How Good Oil Goes Bad

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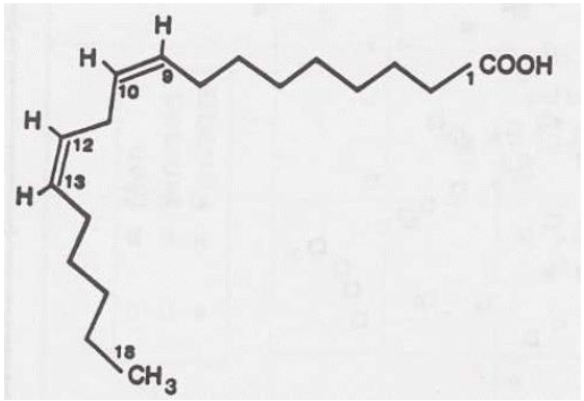
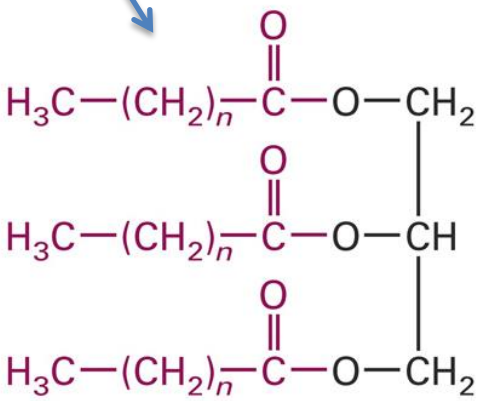
Definitions

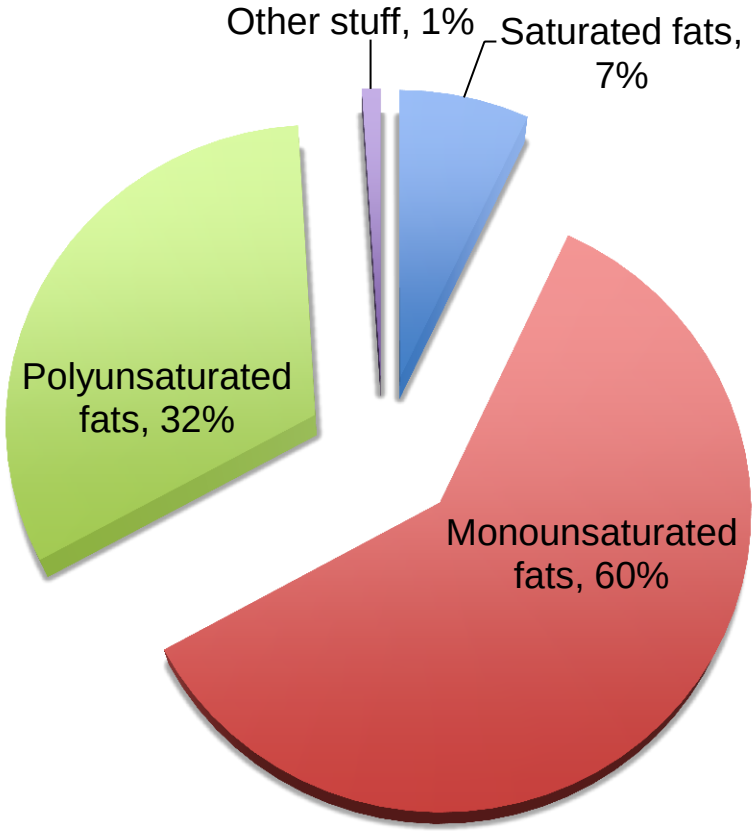
- Lipid
  - Fatty acid (FA)
  - Triglycerides (TG)





  - *Others (cholesterol, phospholipids, waxes, etc.)*

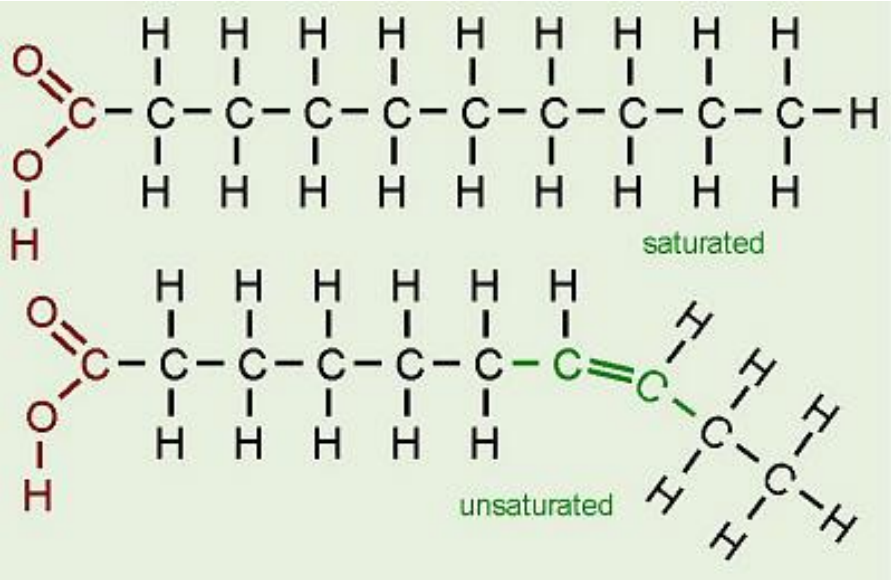
What's in Canola?



