Determination of food acidity

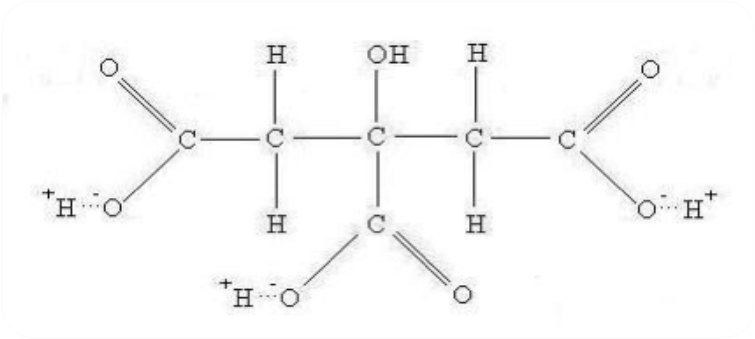
BCH 445

Lab 1

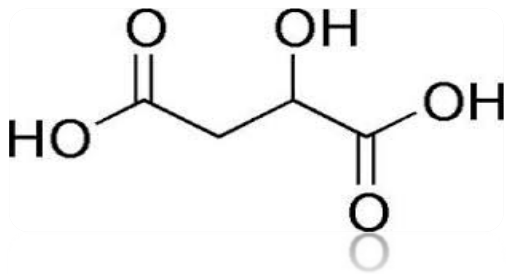
Food acidity

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 acids (arising from carbon dioxide in solution) often play an important and even predominant role in food acidulation.



Citric acid



Malic acid

The organic acids present in foods influence :

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

Organic acids may present :

- Naturally,
- By Fermentation
- 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**.

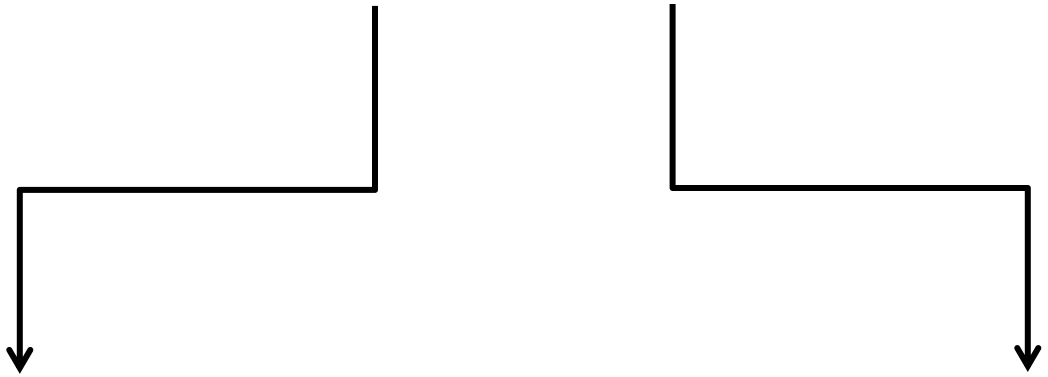
3. Acidity indicators reflect the quality of food

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.

There are two ways to express food acidity:



Titratable acidity

- Simple estimate of the total acid content of food
- Better predictor of acid impact on flavor

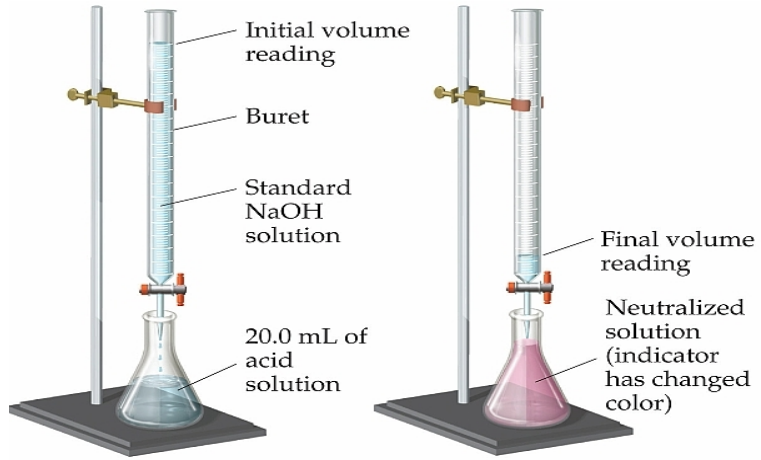
Hydrogen concentration pH

- Depend on the strength of acid condition

Titratable acidity

- **Titratable acidity** provide a simple estimate of acid in food, it is a **routine titration** that cannot differentiate between individual acids. Therefore, titratable acidity is usually stated in terms of **predominant acid**
- It 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 determined usually by the color change of a pH-sensitive dye, typically phenolphthalein.
- It is calculated by the following formula:

  - **TA% = (wt of acid/ wt of sample) x 100**
  - ***Wt of acid is calculated*** as no. of moles of NaOH that neutralizes the acid x mwt of acid



Note the color at end point:

color in acid color at endpoint too much base

Objective

To determine total 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 Natural acidity of fresh milk is due to :

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

Developed acidity is due to:

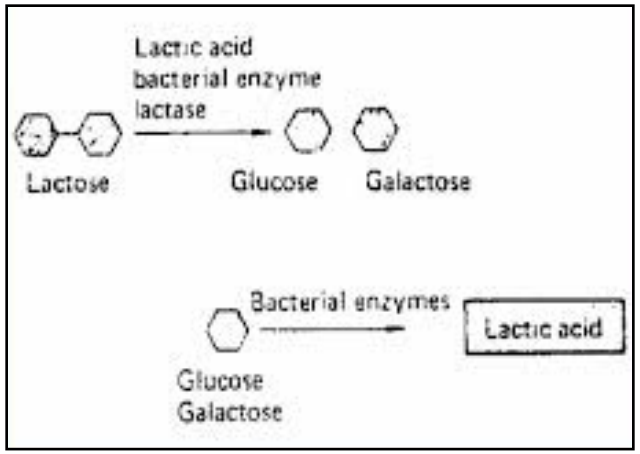
lactic acid produced by the action of bacteria on lactose in milk.

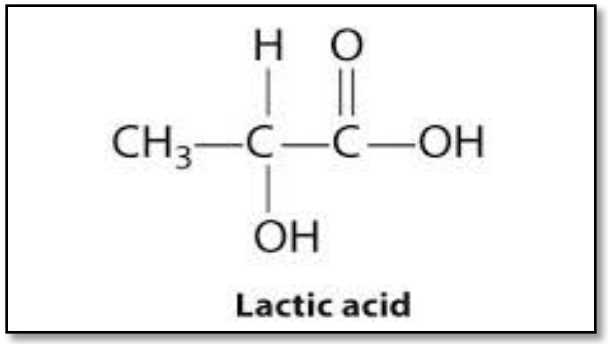
Milk Acidity

TA%=0.12% - 0.16% the average 0.14%

If it **increased** more than 0.16% , is an indication of **lactic acid** by bacteria.

Acidity is expressed as percentage of lactic acid <u>because lactic acid is the principal acid produced by fermentation.</u>





Method:

1. Mix the milk sample thoroughly by avoiding incorporation of air.
2. Transfer 10 ml milk to conical flask or beaker .
3. Add equal quantity of distilled water .
4. Add 2 drops of phenolphthalein indicator and stir.
5. Rapidly titrate the contents with 0.1 N 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.**

Result and Calculation:

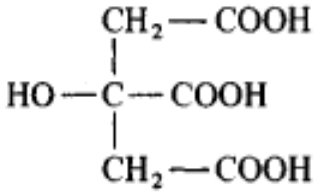
$$\text{Lactic acid \%} = \frac{(0.1\text{M NaOH} \times \text{vol. of NaOH (in liter)} \times 90.08)}{\text{Weight of the sample}} \times 100$$

90.08 g/ mol is the molecular weight of Lactate.

Normal range =0.12% - 0.16%

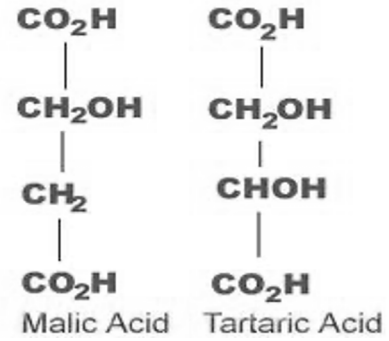
2-Determination of total acidity in juice :

- 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)



Citric acid

- **whereas** grapes are rich in tartaric acid & peaches, apricots and plums in malic acids, both are **dicaroxylic acids.**



Malic Acid Tartaric Acid

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.

