FE 376

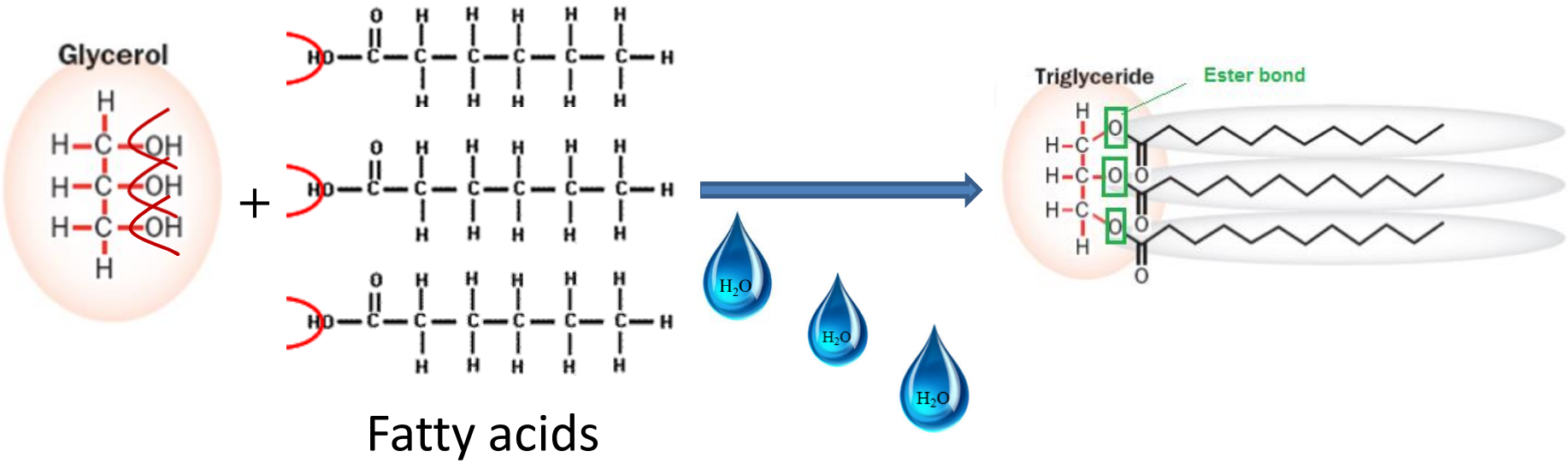
FOOD QUALITY CONTROL

FATS AND OILS

What is fat and oil?

A class of **esters** which results from the reaction of **acids** and **alcohols**

Fats and Oils – Triglycerides



Quality evaluation of fats and oils

The physical Quality parameters for plant oils:

- Refractive index
- Specific gravity
- Color
- Melting point

The chemical Quality parameters for plant oils:

- Acid value
- Peroxide value
- Iodine value
- Saponification value

Experiment: Acid value

WHAT IS THE AIM OF THE EXPERIMENT?

To determine acid value in an oil (or in the oil of a food product)

PRINCIPLE?

ACID BASE TITRATION

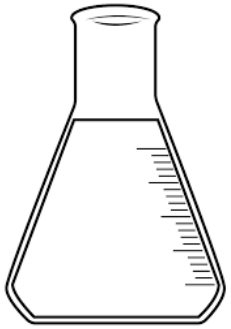
Definition: the weight in milligrams of potassium hydroxide required to neutralize one gram of oil.

measurement of rancidity as free fatty acids are usually formed during decomposition of oil glycerides.

