Food Spoilage, Packaging and Storage

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Food by nature is subject to deterioration either by chemical or microbial means. The ambient temperature in the Caribbean is ideal for rapid rate of both types of degradation. Once the "value added" product is manufactured, the shelf-life will be influenced by factors such as:

- nature of the product (nutritional composition)
- packaging
- temperature

In order to optimise the storage quality and extend shelf-life of fresh and value-added products, a clear understanding of the role of the following factors in food spoilage is important:

- chemical components in the food
- environmental conditions
- initial microbial load
- nature and types of micro-organisms present

CHEMICAL CONSTITUENTS

Deterioration may result from chemical reactions or interactions involving one or more of the macronutrients present in food and food products.

CARBOHYDRATES AND PROTEINS

Non-Enzymatic Browning

Interactions between reducing sugars present in foods and amino acids or proteins, upon heating, or during long-term storage result in brown coloured products. This is known as non-enzymatic browning or the Maillard reaction. It accounts for the difference in flavour and colour between fresh and heat processed foods, e.g., milk.

In addition to the off-colour and off-flavour in foods which undergo this type of deterioration, there is often nutrient loss associated with reduced bioavailability of amino acids (usually lysine) reacting with the sugar.

Caramelisation

When foods high in sugar are heated they tend to caramelise result-ing in a brown colour. The manufacture of browning is based on this reaction. Although caramelisation is expected to occur rapidly when sugars are heated at high temperatures, at temperatures above 10°C under certain conditions, caramelisation may still proceed causing deterioration of the food.

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Enzymatic Browning

The brown discoloration often observed in fresh, peeled or cut fruits such as bananas and apples and in dried fruits is due to the action of certain enzymes (phenolases) present on phenolic compounds such as tyrosine (an amino acid). This discoloration is only evident when the commodity is bruised, cut or peeled and exposed to the air. It detracts from the fresh, wholesome appearance of the fruits, vegetables and shellfish and may be minimised by addition of lime juice. Other acidulants such as citric acid may also be used as these agents serve to lower the pH below the level at which the enzyme can work. Other methods may involve the removal of oxygen from the package in which the product is packed. This may be achieved by vacuum packing or packing in brine or syrup.

FATS

Oxidation or Oxidative Rancidity

Fats in foods are susceptible to oxidation or rancidity resulting in off-flavours, off-odours and sometimes off-colours. Although for good health unsaturated fat is preferred to saturated fat, it is more prone to oxidation leading to undesirable changes in the food. Oxygen, certain metals such as copper and iron, and heat, are known to aid in this type of deterioration of fats and fatty foods. Exclusion of one or more of these factors may therefore lessen the risk of rancidity.

Foods often implicated include meats, fish and poultry. In addition, dried foods containing small amounts of fats (e.g., vegetables) and foods processed in oil are also susceptible to oxidative rancidity.

Hydrolytic (or Lipolytic) Rancidity

This type of rancidity is characterised by a distinctive undesirable odour and taste. It results from an enzymatic (lipase) hydrolysis of fat, splitting off short chain fatty acids. Raw milk is known to undergo lipolysis even with mere agitation, producing the typical "rancid milk flavour". Lipolysis also adversely affects the quality of cooking and frying fats resulting in the lowering of the smoke point (temperature at which smoke is noted) and causing increased fat absorption and cracked surfaces in fried foods.

VITAMIN C

Reaction of vitamin C (ascorbic acid) with oxygen initiates a series of complex reactions, which terminate in the same type of compounds as in the case of caramelised sugar. Fruits, juices, etc., containing ascorbic acid are therefore subject to browning in the presence of oxygen. Loss of vitamin C, which accompanies this type of browning reaction, is increased

at elevated temperatures. Over-processing of fruit juices should therefore be avoided at all cost.

ENVIRONMENTAL CONDITIONS

Whether foodstuff is fresh or processed, the rate of deterioration is influenced by the environment to which it is exposed. The environment may be the air in the package in which the product is packaged, or the room in which it is stored. The exposure of food to oxygen, light, or even small amounts of moisture can often act as the "trigger" to set off a series of deleterious chemical and/or microbial reactions.

PACKAGING AND STORAGE

Packaging essentially safeguards the food at the raw material and finished product stages, provid-ing protection against deleterious elements in the environment, in some cases light, oxygen and moisture. Selection of the appropriate packaging material for various products may be quite complex, involving knowledge of oxygen/water barrier systems, film thickness, and light penetration.

The type of packaging for both bulk and retail items is a key factor in ensuring that the preserved or processed food is protected. Therefore the packaging of food commodities in cans, jars, cartons, permeable and semi-permeable films or paper, serves to ensure food safety as well as preservation.

Intact packaging material is also important because it provides protection of the food from entry of micro-organisms and other contaminants such as dust, insect parts, and other extra-neous matter. It is therefore important in the canning process that cans are free from pinholes in the seams through which microbes may enter the product. They should be free from dust, and from bulges which could cause improper closure. All packaged pro-ducts, whether in glass, cartons, or other material, should be thoroughly sealed against post process contamination.

The proper storage of pre-processed as well as post-processed foods is a key factor in the shelf-life of the food. Raw materials should be properly stored before use in pro-cessing. Ripe fruits and vegetables should be kept in clean plastic crates in a cool area, when they are being held for processing. Dry ingredients such as spices should be stored in dry well ventilated areas. Packaged products should be placed in cartons and packed on pallets, (never directly on the floor), away from walls, to ensure effective placing of pest control baits in warehouses or holding areas.

Packages in storage should be checked periodically to ensure that they are still intact and spillage should be removed immediately and the area sanitised. Both raw materials and finished products should be rotated and used on a "first-in, first-out basis".

This will ensure that older materials are used up before fresh ones and finished products do not remain in storage beyond the stated shelf life. Packaging material such as cans, jars, lids, cartons, should all be kept in clean dry areas as free as possible from dust. The outer wrapping of these should not be removed until packaging material is ready for use in processing area.

All stored material should be labelled and dated and raw materials/ product slated for reworking or dumping, and finished products awaiting shipment should all be segregated in designated areas.