in other words, 99% TG's and 1% "other"

F.D. Gunstone. Rapeseed and Canola Oil. CRC Press. 2004

Triglycerides



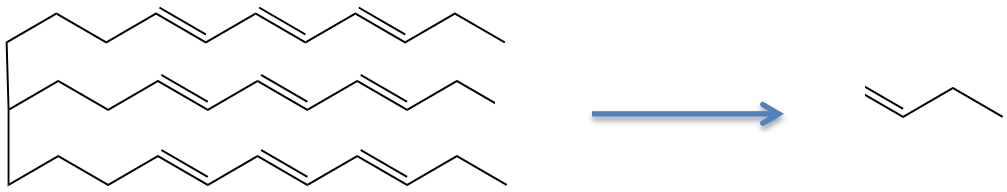
- Often **solid** at RT
- Chemically **stable**
- **Unhealthy?**
- Examples: Margarine, lard, tropical oils

- Often **liquid** at RT
- Chemically **unstable** (go rancid)
- **Healthy?**
- Examples: Fish oil, vegetable oils

Types of Rancidity

- Hydrolytic rancidity
  - Cause: Enzymes (*lipases*) present in seed
  - Consequences: Free fatty acids that taste like soap

- Oxidative rancidity
  - Cause: Free radicals / Oxidation
  - Consequences: Small lipid fragments (*aldehydes*) that stink



Hydrolytic Rancidity of Oils

- Off-flavor development
- Decreases temperature at which frying oils begin to smoke (smoke point)
- Dealing with hydrolytic rancidity in oils
  1. Prevent their formation
     - Keep things cool to reduce enzyme activity
     - Preheat seeds (75 – 100 C) before pressing to destroy enzymes
  2. Remove them by **neutralization**
     - Means to remove free fatty acids from your oil
     - Weak (e.g. 12%) caustic solution (Na^{+}, Ca^{2+})

Hydrolytic Rancidity of Oils

- Reaction of unsaturated fatty acids with oxygen
- Accelerated in the presence of a metal catalyst and/or UV light
- The most common cause of lipid-related flavor problems in foods

Ways to Inhibit Lipid Oxidation

1. Get rid of unsaturated lipids
   - Hydrogenated oils (e.g., soybean oil to margarine)
   - Improve shelf stability
   - Make liquid oils into hard fats
   - Unsaturated lipids = “healthy”
   - Saturated lipids = “unhealthy”

soybean oil

+ Hydrogen

vegetable shortening

Things you need for lipid oxidation:

1. TAGs with double bonds (substrate)
2. Free radicals (initiators)
3. Oxygen (the fuel)
4. Transition metals (the catalysts)

Ways to Inhibit Lipid Oxidation

2. Prevent or scavenge free radicals
   - Use Antioxidants
     - Sacrificial lambs
     - Antioxidants oxidize **preferentially** to oil
     - e.g., tocopherol, BHT, propyl gallate
   - Prevent exposure to light (UV)
     - Avoid clear packaging materials
     - Store oils in the dark
   - Avoid high temperatures
     - Oxidation reaction rates **increase** with heat

Things you need for lipid oxidation:
1. TAGs with double bonds (substrate)
2. Free radicals (initiators)
3. Oxygen (the fuel)
4. Transition metals (the catalysts)

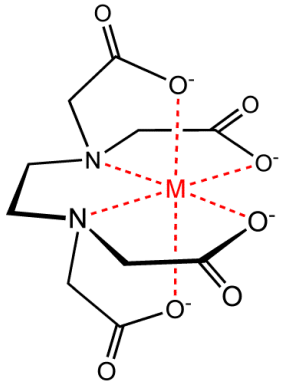
Ways to Inhibit Lipid Oxidation

3. Limit exposure to oxygen
   - Packaged foods
     - Vacuum packaging
     - Oxygen absorbers
   - Bulk vegetable oils
     - Minimize air exposure
     - Inert gases (N_2, CO_2, Ar)

Things you need for lipid oxidation:
1. TAGs with double bonds (substrate)
2. Free radicals (initiators)
3. Oxygen (the fuel)
4. Transition metals (the catalysts)

Ways to Inhibit Lipid Oxidation

4. Remove or bind transition metals
   - Metals "**chelators**"
   - Synthetic examples: EDTA, DTPA
   - "Natural" examples: citric acid, phytic acid
   - Good for emulsions (e.g., dressings, mayo), not really effective for bulk oils



