Nutritive value of processed foods

Nutrition Dept- 2nd stage

EXPERIMENT (4)

Influence of fermentation and pickling on nutritive value of processed foods

Fermentation: Means the breakdown of carbohydrate or carbohydrate-like materials by micro-organisms (or enzymes) under anaerobic or aerobic conditions, to alcohols and carbon dioxide or organic acids by yeasts, bacteria, or a combination of there. Fermentation is breakdown of carbohydrates under limited supply of oxygen or under anaerobic conditions. (Yeasts: Sugar $\rightarrow$ Alcohol + CO_2).

Aerobic, (Acetobacter: Ethylalcohol + $O_2 \rightarrow$ acetic acid).

Benefits of fermentation

1. Preservation.
2. Providing variety to the diet.
3. Production of important compounds like organic acids and alcohols.
4. Fermented foods are often more nutritious than their unfermented food.

The changes that hapens in foods by fermentation

1. Changes in carbohydrates.
2. Changes in proteins.
3. Changes in fats.

The end products of fermentation depend upon:

(i) The nature of the food.

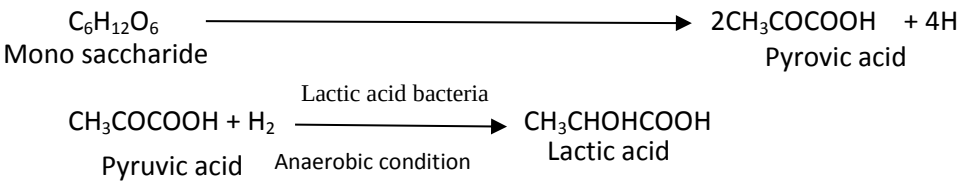
(ii) The types of microorganisms present.

(iii) The environmental factors affecting microbial activity.

There are three types of fermentation:

1. *Lactic acid fermentation:* Is the process of production of lactic acid by convert of one molecule glucose to two molecules of lactic acid under anaerobic condition as it shown in the following equation.

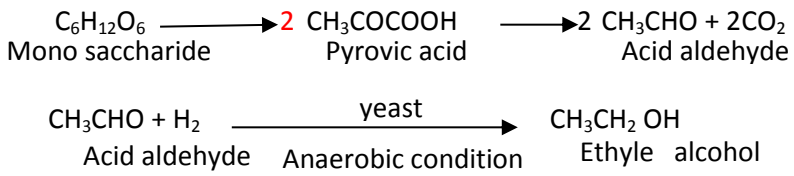
$C_6H_{12}O_6 \rightarrow 2\ CH_3CHOHCOOH$
Glucose — Lactic acid



The lactic acid fermentation usually occurs by the Lactobacillaceae these bacteria present in the foods naturally which called Flora for example, In sour foods such as sauerkraut.

The most important bacteria which produce lactic acid and growth sequentially are *Leconostoc mesenteroids* produce acid its quantity 1%, and then *Lactobacillus plantarum* continue producing till (1.5-2)% and then *Lactobacillus brevis* continuous growth and produce lactic acid till 2.5% .

2. *Alcoholic fermentation:* In this process one mole of glucose $C_6H_{12}O_6$ is converted into two moles of ethyle alcohol (ethanol) C_2H_5OH, which produce during conversion mono saccharide to pyrovic acid which converts to acid aldehyde and carbon dioxide, and then the acid aldehyde reduce to ethyle alcohol in anaerobic condition with the presence yeast as it shown in the following equation:



The yeast which use for fermentation is *Saccharomyces cerevisiae* and the specific species for production alcohol is *ellipsoides*.

3. *Acetic acid fermentation*: In this process one mole of ethanol will oxidized to the acetic acid and water with the presence of acetic acid bacteria (Acetobacter aceti) as it shown in the following equation :

$$\underset{\text{Ethyle alcohol}}{CH_3CH_2OH} \xrightarrow[\text{acetic acid bacteria}]{O_2} \underset{\text{Acetic acid}}{CH_3COOH} + H_2O$$

Controlling fermentation

The factors that affect on fermentation are:

1. Acidity**.**
2. Level of alcohol. Yeasts cannot tolerate high levels alcohol (12-15%).
3. Starter cultures**.**
4. Temperature.
5. Level of oxygen.
6. Level of salt.

Cucumbers gathered for pickling.

Pickling, Also known as **brining** is the process of preserving food by anaerobic fermentation in brine solution to produce lactic acid, and storing it in an acid solution, usually vinegar (acetic acid). The resulting food is called a **pickle**. This procedure gives the food a salty or sour taste.