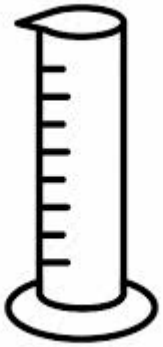
Chemicals and Materials

Apparatus

Analytical balance



Erlenmeyer flask



Graduated cylinder

Balloon joje

Burette

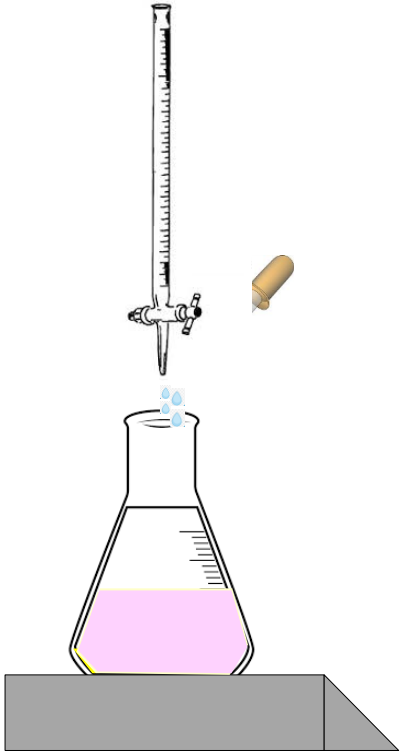
Reagents

- **0.1 or 0.5 N Potassium hydroxide solution (standardized) :** The solution should be colorless or straw yellow

- **Phenolphthalein indicator solution:** Dissolve one gram of phenolpthalein in 100 ml of ethyl alcohol (95%)

- **Ethyl alcohol- diethyl ether solution:** 1:1 v/v mixture of ethanol and diethyl ether neutralized to phenolphthalein

Procedure



1. Weigh 5 to 10 g of oil into a 250 ml Erlenmeyer flask.
2. Add 50 to 150 ml of a mixture of ethanol and diethyl ether (1:1 v/v) to dissolve the oil
3. Add about one ml of phenolphthalein indicator solution
4. Titrate, while shaking, with the 0.1 N KOH solution until the color of the indicator changes.
5. Steps above are repeated with a blank sample which does not contain any oil sample

DATA TO RECORD

1 Weight of oil sample (g)

2 Volume of consumed potassium hydroxide solution (ml)

0.1 N KOH solution used for blank sample (Blank) V_b(ml)
0.1 N KOH solution used for sample (with oil sample) V_s(ml)

$V_s - V_b = V_t$ (ml)

CALCULATION

$$\text{Acid value (mg KOH/g oil)} = \frac{\text{Titre value } (V_t) \times \text{Normality of KOH} \times 56.1}{\text{Weight of oil sample (g)}}$$

Experiment: Peroxide value

WHAT IS THE AIM OF THE EXPERIMENT?

To determine peroxide value in an oil (or in the oil of a food product)

PRINCIPLE?

Peroxide value

The most widely used indicator of fat oxidation

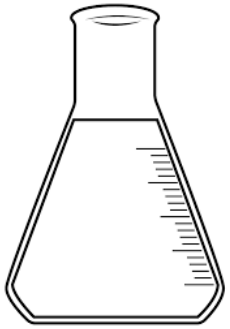
measurement of the lipid peroxides and hydroperoxides formed during the initial stage of the oxidation.

The peroxide value is determined by measuring the amount of iodine which is formed by the reaction of peroxides with iodide ion.

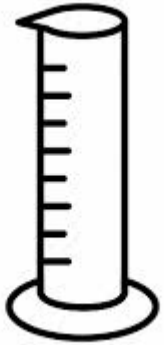
Chemicals and Materials

Apparatus

Analytical balance



Erlenmeyer flask



Graduated cylinder

Burette

Reagents

- **0,1 or 0,01 N sodium thiosulfate (standardized) :** The solution has to be kept well sealed and in the dark