Things you need for lipid oxidation:
1. TAGs with double bonds (substrate)
2. Free radicals (initiators)
3. Oxygen (the fuel)
4. Transition metals (the catalysts)

INGREDIENTS: WATER, SOYBEAN OIL, VINEGAR, WHOLE EGGS AND EGG YOLKS, MODIFIED CORN STARCH**, SUGAR, SALT, LEMON JUICE, (SORBIC ACID**, CALCIUM DISODIUM EDTA) USED TO PROTECT QUALITY, XANTHAN GUM**, PHOSPHORIC ACID**, CITRIC ACID, DL ALPHA TOCOPHEROL ACETATE (VITAMIN E), NATURAL AND ARTIFICIAL** FLAVORS (CONTAIN SOY LECITHIN), BETA-CAROTENE** (FOR COLOR), PAPRIKA OLEORESIN, PHYTONADIONE (VITAMIN K). **INGREDIENTS NOT IN MAYONNAISE

Total Fat 14g	22%
Saturated Fat 3g	15%
Trans Fat 0g	
Cholesterol 0mg	0%
Sodium 105mg	4%
Total Carbohydrate 0g	0%
Protein 0g	

Not a significant source of Dietary Fiber, Sugars, Vitamin A, Vitamin C, Calcium, and Iron.

* Percent Daily Values are based on a 2,000 calorie diet.

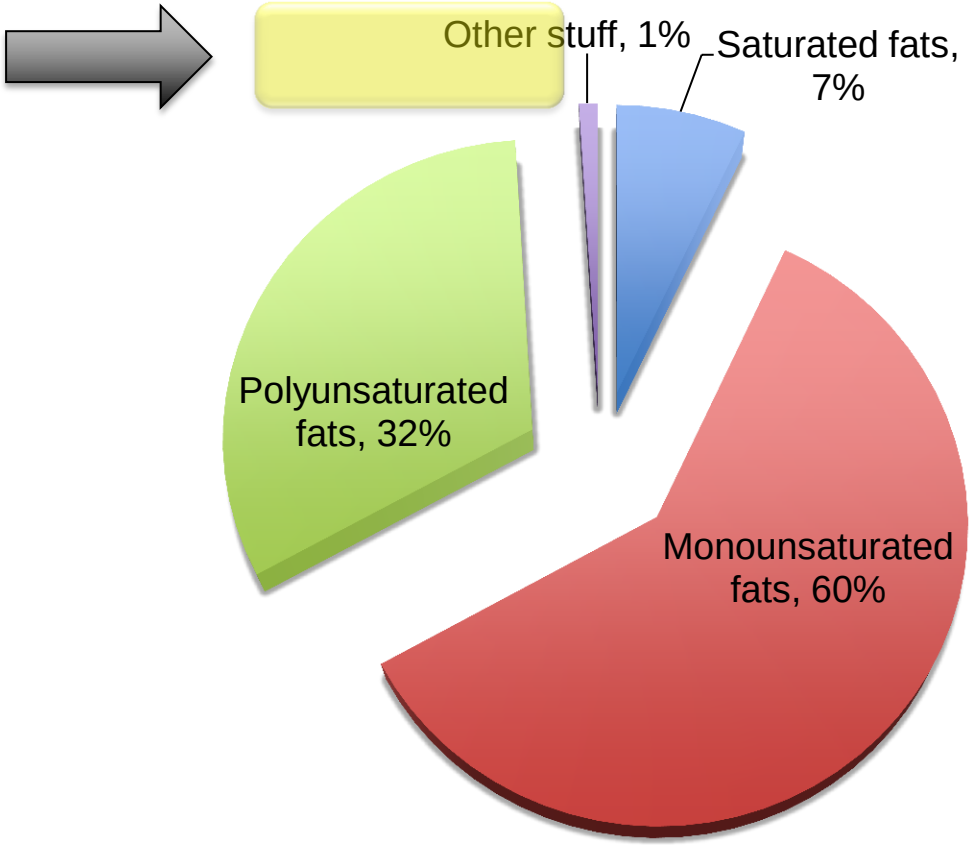
INGREDIENTS: SOYBEAN OIL, COTTONSEED OIL, HYDROGENATED SOYBEAN OIL,* LESS THAN 2% OF: SALT, MONO- AND DIGLYCERIDES AND POLYGLYCEROL ESTERS OF FATTY ACIDS, SOY LECITHIN, NATURAL AND ARTIFICIAL FLAVORS, MEDIUM CHAIN TRIGLYCERIDES, TBHQ (PRESERVATIVE), COLORED WITH BETA CAROTENE.
CONTAINS: SOY.

ConAgra Foods®
ConAgra Foods, Inc.
P.O. Box 3768, Dept. CUL
Omaha, NE 68103-0768 U.S.A.

Why Refine?

