Analysis of fats & oils:

Many useful analytical methods have been developed to have quality control over fat and oils.

These are ⟹

a) Acid value
b) Saponification value
c) Ester value
d) Iodine value
e) Acetyl value
f) RM value.

(a) Acid value:

- The no. of milligram of KOH which is req. to neutralise 1 gm of oil (or) fat.
- It indicate the amount of free fatty acid are present in Sample.

Procedure:

weigh accurately amount of oil / fat in a conical flask.

⇓

Add 50 ml of Hot ethanol-ether solution.

⇓ shake well.

Titrate the soln. with KOH soln & use phenopthaline as an indicator

⇓

End point pink colour obtained.

⇓

Measure the KOH used.

Formula:

$$\text{Acid value} = \frac{56.1 \times V \times N}{W}$$

Where,

V = Vol. of std. KOH soln used in ml.

N = Normality of KOH soln.

W = Weight of sample (Fat (or) oil) in Grams.

- Acidity is expressed as free fatty acid,

So calculation:

- Free fatty acid = $\frac{28.2 \times V \times N}{W}$ % by W.

[Acid value = % Fatty acid × 1.99]

- significance of Acid value:

1) Measurement of breakdown of triglycerides into free fatty acid which has an adverse and undesirable effect.

2) It measures degree of Hydrolytic Rancidity.

3) useful to determine the quality of fat and oil.

4) Also useful to check storage condition.

5) Edible oil should contain →
≤ 1% Free fatty acid.

6) pharmaceutical oil should not contain any acidity.

(b) Saponification Value:

- The saponification value is the no. of KOH required to saponify 1gm of oil/fat.

Principle:

- Determined by refluxing a known quantity of the sample with excess of standard. Alcoholic KOH for 30 min. and the titrating the unused alkali (KOH) with std. Hcl solution.

Procedure:

- Take 2gm sample in a conical flask & filtrate with a reflux condenser.

⇓

Add 25 ml of Alcohol. KOH

⇓

Boil under Water bath (30min-1hr) in absence of oily matter / clear solution obtained.

⇓

Add 1ml of phenopthalin Indicator & titrate excess KOH with 0.5 N HCl solution.

- Also carry out blank titration omitting the substance under examintn.

Formula: $$\text{Saponification Value} = \frac{56.1 \times (B-S) \times N}{W}$$

[DEPTH OF BIOLOGY]

Where,

B = Vol. of Std. KOH req. for Blank in ml.

S = vol. of std. KOH req. for sample in ml

N = Normality of std. KOH soln.

W = wt. of sample (fat/oils) in grams.

- Significance

1) Gives Idea about the Mol. wt. of fat and oil.

- Smaller the Saponification value = Higher the Mol. wt.

2) Indicate the length of fatty acid in fats / oils.

- Saponification value ↑↑ ⟹ Greater the % of short chain acid tst in Glycerides.

3) Also indicate the amount of Alkali req. for converting oil/fat into soap.

(C) Ester value:

- Number of Milligram of KOH req. to react with the ester in one gram of oil / fat.
- The difference between saponification value and Acid value is called as Ester value.
- Formula:

$$\text{Ester value} = \text{Saponification value} - \text{Acid value}$$

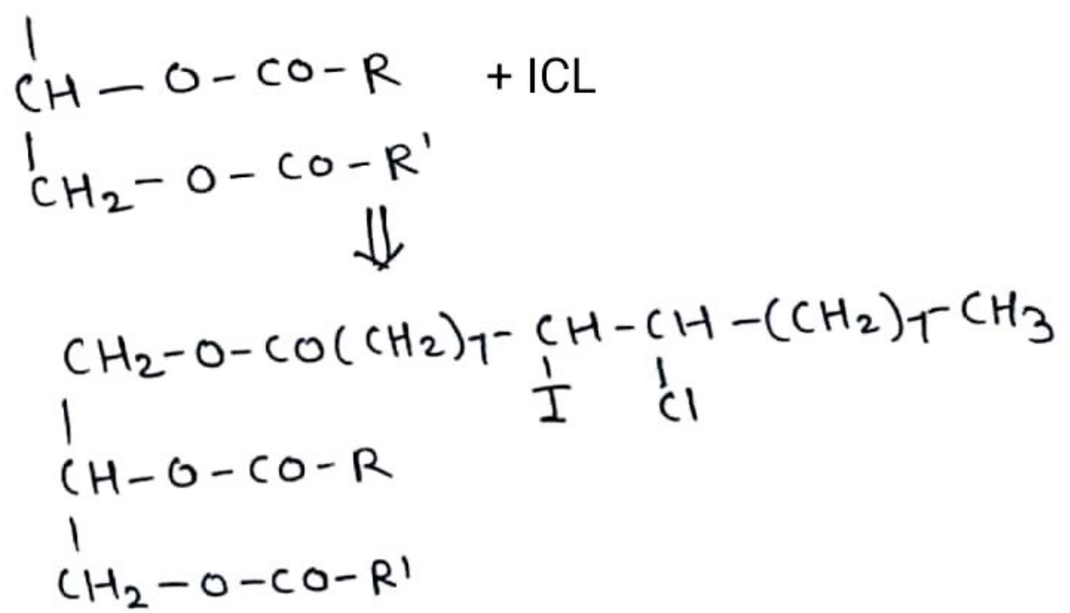
- Significance:
- Higher the ester value Indicates the presence of High amount of ester and Low Molecular weight fatty acid content.

(d) Iodine Value ⇒

No. of Iodine combined (or) absorbed by 100 gm of oil / Fat. (with the help of this we can calculate the unsaturation of fats & oils).

principle:

oil / Fat sample is taken + Treated with excess of Iodine monochloride (Icl).