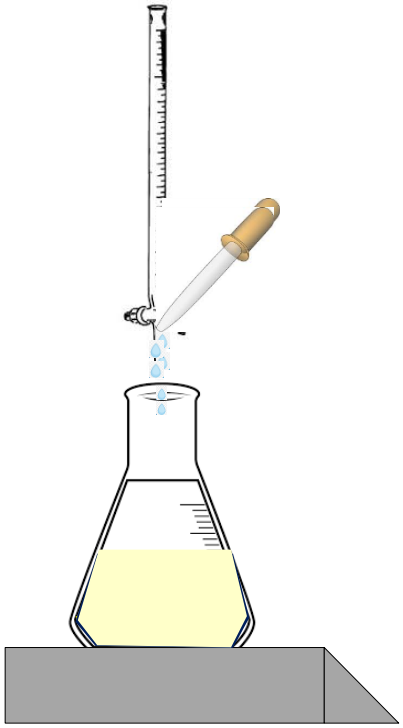
- **Starch indicator solution :** Dissolve one gram of starch in 100 ml of distilled water

- **Saturated potassium iodade**: Saturated solution of potassium iodide in distilled water is prepared. The solution must remain saturated

- **Chloroform**

- **Acetic acid**

Procedure



1. Weigh 5 g of oil into a 250 ml erlenmeyer flask.
2. Add 10 ml of chloroform and 15 ml of acetic acid
3. Add about one ml of saturated potassium iodade solution
4. Place the erlenmayer flask in a dark place for 5-10 min
5. Add 75 ml of distillated water and 1 ml of starch solution (black-blue color)
6. Titrate, while shaking, with the 0.1 N sodium thiosulfate until solution turns from the dark blue into colorless.

Steps above are repeated with a blank sample which does not contain any oil sample

DATA TO RECORD

1 Weight of oil sample (g)

2 Volume of consumed sodium thiosulfate solution (ml)

0.1 N $Na_2S_2O_3$ solution used for blank sample (Blank) V_b(ml)

0.1 N $Na_2S_2O_3$ solution used for sample (with oil sample) V_s(ml)

$V_s - V_b = V_t$ (ml)

CALCULATION

Formula:

$$\text{Peroxide value (meq/kg oil)} = \frac{\text{Titre value } (V_t) \times \text{Normality of } Na_2S_2O_3 \times 1000}{\text{Weight of oil sample (g)}}$$

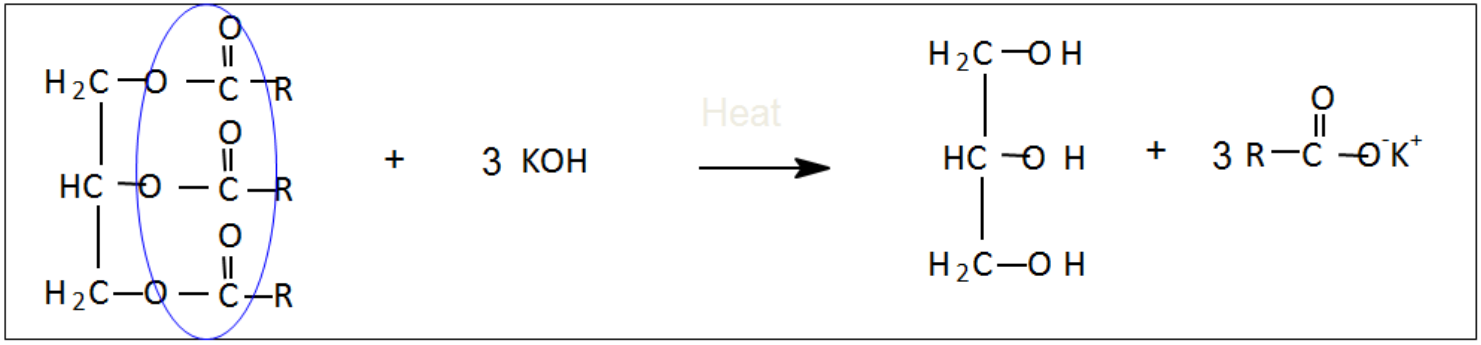
Experimet: Saponification value

WHAT IS THE AIM OF THE EXPERIMENT?

