

# **BROWNING REACTIONS: ENZYMATIC AND NON-ENZYMATIC REACTION**



# INTRODUCTION

- Browning is a common colour change seen in food during pre-preparation, processing or storage of food.
- It occurs in varying degrees in some foods. The colour produced range from cream or pale yellow to dark brown or black.
- Browning reactions observed in food may be classified as enzymatic browning or non-enzymatic browning.



# ENZYMATIC BROWNING REACTION

- Enzymatic oxidative Browning When certain fruits and vegetables are cut or bruised, the tissue expose to the air quickly darkens.
- By the time the tissue is exposed to oxygen, phenolic enzymes (phenolases) bring about oxidation of the phenols in the food and brown or grey black pigments called melanines



# PHENOLAGE

- Phenolases are found in many plants with especially high amount in potatoes mushrooms, peaches, banana, avocado and tea leaves.
- However, the browning that occurs in tea leaves is beneficial as it imparts their characteristic colour.
- The term tannin describes the polyphenolic compounds that participate in enzymatic browning and also contributes to an astringent flavor.



# METHODS USED TO DETER ENZYMATIC BROWNING

## ○ **Maintaining an acid pH**

- An acid pH will retard browning reactions because the activity of the phenoloxidase enzyme is highest at a pH of 7 and diminishes as the pH decreases below 4.
- The lack of activity of this enzyme is seen in fruits that are very acidic such as oranges and grapefruits. This fruits do not undergo enzymatic browning.
- Cut fruits may be dipped in acid solution such as lemon juice and orange juice



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### ○ **Use of sulphur**

- Sulphur is a chemical commonly used to prevent the darkening of foods.
- Pineapple juice is high in sulphur compounds and browning is retarded in cut fruits dipped in this juice.
- Dried fruits such as apricots and golden raisins, that might turn to unappetizing brown colour are routinely dipped in a sulphur solution or exposed to sulphur fumes as a processing aid to prevent colour changes.
- Cut lettuce for salad are dipped in a sulphur solution to retard browning



- **Reducing contact with oxygen**

- This is normally done by coating fruits with sugar or immersing them in sugar solutions.

- **Antioxidants**

- Antioxidants, such as ascorbic acid are also effective in reducing browning
- Ascorbic acid is found in citrus fruit juices and is available as a commercial product that is sprinkled on the fruit.



- Denaturing the enzyme by blanching. Blanching is an effective means of controlling browning.
- Rapidly heating foods by dipping briefly in boiling water will destroy or denature the phenolase enzymes responsible for the reaction with the polyphenolic compounds.
- This destruction of enzymes allows frozen foods to retain their colour for a longer period of time.
- Blanching treatment is done mostly in vegetables such as amaranths, spinach etc. However, blanching is not a good method for retarding browning in fruits to be eaten fresh as it tends to make them mushy and changes their flavor.





# NON ENZYMATIC BROWNING

- Non Enzymatic browning: in which no enzymes are involved to bring about the colour changes
  - (i) Caramelization
  - (ii) Maillard browning
- The non enzymatic reactions usually involve sugar or related compounds. The browning reactions produce changes in colour and flavour that are often desirable, as in the crust of bread or undesirable, as in the discoloration of dried milk products.



# CARAMELIZATION

- Caramelization or sugar browning occurs when any of the different types of sugars are heated over their melting points.
- When heated, granulated sugar will melt at approximately 160°C with continued heating the melted sugar will gradually turn brown to form Caramelized sugar.



# MAILLARD BROWNING

- The Maillard browning reaction is the reaction of the carbonyl group of a reducing sugar and an amino acid or amino group of a protein or peptide.
- The initial step is a condensation reaction that removes a molecule of water. Glucose reacts with an amino group (usually a protein) to produce a glycosylamine.
- Glycosylamine subsequently undergoes the Amadori rearrangement to form a Ketone ( $-C=O$ ) derivative that can be fragmented and polymerized into brown pigments called Melanoidins.
- This reaction can occur also at room temperature but it is accelerated with high temperatures increasing alkalinity (high pH) and low moisture content



Thank You