Why refine?

to get rid of this



Minor Components (<1%) in Canola

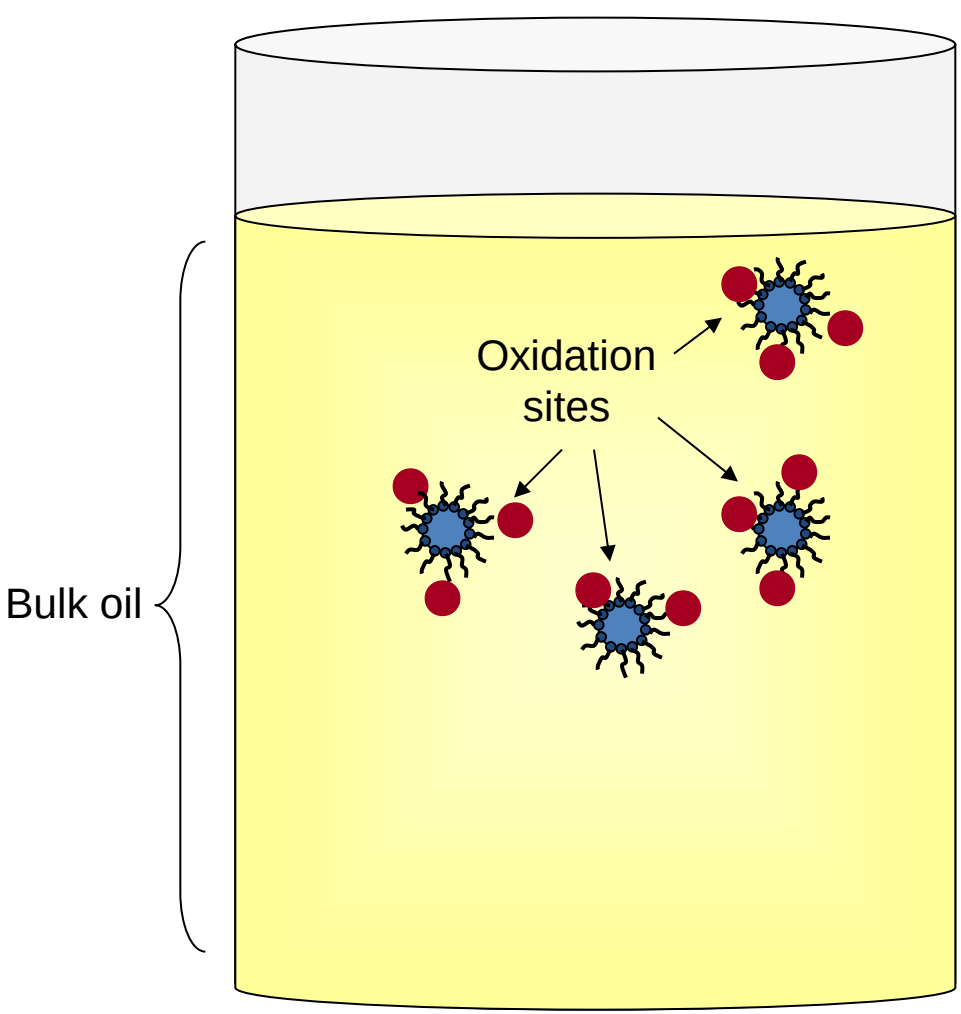
Antioxidants

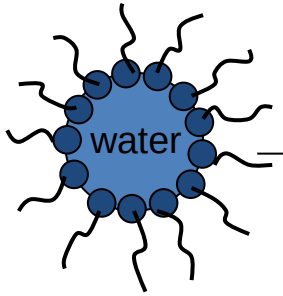
- Tocopherols (vitamin E)
- Carotenoids (xanthophylls, lutein)

Pro-Oxidants

- Water
- Transition metals (Fe, Cu)
- Polar lipids
- Chlorophyll (chlorophyll a, chlorophyll b)

Oil is Not a Homogeneous System

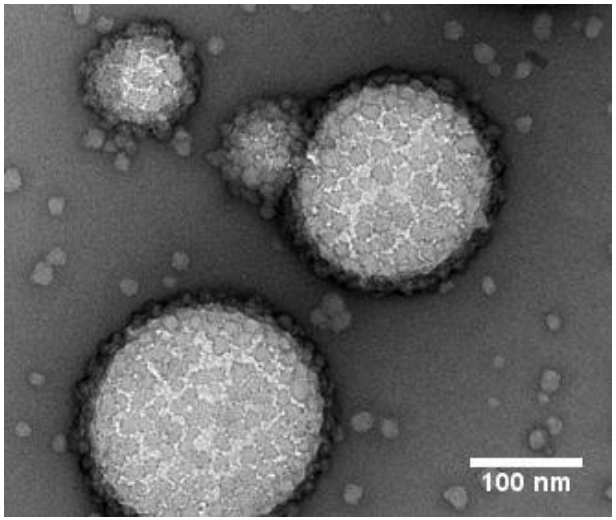




Reverse micelle

surfactant, *e.g.*

- monoacylglycerols
- diacylglycerols
- phospholipids
- free fatty acids
- sterols
- lipid oxidation products