To determine saponification value in an oil (or in the oil of a food product)

PRINCIPLE?

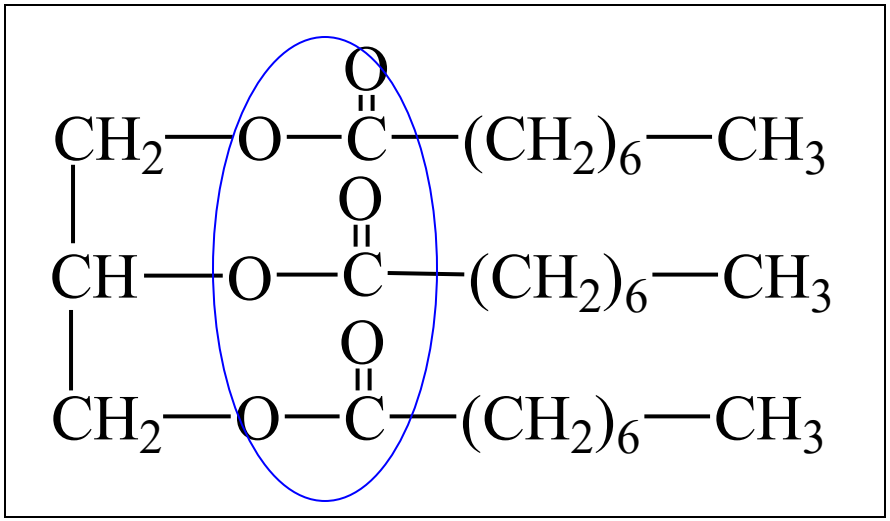
Saponification - Hydrolysis of ester (triglycerides) under alkaline condition.



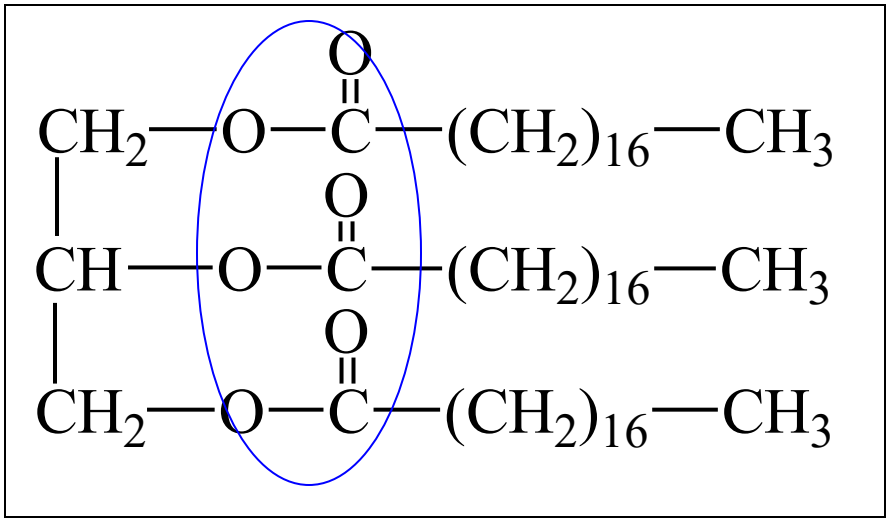
Definition: weight of KOHin mg required to saponify 1 g of the oil or fat

Saponification Value

B Tricaprylin (MW= 450)