Calculations:

Calculate percent acidity of fruit juice (citric acid):

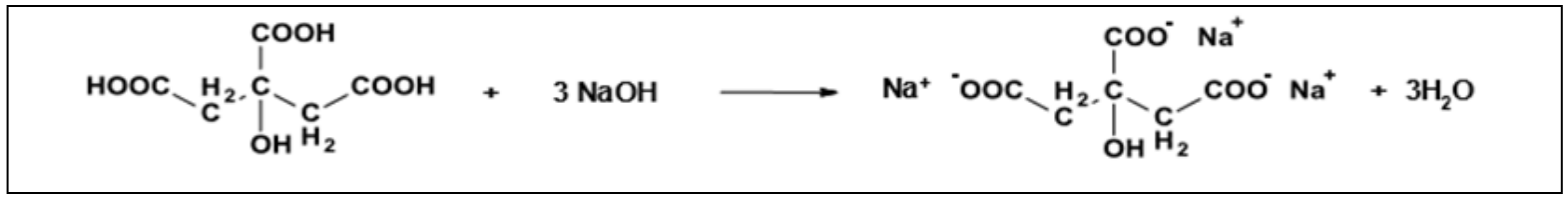
1- **Wt. of citric acid** $= \frac{0.1M\ NaOH\ \mathbf{X}\ vol.\ of\ NaOH\ \ (in\ liter)\mathbf{X}\ 192.43}{3}$

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

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

Normal range for citric acid = 0.39 - 1.1 %

*Why when calculation of the weight of citric acid it divided by 3?

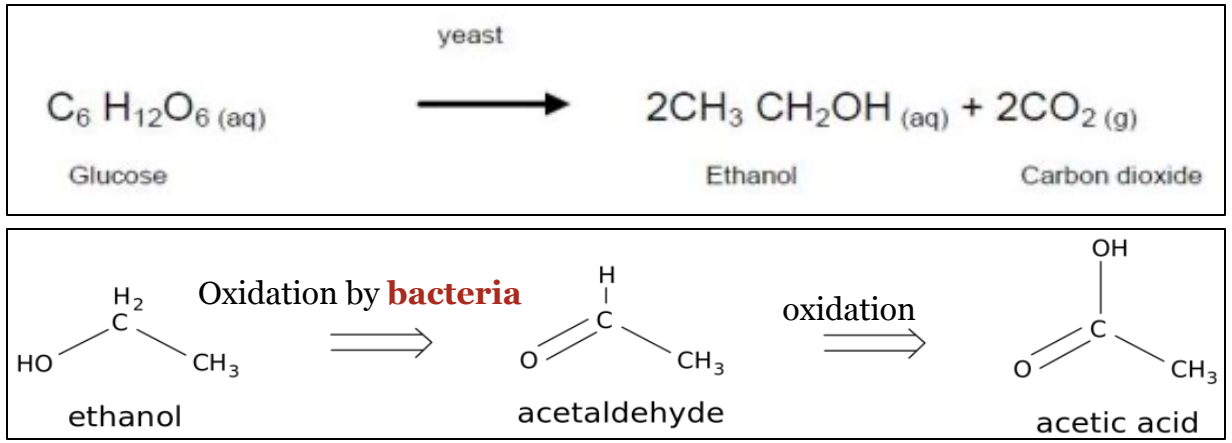


3-Determination of total acidity in vinegars:

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

- 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:

Determination of total acidity

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.

Calculations:

Calculate percent acidity as acetic acid (MW=60.05)

1- **Wt. 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

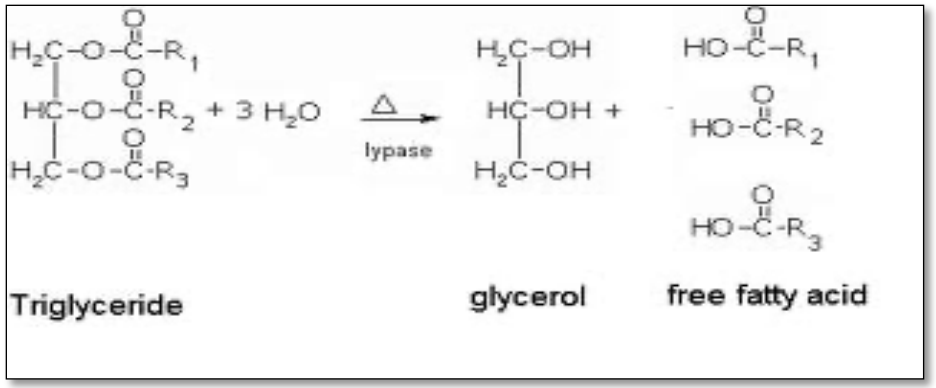
Normal range= 4-6 %

4-Acid value :

The acid value is defined as the number of milligrams of sodium 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 (main fatty acid in olive oil)**.



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 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.
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.

Calculation:

Acid value = 40 X (V x N) / weight of sample

*40 g/mol is the molecular weight of NaOH

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

N = Normality of the Sodium hydroxide solution = **0.1** N .

W = Weight in **g** of the sample

→ The **maximum level** allowed for ***acid value*** of edible fats and oils is **0.6** mg NaOH/g

Discussion

Discuss the result you got for each sample and compare it to the normal range