Now ⇒

you know Iodine tst in excess amount so, Now, remaining Iodine react with KI.

$$ICl + KI \longrightarrow KCl + I_2.$$

Now, this I_2 titrate with sodium Thiosulphate,

So we know about the amount of Iodine.

Procedure:

Determined by 2 methods:

(a) Hubl's Method:

Fat / oil sample is dissolved in CCl_4

⇓ Treated with

Excess of std. Ethanolic I_2 soln. in $HgCl_2$ & then after reaction an used I_2 is calculated by titration with std. sodium thiosulphate soln

(b) Wijs Method:

Fat / oil sample dissolve in CCl_4.

⇓ Treated with

Excess of ICl soln in CH_3COOH.

⇓

Unused ICl is calculated by adding KI.

⇓ Then.

Remaining soln is titrated with std Sodithiosulphate soln. using Starch as an Indicator.

Formula:

$$\text{Iodine value} = \frac{12.69 \times (B \cdot S) \times N}{W}$$

where,

B = Vol. of std. sod. thiosulphate req. in blank titration (in ml)

S = vol. of std. sod. thiosulphate req. for Sample (in ml)

N = Normality of std. sod. Thio sulphate

W = Wt. of sample (fat/oil) in gm.

Significance :

1) Indicates the degree of unsaturation in fat & oil.

2) Iodine value ↑ = Unsaturation ↑↑

3) Also give Idea about drying character (Drying ↑ = unsaturation ↑↑)

★ Iodine value ⟹

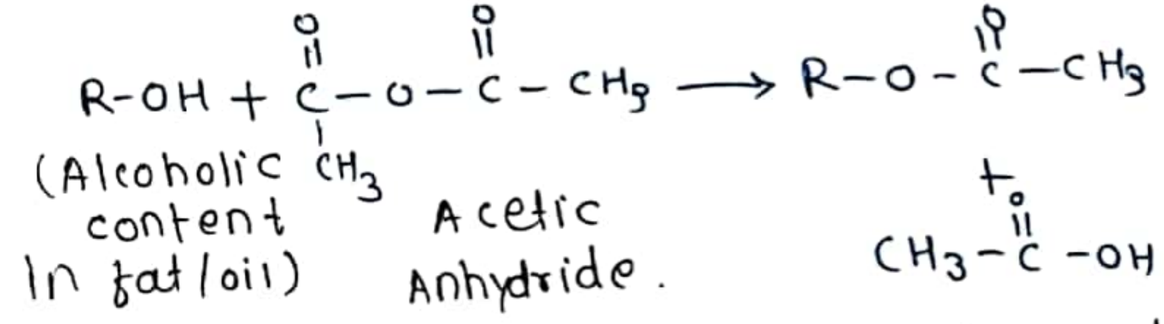
Drying oil = >120

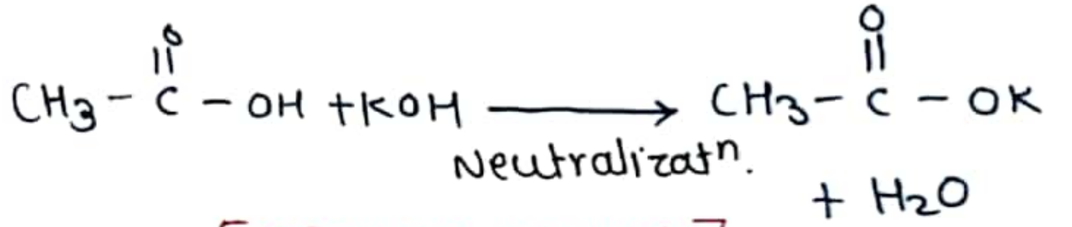
Non-drying oil = 85-105

(e) Acetyl Volume :

Milligram of KOH is req. to Neutralise the Acetic Acid.

produced when 1 gm of fats & oil is acetylated with Acetic Anhydride.





Procedure :

Fat/oil sample + 5ml acetic anhydride/ pyridine mixture (1:7) + 5ml H_2O.

⇓

Put on Boiling H_2O bath for 30 min and cool.

⇓

Titrate with 0.5 N KOH soln using phenophthaline as an Indicator.

Formula:

$$\text{Acetyl value} = \frac{1335 \times (b-a)}{(1335-a)}$$

where,

a = Sap. value of the sub. (fat / oil)

b = Sap. value of Acetylated sub.

Significance:

① Help in determining the no. of Alcoholic groups present in fat / oil.

② Greater Acetyl value Indicates more amount of free fatty acid.

(f) RM value: (Reichert-Meissl value)

Number of milligram of 0.1 N aq. NaOH soln req. to Neutralise

↓

Steam volatile water soluble fatty acid distilled from 5gm of oil / fat.

principle:

- Material is saponified with NaOH then acidified (split) with dil. H_2SO_4.

⇓

So Release of volatile fatty acid

⇓

Now, the distillated product is collected & cooled.

⇓

Now, titrate the volatile oil present in distillate with 0.1 N NaOH soln.

Procedure:

10gm sample + excess of 0.1 N NaOH soln.

↓

soln acidified with dil. H_2SO_4 & undergo steam distillation.

↓

Distillate containing volatile acid.

↓

Treated with 0.1 N NaOH soln using phenopthaline as Indicator.

[DEPTH OF BIOLOGY]

Formula :

RM value = $(A-B) \times N \times 11$.

A = volm in ml of std. NaOH soln for test.

B = volm in ml of std. NaOH soln req. for blank.

N = Normality of std. NaOH soln.

Significance :

① useful for testing the purity of Butter and Ghee. which contain high amount of Glycerides butyric acid and other volatile fatty acid.

② RM value ↓↓ = Low quality of Ghee / Butter.