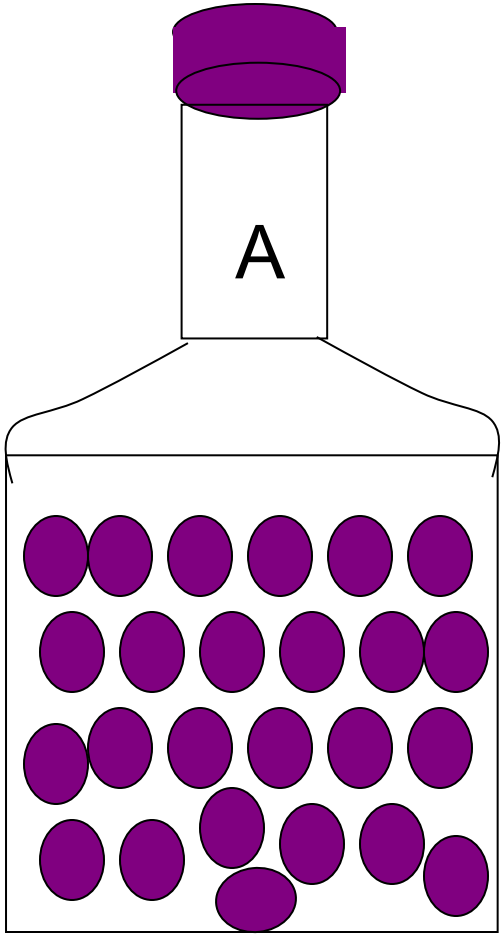


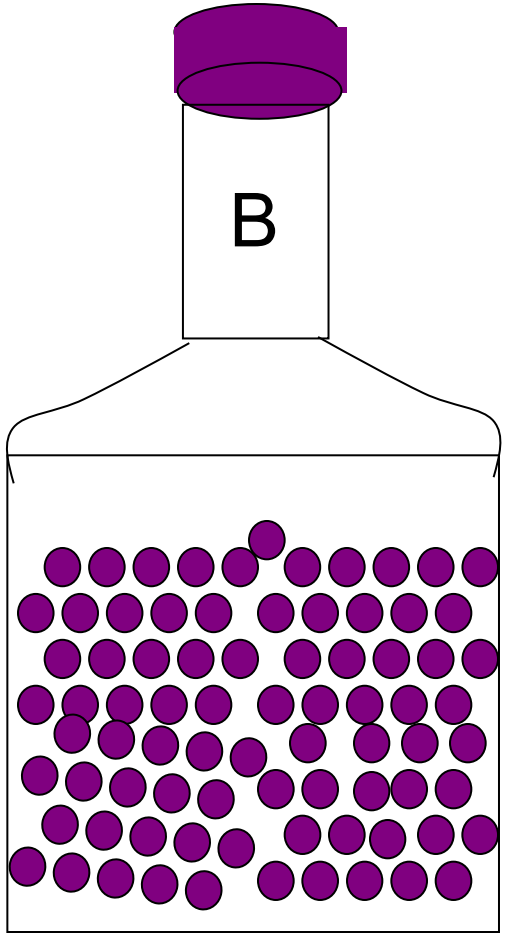
A Tristearin (MW= 890)



1Gram of Oils **A and B**

Saponification Value





; Large molecular triglycerides

; Small molecular triglycerides

Sample A has large molecular weight triglyceride (e.g. MW.890).

Sample B has small molecular weight triglyceride(e.g. MW.450).

In one gram of sample, number of triglyceride in B is about two times more than number of triglyceride in A.

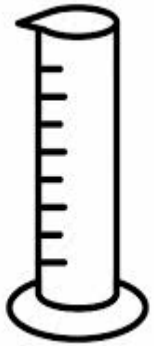
Less mg of KOH is needed to saponify sample A than sample B.

