LECTURE 5

5.0 NON-ENZYMIC BROWNING OF FOODS

Browning that is not catalysed by enzyme. Three types exists:

- Maillard Reaction
- Caramelization
- Ascorbic Acid browning

5.1 MAILLARD REACTION

This type of browning involves reaction between sugars and amino acids (proteins). It occurs at high temperature. The reactions involved can be divided into 5 main steps:

- Condensation of sugars with amino compound.
- Rearrangement of condensation products (Amadori-rearrangement)
- Dehydration of rearrangement products leading to formation of furfural or its derivative (HMF).
- Degradation and fission reaction
- Polymerization of the products of degradation and fission into melanin/melanolin

5.1.1 **Application**

- Browning during food processing such as baking of bread, roasting of

5.2 ASCORBIC ACID BROWNING

Non enzymic browning phenomenon associated units fruit juices and concentrated especially discolouration of citrus products.

- Ascorbic acid browning can occur in the presence or absence of amino acids.
- Although mechanism of reaction is not very clear, it involves oxidation of Ascorbic acid in the presence of air to dehydroascorbic acid and subsequently to 2, 3-diketogulonic acid.
- The presence of oxygen tends to intensify colour formation until it reaches a maximum and then colour formation decreases in the presence of excess oxygen as if oxygen had a bleaching effect on the pigment formed.
- Among the intermediates identified:
    - furfural
    - 2-furoic acid
    - Threonic acid

- Oxalic acid
- L-erythro-pentosulose
- Carbon dioxide

5.3 CARAMELIZATION

- Browning reactions of sugars in the absence of amino acids and at high temperatures >100^{o}C. This temperature is higher than temperatures at which maillard reactions occur. It is otherwise called pyrolysis of sugars.
- Pyrolysis usually lead to formation of brown colour and characteristic flavours.
- It may be intentional or incidental during food processing.
- Catalysts.

  Caramelization is catalysed by phosphates, alkalis, acids and salts of carboxylic acids of citrate, fumarate, tartarate and malate.
- Mechanism of reaction not totally clear but may be similar to that of sugar-amino browning and could involve:
  - Enolization
  - Dehydration
  - Fission

  Leading to formation of Hydroxy- furfural (HMF).

5.4 NUTRITIONAL EFFECT OF BROWNING

- Irreversible binding of amino acids into complex pigments
- Destruction of amino acids through strecker degradation.

5.5 PRACTICAL PREVENTION OF BBROWNING

- Refrigeration
- Use of chemicals e.g. SO_2
- Low pH
- Lowering concentration
- Use of sucrose
- Fermentation