VIRONOVA AB (PUBL), STOCKHOLM, SWEDEN

Oil Extraction & Refining

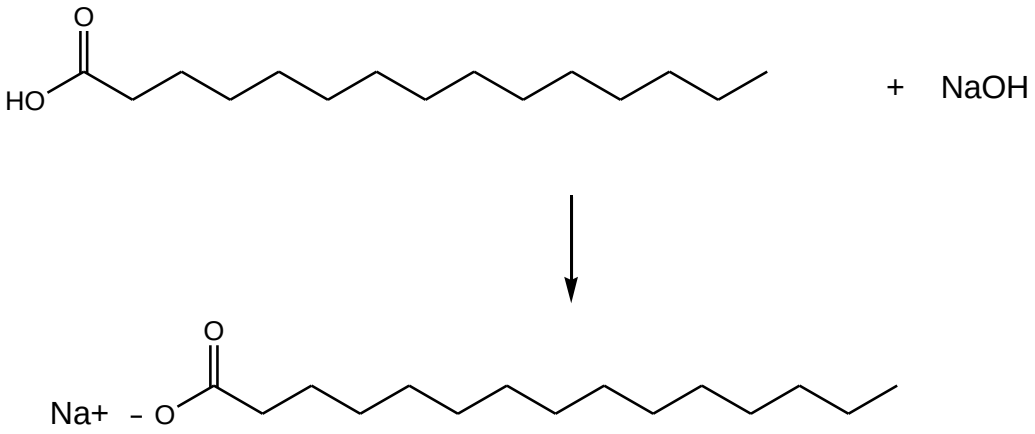
Refining of vegetable oils

1. Neutralization
2. Degumming
3. Bleaching
4. Deodorization
5. Winterization

Oil Extraction & Refining

Refining of vegetable oils

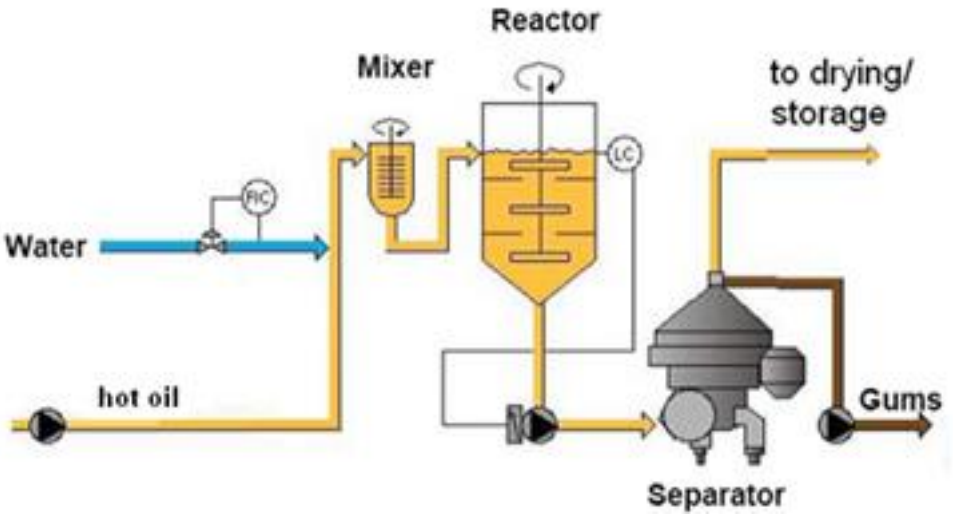
1. Neutralization
   - Means to remove FFA's
   - Weak (e.g. 12%) caustic solution (Na^+, Ca^{2+})



Oil Extraction & Refining

Refining of vegetable oils

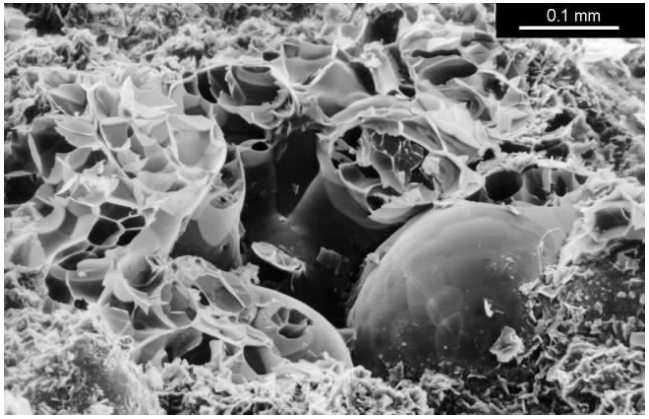
2. Degumming
   - Water or weak acid solution
   - Remove phospholipids



AOCS

Bleaching

- “Improves” oil color
- Involves use of activated earth (bentonite) to strip:
  - Chlorophylls
  - Carotenoids
  - Soaps
  - Phospholipids
  - Aroma & flavor?
  - Health-promoting minor components?
- Relatively quick process
- Done under vacuum



Can We Skip Bleaching?