Therefore, saponification value of A is about half of that of sample B

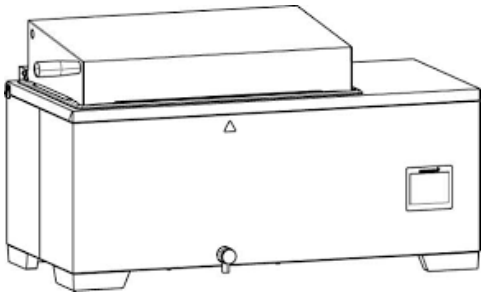
Chemicals and Materials

Apparatus

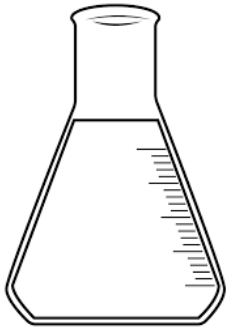
Analytical balance



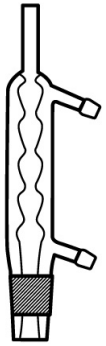
Graduated cylinder



water bath



Erlenmeyer flask



condenser

Burette

Reagents

- **0.5 N alcoholic KOH solution :** Dissolve 28.055 g KOH in 1 L of alcohol.

- **Phenolphthalein indicator (1%):** Dissolve one gram of phenolpthalein in 100 ml of ethyl alcohol (95%)

- **0.5 N HCl**: Dilute 43.01 mL of 36.5-38% HCl to 1 L with distilled water

Procedure

1. Weigh out accurately 2 g of oil ito a flask (A) and blank (B).
2. Add exactly 25 mL of 0.5 N alcoholic KOH solution.
3. Attach the reflux condenser and immerse the flask in boiling water for 60 min.
4. Swirl the flask frequently during the heating.
5. After refluxing, add 0.5 mL of 1% phenolphthalein and titrate with 0.5 N HCl.
6. Conduct blank determination.

DATA TO RECORD

1 Weight of oil sample (g)

2 Volume of consumed HCl (ml)

0.5 N HCl solution used for blank sample (Blank) B(ml)

0.5 N HCl solution used for sample (with oil sample) A(ml)

CALCULATION

Formula:

$$\text{Saponification value} = \frac{(B-A) \times 28.05}{\text{Weight of oil sample (g)}}$$

Turkish Food Codex and TSE standards

The Turkish Food Codex (TFC) is a regulatory framework that includes standards, rules and regulations for food production, processing, consumption and trade in Türkiye. This codex was created to ensure food safety, protect the health of consumers and regulate trade in the food sector.

TURKISH FOOD CODEX NOTIFICATION ON OILS CALLED BY PLANT NAMES (NOTIFICATION NO: 2012/29)

Purpose

The purpose of this Notification is to determine the characteristics of the oils called by plant names within the scope of this Notification in order to ensure their production, preparation, processing, preservation, storage, transportation and marketing in a hygienic manner and in accordance with the technique.

Ek-2 Diğer Kalite Kriterleri

Uçucu Madde (l05° C)	En çok % 0,2 (m/m)
Çözünmeyen Safsızlıklar	En çok % 0,05 (m/m)
Sabun Miktarı	Rafine yağlarda en çok % 0,005 (m/m) Soğuk preslenmiş ve natürel yağlarda bulunmamalı
Asit Sayısı	Rafine yağlarda en çok 0,6 mg KOH /g yağ Soğuk preslenmiş ve natürel yağlarda en çok 4,0 mg KOH/g yağ Natürel palm yağında en çok 10,0 mg KOH/g yağ
Peroksit Sayısı	Rafine yağlarda en çok l0 miliekivalen aktif oksijen / kg yağ Soğuk preslenmiş ve natürel yağlarda en çok l5 miliekivalen aktif oksijen / kg yağ

