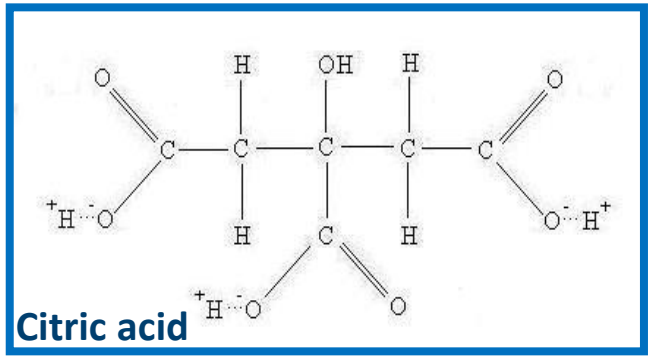
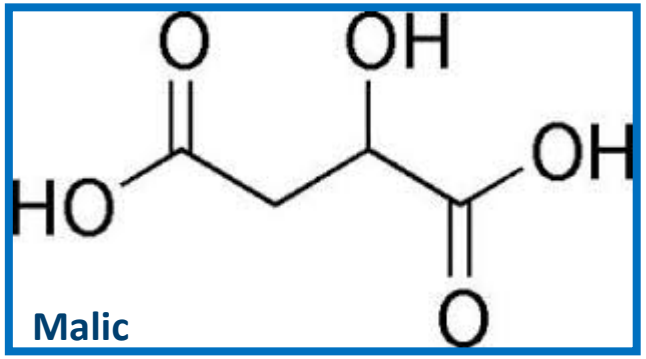
Determination of total acidity of food

Food acidity:

- Food acids are usually organic acids, with citric, malic, lactic, tartaric, and acetic acids being the most common.





- However, inorganic acids such as phosphoric and carbonic (arising from carbon dioxide in solution) acids often play an important and even predominant role in food acidulation.

Food acidity:

- **The organic acids present in foods influence the :**

1. flavor (i.e.,tartness).
2. Color (though their impact on anthocyanin and other pH-influenced pigments).
3. prevent/retard the growth of microorganisms or inhibit the germination of spores.
4. Providing the proper environment for metal ion chelation, an important phenomenon in the minimization of lipid oxidation.

- Organic acids may present :

1. Naturally.
2. By Fermentation .
3. Added as part of a specific food formulation.

The importance of determining food acidity:

1. Determine the degree of maturity of fruits and vegetables:

- The titratable acidity of fruits is used, along with sugar content, as an indicator of **maturity**, generally the higher the maturity, the lower the acid content. e.g. in the ripening process.
- Such as tomatoes from green to mature stage , there is an increase in sugar content.

2.To determine the freshness of foods:

- For example in milk, the more the lactic acid levels, means that milk is rotten.

The importance of determining food acidity:

3. Acidity indicators reflect the quality of food:

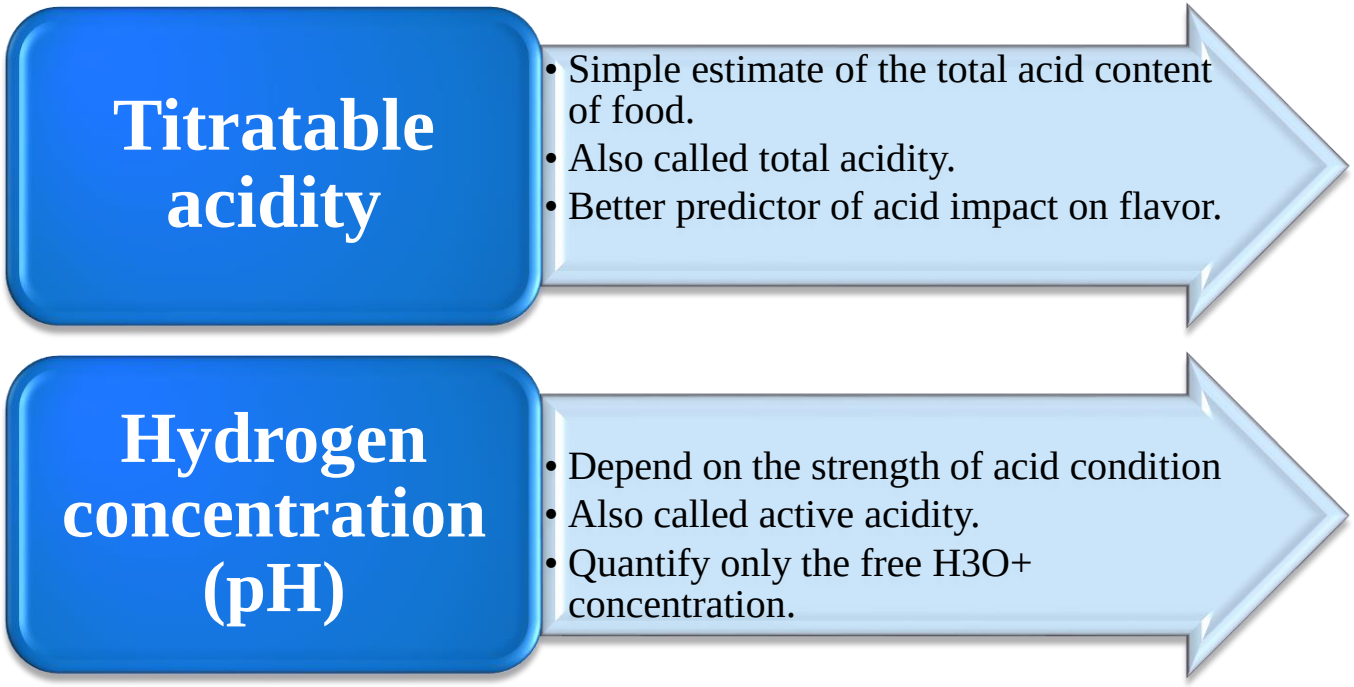
- The amount of organic acids in food **directly** affects the food flavor, color, stability, and the level of quality.

4. Determination of acid on the microbial fermentation process:

- Such as: fermentation products in soy sauce, vinegar and other acids is an important indicator of **quality.**

Food acidity determination:

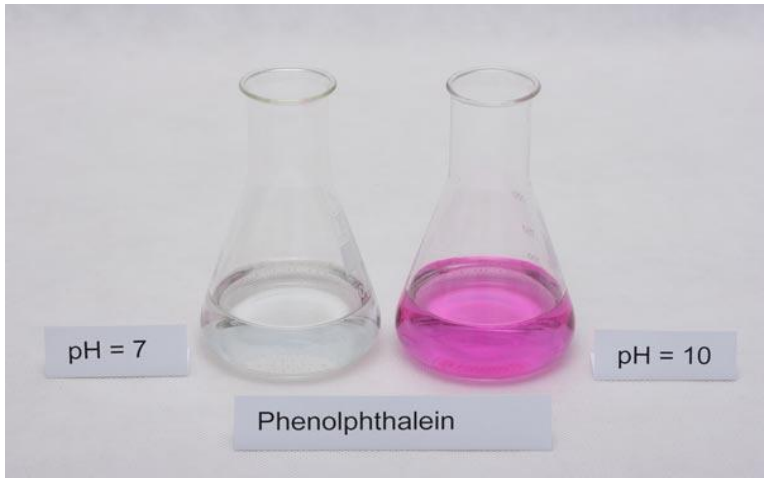
- There are two ways to express food acidity:



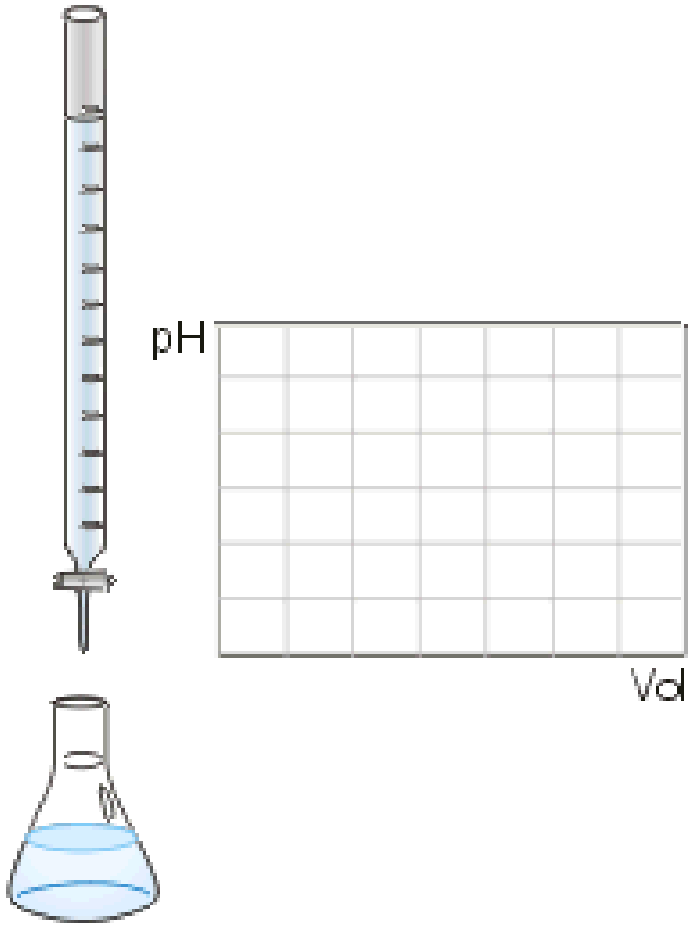
Titratable acidity:

- Titratable acidity is determined by neutralizing the acid present in a known quantity (weight or volume) of food sample using a standard base.

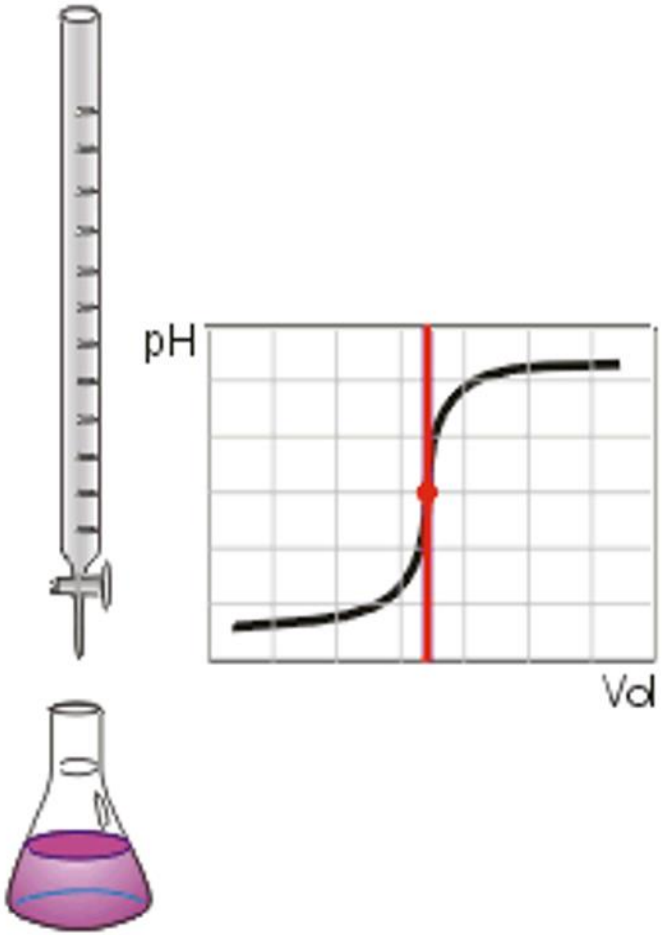
- The endpoint for titration is usually either a target pH or the color change of a pH-sensitive dye, typically phenolphthalein.



Before titration (acidic media)



After titration (neutral point)



Practical Part

Objective:

- To determine total acidity (Titratable Acidity) of milk, juice, vinegar and oil acid value.

1-Determination of Milk Acidity :

- Measuring milk acidity is an important test used to determine milk quality.

- **The acidity of fresh milk (Natural acidity) is due to:**

➔Phosphates, casein and whey proteins, citrates and carbon dioxide dissolved during the process of milking.

- **(Developed acidity) which is due to:**

➔ Lactic acid produced by the action of bacteria on lactose in milk.

- **Titratable Acidity:** The Acidity that results from accumulation of Natural and Developed acidity.

1-Determination of Milk Acidity cont':

- Normal range : TA%= 0.12% - 0.16%, (The average 0.14%)

- If it increased more than 0.16% indication of lactic acid by bacteria.
- **Acidity is expressed as:** percentage of lactic acid.