Another factor for preserving food by pickling which is low pH less than 4.6 which is sufficient to kill most bacteria. Pickling can preserve perishable foods for months. Antimicrobial herbs and spices, such as garlic, are often added.

Imperfections of pickling

1-Soft, or slimy pickles: Is a type of spoilage and should be destroyed so spoiled pickles cannot be eaten by people or animals. It happens when there is no sufficient heat treatment and poor jar seals lead to spoilage or using a weak brine or vinegar solution, using deteriorated ingredients, or storing the pickles at too warm temperature.

2-Shriveling: Usually happens in very sweet or sour pickles and in large whole cucumber pickles. It is caused by using brine, syrup or vinegar solution which is too strong at the beginning of the pickling process.

3-Hollow pickles: Are the results of faulty growth, holding cucumbers too long before pickling or too rapid fermentation. So hollow cucumbers usually float, they can be picked out easily when the cucumbers are washed.

4-Too dark: It may caused by iron of hard water or an iron cooking utensil, Iodized salt, or use high amount of spices.

5-A white sediment: At the bottom of the jar may be caused by ant caking agents in the salt or by the fermenting bacteria.

procedure:

1- Cucumbers

1- Pick up and transporting the cucumber.
2- Washing, isolating and sorting.
3- Prepare the brine solution it is conc. 10%.
4- Soak the cucumber in the brine solution.
5- Put a plate & a heavy material to ensure immersing the cucumber in the brine solution to be in anaerobic condition.
6- Addition of salt to prevent decrease the conc. less than 10% & mixing the solution well to prevent growth of harmful microorganisms and to encourage fermentation.
7- After fermentation process, soak the fermented cucumber in a clean warm water for a period of time and repeating the process to release the salty taste.

8- Prepare a brine solution with the conc. 1-2% with vinegar(5%) and spices and boil it then cool it.
9- Packing the product in jars with the addition the prepared solution then vacuum and seal it, and then pasteurizing and cooling it.

Influence of fermentation on nutrition value of processed foods

Enhanced nutrition

Fermentation increases the **bioavailability of vitamins and minerals** in plant-based foods. It makes folate, riboflavin, and vitamin B12 more absorbable, while also synthesizing amino acids For example, the fermented soybean dish called tempeh contains higher levels of B vitamins than unfermented soybean products. Similarly, people who eat lactic fermented vegetables have been shown to absorb more iron than people who eat fresh vegetables. This is because the fermentation process changes iron into its more absorbable ferric (Fe3+) form.

Fermentation also enhances the antioxidant activity of phenolic compounds and lowers the negative impact of the anti-nutrient phytic acid. By supporting a healthy gut microflora, fermented veggies increase the synthesis of vitamin K2 by bacteria internally.

Fermentation reduces carbohydrates concentrating amino acids, and making amino acids more available and digestible. There is also reduction in tannins, oxalate, phytic acid, and carbohydrates which can complex with proteins and hence limiting accessibility by digestive enzymes

Some fermented vegetables contain prebiotic fiber that supports the growth of microflora, while others contain living yeast and bacteria that promote healthy digestion, thus contributing directly to the natural balance of intestinal microflora

Fermentation increased magnesium, iron, calcium, and zinc content in some fermented foods that are commonly consumed in India and associated with the decrease in the amount of phytates However, the increase in mineral content might be due to loss of dry matter during fermentation as microbes degrade carbohydrates and protein. Fermentation also increases bioavailability of calcium, phosphorous, and iron likely due to degradation of oxalates and phytates that complex with minerals thereby reducing their bioavailability.

Mechanisms related to increasing minerals bioavailability are several. Firstly, fermentation reduces phytic acid that binds minerals making them free and more

available. However, this effect is counteracted by release of tannins during fermentation especially in high-tannin. Secondly, fermentation loosens the complex matrix that embeds minerals. Both phytase and α-amylase make the matrix loose by degrading phytate and starch, respectively. Moreover, some fermenting microorganisms have the ability to degrade fiber which loosens the food matrix further. Thirdly, low pH obtained during fermentation increases iron absorption due to conversion from ferrous iron, which is less absorbable, to ferric iron, which is readily absorbed. Moreover, fermentation provides optimum pH for enzymatic degradation of phytate.

The mechanism for the glucose-lowering action of lactic acid has been suggested to be due to a lowered rate of starch hydrolysis in the upper small intestine. Unlike lactic acid, the mechanism of action for propionic and acetic acids appears to be a lowered rate of gastric emptying and suppressing enzymatic activity. This perhaps could be the reason why sourdough bread has been linked to lower postprandial glucose level