10.0	1.5	1.6	0.8	0.8	0.2
Erucic (22:1)	0.2	45.1	0.1	0.1	0.5	0.1	-
Linoleic (18:2n-6)	21.7	14.1	28.1	9.8	11.3	26.1	53.3
Alpha Linolenic (18:3n3)	9.6	9.1	2.1	2.6	6.3	1.3	7.6
Gamma Linolenic (18:3n6)	-	1.0	-	-	-	37.2	-
Total Saturated	6.3	7.1	6.6	7.7	48.1	9.9	14.9
Total MUFA	62.4	69.7	63.1	79.9	34.3	25.5	24.3
Total PUFA	31.3	23.2	30.2	12.4	17.6	64.6	60.8

*Adapted from Bailey's Industrial Oil and Fat Products, 6th Edition. Editor: F. Shahidi. John Wiley and Sons, N.J.

HEAR: High erucic acid rapeseed oil, LLCAN: Low linolenic acid canola oil, HOCAN: High oleic acid canola oil, LTCAN: High lauric acid canola oil, GLCO: High gamma linolenic acid canola oil, MUFA: Monounsaturated, PUFA: Polyunsaturated.

acid canola oil can be an option to eliminate trans fats (Fact Sheets - FAPC 133, 134, 164) in foods, particularly in bread and bakery products. Canola oil containing about 10 percent palmitic acid has better crystallization properties, which are important in many food products including margarines, chocolate, butter and shortenings. Solid fat crystalline phase affect appearance, texture, spredibility and functionality of the products. Gamma linolenic acid rich canola oil was developed for the health food market. There are clinical studies indicating gamma linolenic acid is beneficial for treating atopic dermatitis and reducing inflammation in rheumatoid arthritis with few side effects. Gamma linolenic acid works only when it is taken orally. There is no evidence that topical applications would be effective. Gamma linolenic acid also may regulate the immune system. The Dietary Guidelines specify Dietary Reference Intakes (DRI) for the essential fatty acids, alpha-linolenic acid (ALA) and linoleic acid which are both PUFA found in canola oil. Since ALA is less prevalent than linoleic acid in the American diet, consumption of foods containing this omega-3 fatty acid (Fact Sheet - FAPC 135, 211) is important. Canola oil has the highest ALA content among the other commodity vegetable oils.

In addition to PUFAs, canola oil is rich in MUFA and a good source of vitamin E (alpha tocopherol), which is often under-consumed by Americans. Based on a 2,000-calorie diet, the USDA Food Guide recommends daily 24 grams of MUFAs, 20 grams PUFAs, 1.7 grams ALA and 9.5 milligrams of vitamin E intake. One tablespoon of standard canola oil provides 9 grams of MUFA, 4 grams PUFA, about 1 gram of ALA and nearly 1 mg vitamin E. In 2000, U.S. Food and Drug Administration (FDA) has confirmed the GRAS (Generally Recognized As Safe) status of canola oil. A rule issued by FDA in 2006 allows health claim labeling of food products made with canola oil. The approved health claim states: "Limited and not conclusive scientific evidence suggests that eating about 1 ½ tablespoons (19 grams) of canola oil daily may reduce the risk of coronary heart disease due to the unsaturated fat content in canola oil."

Canola oil is widely used as a cooking oil, salad oil and in making margarine. Commodity canola oil is low in saturated fatty acids, which may have adverse effects on blood cholesterol levels. Hence, replacing highly saturated oils (i.e., animal fats, cottonseed) with canola oil in diet is a good option for a healthier life style.

Some other current and potential non-food uses of canola oil include hydraulic fluid, biodiesel, cosmetics, engine oils, heat transfer oils, demolding agents, solvents, lubricants and printing ink formulations.

References

Bailey's Industrial Oil and Fat Products, 6th Edition. Editor: F. Shahidi. John Wiley and Sons, N.J.

https://www.canolacouncil.org/

http://www.uscanola.com/

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