➔Because lactic acid is the principal acid produced by fermentation.

Method:

1. Mix the milk sample thoroughly by avoiding incorporation of air.
2. Transfer 10 ml (10g) milk to conical flask or beaker .
3. Add equal quantity of distilled water .
4. Add 3-4 drops of phenolphthalein indicator and stir.
5. Rapidly titrate the contents with 0.1 M NaOH solution, continue to add alkali drop by the drop and stirring the content till first definite change to pink colour .
6. Note down the final burette reading.

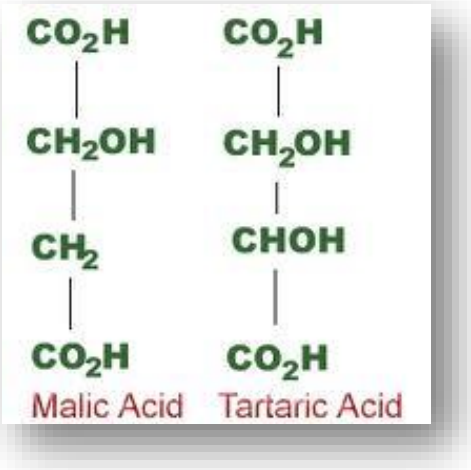
Results and calculations:

- **Lactic acid %=** $\dfrac{(0.1\text{M NaOH X vol. of NaOH (in liter)X } 90.08^{*}) \times 100}{\text{Weight of the sample}}$

*90.08 g/mol is the molecular weight of Lactate.

2-Determination of total acidity in juice :

- The acidity of natural fruit juices is the result mainly of their content of organic acids.
- For example, most **fruits** contain the tricarboxylic acid (citric acid) whereas **grapes** are rich in tartaric acid and **peaches, apricots and plums** in malic acids.
- Both tartaric & malic acids are dicaroxylic acids.



- The acidity of fruit juice may be determined by:

➔ simple **direct** titration with 0.1M sodium hydroxide, using phenolphthalein as an indicator.

Method:

1. Weight 10 gm juice in beaker.
2. Add 25 ml of distilled water.
3. Titrate with 0.1M NaOH , using 2 drops of phenolphthalein as an indicator.

Results and calculations:

- **Calculate percent acidity of fruit juice (citric acid):**

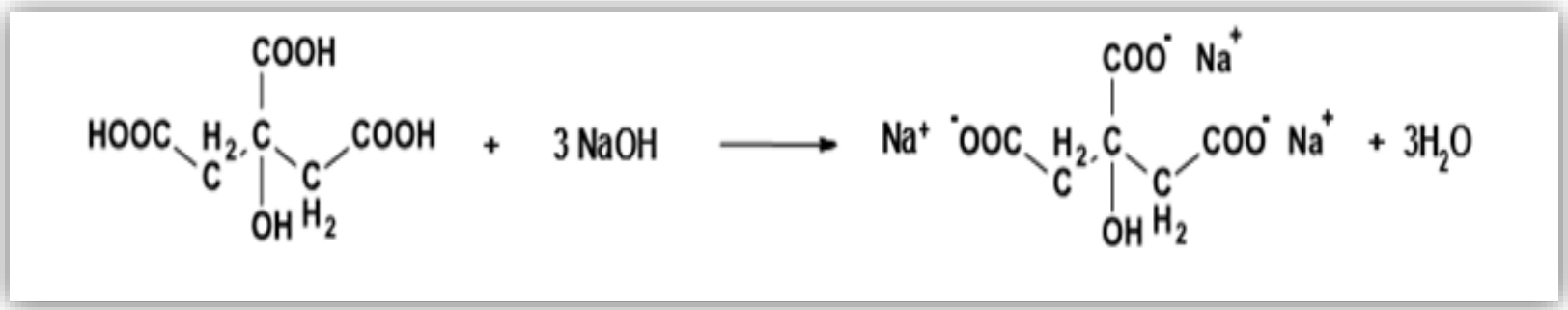
1. **Weight of citric acid=** $\frac{\text{0.1M NaOH X vol. of NaOH (in liter) X 192.43*}}{\mathbf{3}}$

2. **% of total acidity =** (wt. of acid / wt. of sample) X 100

- Normal range for citric acid = 0.39 - 1.1 %

*192.43 g/mol is the molecular weight of citric acid

- Why we divide by 3 when we calculate the weight of citric acid ?