Turkish Food Codex and TSE standards

EK - 3 Bitkisel Yağların Fiziksel ve Kimyasal Özellikleri

Bitkisel Yağlar	Bağıl Yoğunluk (X° C/su 20° C)	Yoğunluk (g/mL)	Kırılma İndisi	Sabunlaşma Sayısı (mg KOH/g yağ)	İyot Değeri (Wijs)	Sabunlaşmayan Madde (g/kg)
Aspir Yağı	0,922-0,927 X=20° C			186-198	136-148	≤ 15
Aspir Yağı (yüksek oleik asitli)	0,913-0,919 X=20° C 0,910-0,916 X=25° C	0,912-0,914 20° C'de	1,460-1,464 40° C'de 1,466-1,470 25° C'de	186-194	80-100	≤ 10
Ayçiçek Yağı	0,914-0,923 X=20° C		1,461-1,471 40° C'de	188-194	94-141	≤ 15
Ayçiçek Yağı (yüksek oleik asitli)	0,909-0,915 X=25° C		1,467-1,471 25° C'de	182-194	78-90	≤ 15
Babassu Yağı	0,914-0,917 X=25° C		1,448-1,451 40° C'de	245-256	10-18	≤ 12
Fındık Yağı	0.898-0.915 X=20° C		1,468-1,473 20° C'de	188-198	81-95	≤ 15
Hindistancevizi Yağı	0,908-0,921 X=40° C		1,448-1,450 40° C'de	248-265	6,3-10,6	≤ 15
Kanola/Düşük Erusik Asitli Kolza Yağı	0,914-0,920 X=20° C		1,465-1,467 40° C'de	182-193	105-126	≤ 20
Mısır Yağı	0,917-0,925 X=20° C		1,465-1,468 40° C'de	187-195	103-135	≤ 28
Palm Yağı	0,891-0,899 X=50° C	0,889-0,895 50° C'de	1,454-1,456 50° C'de	190-209	50,0-55,0	≤ 12
Palm Çekirdeği Yağı	0,899-0,914 X=40° C		1,448-1,452 40° C'de	230-254	14,1-21,0	≤ 10
Palm Çekirdeği Olein	0,906-0,909 X=40° C	0,904-0,907 40° C'de	1,451-1,453 40° C'de	231-244	20-28	< 15
Palm Çekirdeği Stearin	0,902-0,908 X=40° C	0,904-0,906 40° C'de	1,449-1,451 40° C'de	244-255	4-8,5	<15
Palm Olein	0,899-0,920 X=40° C	0,896-0,898 40° C'de	1,458-1,460 40° C'de	194-202	≥ 56	≤ 13
Palm Stearin	0,881-0,891 X=60° C	0,881-0,885 60° C'de	1,447-1,452 60° C'de	193-205	≤ 48	≤ 9
Palm Süperolein	0,900-0,925 X=40° C	0,886-0,900 40° C'de	1,459-1,460 40° C'de	180-205	≥ 60	<13
Pamuk Yağı	0,918-0,926 X=20° C		1,458-1,466 40° C'de	189-198	100-123	≤ 15
Soya Yağı	0,919-0,925 X=20° C		1,466-1,470 40° C'de	189-195	124-139	≤ 15
Susam Yağı	0,915-0,924 X=20° C		1,465-1,469 40° C'de	186-195	104-120	≤ 20
Üzüm Çekirdeği Yağı	0,920-0,926 X=20° C		1,467-1,477 40° C'de	188-194	128-150	≤ 20
Yer Fıstığı Yağı	0,912-0,920 X=20° C		1,460-1,465 40° C'de	187-196	86-107	≤ 10

Turkish Food Codex and TSE standards

4.4.1.2. Standards for Oils (TS 341, TS 886, TS 887, TS 888)

Table 4.11. Turkish standards for oils

	Specific gravity	Refractive index	% Volatile matter (max.)	Saponification value	Iodine value	% Free fatty acid (max.)	Peroxide (max.)
Olive oil (TS 341)	0.912-0.918	1.468-1.470	0.2	184-196	78-88	0.3	20
Sunflowerseed oil (TS 886)	0.918-0.923	1.467-1.469	0.2	188-194	110-143	0.3	10
Cottonseed oil (TS 887)	0.918-0.926	1.458-1.466	0.2	189-198	99-119	0.3	10
Corn oil (TS 888)	0.917-0.925	1.465-1.468	0.2	187-195	103-128	0.3	10