**MODE OF FOOD SPOILAGE**

**FOOD spoilage** is any change that renders food unfit for human consumption. At this stage food cannot be consumed because of detrimental changes in it. At this food texture become soft become unfit to eat.

**Deterioration**, on the other hand, is considered as detrimental changes in the quality of food but at this stage it can be consumed. It may only include the alteration of color, flavor, texture or ripeness (maturity).

**MODE OF SPOILAGE OF STABLE FOODS**

Stable foods are subject to deterioration and spoilage by the action of physical agents (temperature), pests (insects, rodents, birds) and microbes.

Due to poor storage conditions insects, rodents and birds can attack the stable foods which may decrease the quantity but also affect the quality of food. These pests may leave the excreta which is hazardous to human health.

The relative humidity may increase or decrease in the storage atmosphere may increase or decrease moisture content of food which may lead to growth of bacteria or moulds.

Example of stable foods are maize, wheat, rice, barley, oats, cereals and pulses.

**MODE OF SPOILAGE OF SEMI-PERISHABLE FOODS**

These foods includes potatoes, onions, and other similar commodities which are stored in cool places in the house. They are mostly attacked by rodents or insects at houses which brings loss in weight and quality.

Under unfavorable conditions, like moisture loss it leads to weight loss or shrink the size of food, but also they will sprout due to activity of enzymes, results in softening. This encourages the microbe’s growth and black mould rot especially in garlic, onion, and potatoes.

**MODE OF SPOILAGE OF PERISHABLE FOODS**

The agents that are accountable for deterioration and spoilage of perishable foods are autolysis, microorganisms and physical factors. Pests are also responsible for causing spoilage.

The ripening process in fruits and vegetables is a series of complex chemical and biochemical reactions catalyzed by enzymes. This leads to deterioration and spoilage if left uncontrolled.

Mechanical damage to the commodity, caused by the attack of rodents, insects and birds leads to increased enzymatic activities and microbial contamination. Meat and milk are spoiled by microorganisms that are either have entered from outside or natural. Meat will give off odour and milk will curdle.

**SPOILAGE BY AUTOLYSIS**

The term autolysis means self-destruction and refers to the deteriorative changes originating from within the food system. Autolysis in food is caused primarily by the activity of enzyme.

**CHEMICALLY INDUCED AUTOLYSIS**

Deterioration in foods can occur from simple chemical reactions during storage, cooking and processing. This may results in the darkening of color in flavors, odour, and nutritive value.

1. **Auto-oxidation in oils and fats**

Short wavelength light initiates auto-oxidation in lipids, through the formation of lipids radicals, which leads to formation of peroxidase radicals. It begins with the uptake of oxygen. The breakdown of products of peroxidase are responsible for off flavor.

Dry foods such as milk powder, crisps and breakfast cereals are particularly susceptible to auto-oxidation.

1. **Changes in meat color**

Deteriorative oxidation results in off-color development in red meat exposed to oxygen. When the meat is exposed to oxygen the bright red color (due to myoglobin) is changes into brown color due to formation of metmyoglobin.

1. **Non-enzymatic browning**

Brown color changes can be noticed when some potato and apple varieties are cut and exposed to the air.

Non-enzymatic browning results from the reaction of carbonyl and free amino acid groups from reducing sugars and amino acids (maillard reaction), sugar degradation (caramelization), or form of oxidative degradation of ascorbic acid.

1. **Maillard reaction**

When carbonyl group of reducing sugars react with amino group of amino acids they form amino-sugars. These compounds ultimately polymerized to yield brown color melanoidins.

It occurs in foods that undergo substantial heat treatment during processing. It limits the shelf life of various fruits, vegetables, citrus products and juices.

1. **Caramelization**

When sugars are heated under controlled conditions in the absence of water, they form anhydro-sugars that readily polymerize to give taint brown pigment, called caramel. Caramels are responsible for the desirable brown color of bread crust, sweets, toffees, some beverages and syrups.

**ENZYME INDUCED AUTOLYSIS**

Some enzyme induced activities such as the development of desirable flavor, color, and texture in fruits are beneficial.

1. **Enzymatic Rancidity**

When fats and oils develop off-flavor or taints generally referred to as rancidity. It is an enzyme mediated process. In this reaction lipase enzyme hydrolyzed the lipids into free fatty acids and glycerol. Sometimes this process is referred as hydrolytic rancidity.

 Fat + water free fatty acids + glycerol

Hydrolytic rancidity is a common phenomenon in oil extracted from wet seeds or in oil containing high residual water. It gives bad odour. Lipase enzyme hydrolyze triglycerides to give fatty acids. Short chain fatty acids are mainly responsible for taints, hence dairy products regularly suffer from rancidity.

1. **Enzymatic Browning**

Enzyme induced browning is a common phenomenon in potatoes, bananas, mushrooms, apples and many other fruits and vegetables because these contain polyphenols, the enzyme phenolase and, of course, oxygen is readily available in the environment.

A cut or injury to the cell is required to bring the substrate and enzyme together. This discoloration limits the shelf life of some minimally processed foods and also may be a problem in the production of dehydrated and frozen fruits and vegetables.

Traditionally, freshly peeled potatoes, apples, and similar food stuff are kept immersed under water to prevent enzymatic browning, since this keeps off oxygen which is essential for the reaction to proceed. This can also be prevent by using hot water or steam treatment, lowering the pH of food and also by using chemicals like citric acid etc.,