Potential Upside

- Cost & energy savings
- Retain characteristic flavor and aroma
- Retain color
- Retain healthy components?
- Marketing

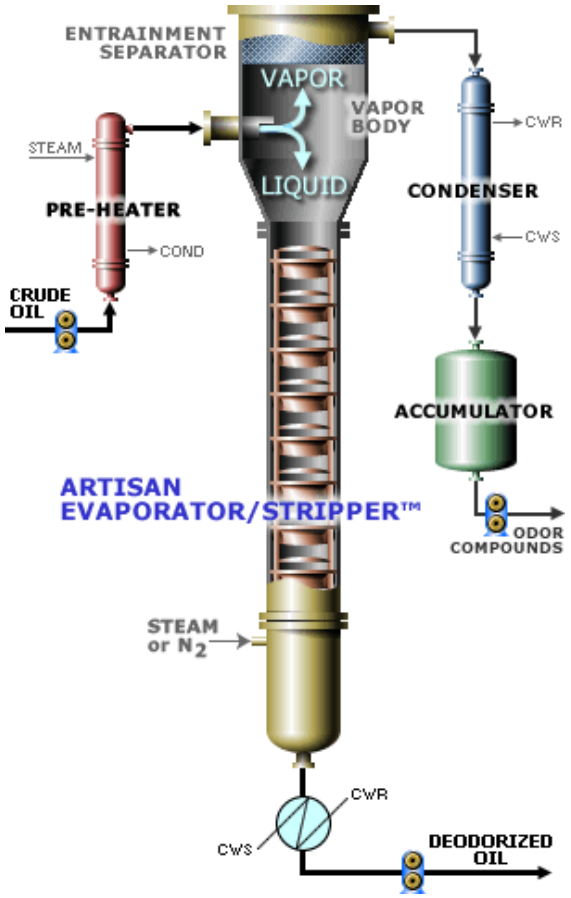
Potential Downside

- Limited shelf life
- Retain characteristic flavor and aroma
- Retain color
- Limitations for direct use in engines and high heat culinary applications (frying)

Oil Extraction & Refining

Refining of vegetable oils

4. Deodorization
   - Drive off volatiles under low pressure / vacuum
   - Plant-associated volatiles
   - Rancid notes



Oil Extraction & Refining

Refining of vegetable oils

5. Winterization
    - Hold oil at low temperature
    - Filter

Can We Skip Refining?

Potential Downside

- Limited shelf life?
- Retain characteristic flavor and aroma
- Retain color
- Limitations for direct use in engines and high heat culinary applications (frying)

Potential Upside

- Cost & energy savings
- Retain characteristic flavor and aroma
- Retain color
- Retain healthy, bioactive components?
- Marketing

Covy Moore/Rocky View Publishing

FBC Foods president Keith Jones shows off the company's new Vibrant Cold Pressed Canola Oil at Calgary Co-op in Airdrie, Feb. 3.

view all photos (1)

Local farmer-owned plant produces unrefined canola oil

Feb 06, 2012 06:00 am | By Stacie Snow | Rocky View Weekly

A farmer-owned plant near Airdrie is producing a new whole food oil made from Alberta-grown canola.

"We're pleased to partner with retail and food service partners to bring this exciting new local product to Canadian families," said Fame Biorefinery Corporation (FBC) Foods president Keith Jones.

FBC Foods produces the oil.

"Over 33 million litres of olive oil is imported into Canada each year, and with Vibrant Cold Pressed Canola Oil, we're looking to regain market share for Canadian farmers," he said.

Vibrant Cold Pressed Canola Oil is made from canola seed selected directly from Alberta farms, then cold pressed and gravity filtered to produce pure, whole oil, he added.

"Vibrant Cold Pressed Canola Oil is made without the conventional canola refining processes (solvent extraction at high heat, then degumming, bleaching and deodorizing)," Jones said.

"This produces a natural, flavourful and colourful oil that replaces extra virgin olive oil in salad dressings, dips, sauces, marinades and moderate temperature cooking."

Vibrant

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Bright Colour
Includes Natural Vitamin E and Betacaroteins.

Flavour Enhancing
Brings out the best in salads, sauces, dips and marinades.

Healthiest Oil
Higher Omega 3 content, lower saturated fat than olive oil.

Natural
Cold pressed and gravity filtered...oil the way nature intended.

Canadian Sunshine In a Bottle!