3-Determination of total acidity in vinegars:

- The acidity of vinegars is derived by the fermentation of ethanol by acetic acid bacteria which produce acitic acid.

$$C_6H_{12}O_6 \xrightarrow[\text{Complex}]{\text{Zymase}} \underset{\text{ethyl alcohol}}{2C_2H_5OH} + 2CO_2$$

$$C_2H_5OH + O_2 \xrightarrow{\text{Acetobacter}} \underset{\text{acetic acid}}{CH_3COOH} + H_2O$$

- It may be determined **titrimetrically** using phenolphthalein as an indicator .

- The natural acidity of vinegar is mainly due to the presence of acetic acid (CH3COOH) , which is volatile.

Method:

1. Weight 1 gm vinegar.
2. Add 10 ml of distilled water.
3. Titrate with 0.1M NaOH , using 2 drops of phenolphthalein as an indicator.

Results and calculations:

- Calculate percent acidity as acetic acid (MW=60.05):

1. Weight of acetic acid= (0.1M NaOH X volume of NaOH (in liter) X MW).

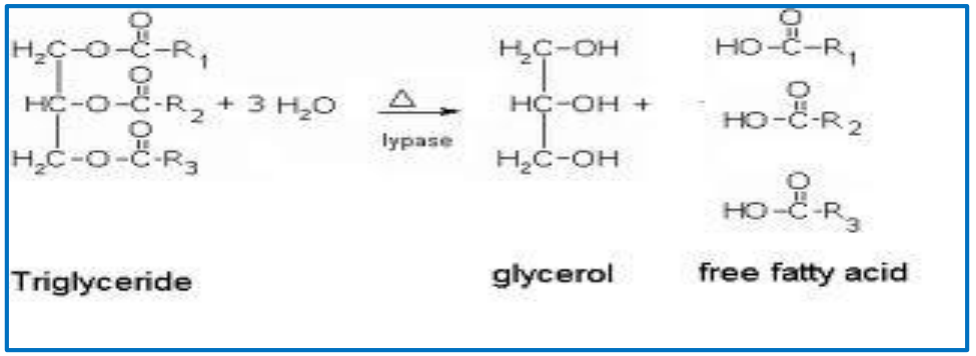
2. **% of total acidity=** (wt. of acid / wt. of sample) X 100

4- Oil acid value :

- **The acid value is defined as:** the number of milligrams of potassium hydroxide required to neutralize the free fatty acids present in one gram of fat.

- It is a relative measure of rancidity as free fatty acids are normally formed during decomposition of oil glycerides.

- **The value is also expressed as:** percent of free fatty acids calculated as **oleic acid.**



Principle:

- The value is a measure of the amount of fatty acids which have been liberated by hydrolysis from the glycerides due to the action of **moisture, temperature and/or lipolytic enzyme lipase.**

- The acid value is determined by directly titrating the oil/fat in an alcoholic medium against standard potassium hydroxide/sodium hydroxide solution.

Method:

1. Mix the oil or melted fat thoroughly before weighting.
2. Weight accurately about 5 g of cooled oil sample in a 250 ml conical flask.
3. Add 50 ml of freshly neutralized hot ethanol. (why ethanol not chloroform?)
4. Add one ml of phenolphthalein indicator solution.
5. Boil the mixture(in water bath) for about 5 minutes and titrate while hot against standard alkali solution shaking vigorously during the titration.

Results and calculations:

- **Acid value =** 56.1 X (V x N) / weight of sample

➔Where:

V = Volume in ml of standard potassium hydroxide or sodium hydroxide used.

N = Normality of the potassium hydroxide solution or Sodium hydroxide solution.

W = Weight in g of the sample.

- The maximum levels allowed for acid value of edible fats and oils is 0.6 mg NaOH/g (Normal Range).

Note:

- Titratable acidity provide a simple estimate of acid in food,Routine titration cannot differentiate between individual acids. Therefore, titratble acidity is usually stated in terms of predominant acid

- **Note the color at end point:**

References:

- Nielsen S. Food Analysis. Springer Science & Business Media, 2014.
- BCH 445- practical note