Our Cold Pressed Canola Oil is crafted from fresh, pure Canadian Canola seed, with no additives or harsh processing. A whole oil, containing its natural colour, flavour and healthy compounds. Ideal for bread dips, salad dressings, marinades, sauces and baking. Produced in Western Canada, from top grade Canola seed grown by local Farmers

Latest News

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4 Bottle Pack

Contains 4 x 500 ml glass bottles in cardboard shipping pack, 11"L x 5"W x 5"H, Wt. 3.75 kg, Price $50.00 plus shipping and handling, plus GST

(~$95/gallon)

Food Applications

Creamy-style Italian salad dressing developed by PSU undergraduate students

Ingredient	% Formula (w/w)
Water	39.94
PSU Canola Oil (unbleached)	39.84
Vinegar	10.66
Lemon Juice	2.49
Salt	2.19
Onion Powder	0.10
Garlic Powder	0.10
Italian Seasoning	0.20
Xanthan	0.30
Pectin	0.30

(break for tasting)

Measuring Culinary Oil Quality

1. Hydrolytic rancidity
2. Oxidative rancidity

Hydrolytic Rancidity

- How do I measure hydrolytic rancidity?

test strips

manual titration

automated titration

Hydrolytic Rancidity

- How do I measure hydrolytic rancidity?

Oxidative Rancidity

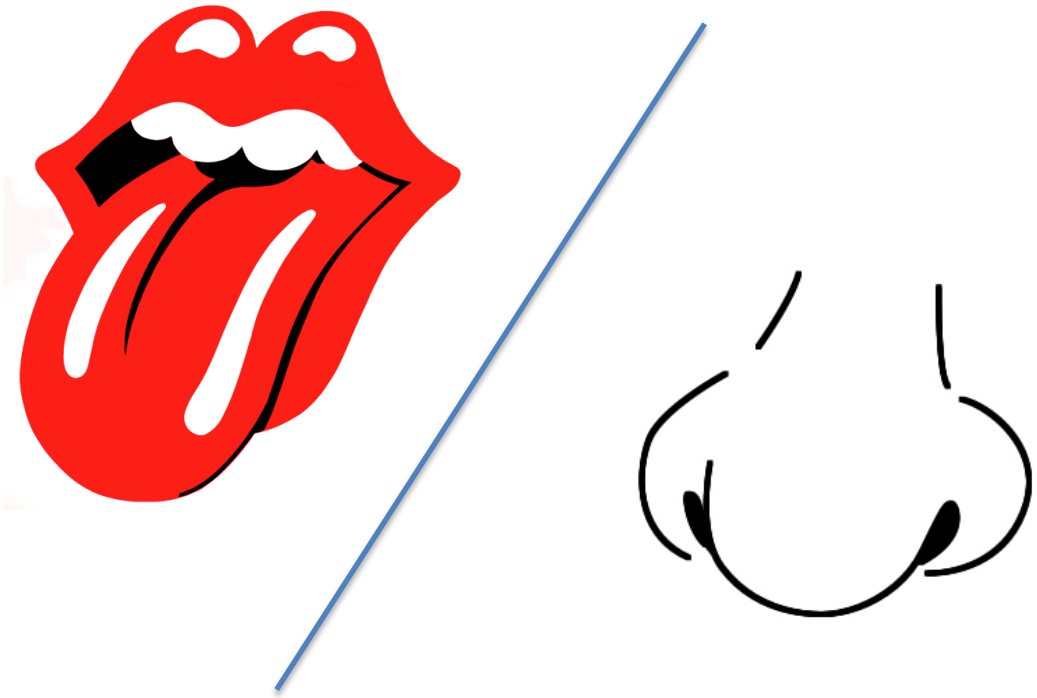
- How do I measure oxidative rancidity?

spectrophotometry

titration

Oxidative Rancidity

- How do I measure oxidative rancidity?



Measuring Oil Quality

Designation: E1627 – 11

Standard Practice for Sensory Evaluation of Edible Oils and Fats[1]

This standard is issued under the fixed designation E1627; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This practice covers the recommended procedures for the sensory evaluation of edible oils and fats.

1.2 This practice covers techniques for evaluating odor and flavor in fats and oils, for determining overall odor and flavor intensity, and the intensity of individual odors or flavors.

1.3 The techniques used in this practice are applicable to oils (liquid at room temperature) and liquified fats (solid at room temperature).

1.4 The values in SI units are to be regarded as the standard.

1.5 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.* Specific precautions are given in Section 7.

2. Referenced Documents

2.1 *ASTM Standards:*[2]
E1346 Practice for Bulk Sampling, Handling, and Preparing Edible Vegetable Oils for Sensory Evaluation

3. Terminology

5. Significance and Use

5.1 The application of this practice will help ensure consistency in procedures used for the sensory evaluation of edible oils.

5.2 This practice is designed for use by oil processors or research laboratories for evaluations by a trained, experienced sensory panel under the supervision of a sensory professional or for use by quality control and quality assurance personnel for the sensory evaluation of edible oils and fats.

6. Apparatus

6.1 *Glass Vial,* 30-mm outside diameter by 57-mm height, wide-mouth threaded top. Use amber glass for odor/flavor evaluations; clear glass for visual examination. Alternatively, use 2 oz sample cups also for odor/flavor evaluations only.

6.2 *Circulating Waterbath,* with automatic timer, thermostat, and rack.

6.3 *Waterbath Thermometer,* with range from 20 to 100°C in 1°C divisions, calibrated for 76-mm immersion, 305 mm long.

6.4 *Hard plastic threaded caps* with liners, or tape (PFTE pipe thread tape), to cover top of vial opening before capping with new, nonmetallic screw-type caps. Tape should completely cover vial opening or multiple strips of tape should be used.

Measuring Oil Quality

X1. VOCABULARY AND OIL ATTRIBUTES CHARACTERISTIC OF UNPROCESSED OIL (U), FRESHLY PROCESSED OIL (F), DETERIORATED OIL (D), OR ORIGIN UNIDENTIFIED (X)

TABLE X1.1 Oil Types and Attributes[A]

Attributes	Oil Type												
	Corn	Cotton Seed	Coconut	Fish/ Marine	MCT[B]	Olive	Palm	Peanut	Canola Rapeseed	Ricebran	Saflower	Soy	Sunflower
Bacony	...	...	U	...	...	...	X	...	...	...	...	...	...
Beany	...	...	...	...	...	...	...	...	D	...	...	D/U	...
Bitter	...	...	...	...	...	...	X	...	...	...	...	...	...
Burnt	U	...	X	...	...	...	...	X	...	X	...	U	X
Buttery	F	F	F	...	F	...	F	X	F	...	F	F	F
Cardboard	D	...	...	...	...	...	D	D	...	...	...	D	D
Corny	F	...	...	...	...	...	...	...	...	...	...	...	...
Fishy	...	...	...	U/F/D	...	...	...	...	D	...	...	D	...
Fruity	...	...	...	...	...	F	...	F	...	...	...	...	...
Grassy	X	...	...	...	...	...	...	X	D	X	X	U/D	U/D
Green	...	...	...	...	...	X	...	...	D	X	...	...	...
Hay	X	...	...	...	...	...	...	X	...	X	X	U/D	U/D
Hully	...	...	...	...	...	...	...	...	...	...	...	...	X
Nutty	F	X	X	...	X	...	X	F	...	X	...	F	...
Painty	...	...	...	...	...	...	...	...	D	...	...	D	...
Pine	...	...	...	...	...	...	...	...	...	...	...	...	U
Rancid	D	D	D	...	...	D	D	D	D	D	D	D	D
Rubbery	X	...	...	...	...	...	...	...	X	...	...	X	...
Soapy	...	...	X	...	...	...	X	...	...	...	...	...	...
Sulfur	...	...	...	...	...	...	...	...	U/D	...	...	...	...
Waxy	X	...	X	...	U	...	...	...	...	X	X	...	X
Weedy	X	...	...	...	...	...	...	X	X	X	X	X	X
Woody	...	...	...	...	...	...	...	X	...	X	X	...	X

[A] U = characteristic of unprocessed or partially processed oil
F = characteristic of freshly processed oil
D = characteristic of deteriorated oil.
X = unidentified origin.
Other flavors may be present from contamination, processing conditions, etc.: pumpkin, melon, watermelon, petroleum, metallic, musty.
[B] Medium chain triglycerides.

Measuring Oil Quality

Metallic
- *Definition*— An aromatic associated with metal coins.
- *Reference*— 0.01 % ferrous sulfate diluted in distilled, filtered water.
- *Example*— Copper pennies soaked in filtered water for 12 h; soybean oil processed without citric acid.

Musty
- *Definition*— An aromatic reminiscent of odor of a moldy or damp cellar or room.
- *Reference*— 25 ppb methyl isoborenol.
- *Example*— Damp cloth stored in a plastic bag.

Nutty
- *Definition*— An aromatic reminiscent of fresh, sweet nutmeats.
- *Reference*— Freshly ground English walnuts.
- *Example*— Freshly processed peanut oil.

Oxidized
- *Definition*— A general term denoting the process of oxidative deterioration of oil. Oxidized flavors or odors range widely from buttery, grassy, rancid, to painty. Not recommended as a specific odor or flavor.

Grassy
- *Definition*— An aromatic reminiscent of the green character of mowed grass.
- *Reference*— Crude soybean oil from non-heat-treated soybeans diluted in good-quality soybean oil (5:95).
- *Example*— Fresh cut grass.

Green
- *Definition*— An aromatic associated with unprocessed immature fruits or grains.
- *Reference*— 5 ppm cis-3-hexenol in water.
- *Example*— Raw immature soybeans.

Hay
- *Definition*— An aromatic reminiscent of dried grass character of air-dried grain or vegetation.
- *Reference*— Crude soybean oil from heat-treated beans diluted in good-quality soybean oil (5:95).
- *Example*— Dried alfalfa.

Hully
- *Definition*— An aromatic associated with the outer protective coating of a grain or oilseed.

Questions?

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