Introduction to Food Process technology

ACTIVITY

A workshop with breakaway groups is provided for, rather than practical work or demonstrations, due to the nature of the information covered in the module. The participants are divided into groups of four. Each group will discuss the problems outlined below.

Drying of foods

The following is a process for the drying of sliced cabbage.

```
Cabbage
  Sort
  Clean off outer leaves
  Cut out central stalk
  Slice cabbage
  Wash strips
  Blanch in boiling water (4 minutes)
  Cool
  Spread out
  Dry (@ 60 °C for 12 hours)
  Cool and equilibrate moisture
  Packaging
```

Problems

The following problems are identified during drying or in the dried product. Discuss them and identify the possible cause(s) and solutions.

1. The dried product has spots and marks.
2. The product has mould growing on it.
3. The product takes long to dry.
4. The dried product looses colour or browns quickly after drying or during storage.

<table>
<thead>
<tr>
<th>Problem</th>
<th>Cause(s)</th>
<th>Solution(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spots and marks</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mould growth</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Long drying time</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Colour loss/browning</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Possible answers**

<table>
<thead>
<tr>
<th>Problem</th>
<th>Cause(s)</th>
<th>Solution(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spots and marks</td>
<td>Raw material not well selected</td>
<td>Use only good material</td>
</tr>
<tr>
<td></td>
<td>External contamination with foreign material</td>
<td>Prevent contamination through covering</td>
</tr>
<tr>
<td>Issue</td>
<td>Cause</td>
<td>Prevention</td>
</tr>
<tr>
<td>---------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Insect infestation</td>
<td>Prevent access to insects</td>
<td></td>
</tr>
<tr>
<td>Mould growth</td>
<td>Product not completely dried</td>
<td>Dry product until crisp</td>
</tr>
<tr>
<td>Wet spots on dry product</td>
<td></td>
<td>Equilibrate moisture in dried product</td>
</tr>
<tr>
<td>Dried product got wet</td>
<td></td>
<td>Packaging must prevent moisture uptake; prevent moisture getting to product during storage</td>
</tr>
<tr>
<td>Long drying time</td>
<td>Temperature too low</td>
<td>Moisture movement out of product not fast enough</td>
</tr>
<tr>
<td></td>
<td>Temperature too high</td>
<td>Moisture removed too fast from surface leading to case hardening; prevents further fast removal of water</td>
</tr>
<tr>
<td></td>
<td>Humidity of air too high</td>
<td>Facilitate removal of moisture from area surrounding product</td>
</tr>
<tr>
<td></td>
<td>Product spread too thick</td>
<td>Reduce thickness of product layer</td>
</tr>
<tr>
<td>Colour loss/browning</td>
<td>Active enzymes remaining</td>
<td>Improper blanching, increase time and/or temperature</td>
</tr>
<tr>
<td></td>
<td>Too high storage temperature</td>
<td>Reduce temperature</td>
</tr>
</tbody>
</table>

1.2 **Frying of foods**

A packet of potato crisps is opened and the crisps have an unacceptable odour
(rancid) and colour (dark brown). Identify the possible causes of this and how these can be prevented.

<table>
<thead>
<tr>
<th>Problem</th>
<th>Cause(s)</th>
<th>Solution(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Off flavour</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brown colour</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Possible Answers
## Problem | Cause(s) | Solution(s)
---|---|---
Off flavour | Abused frying oil | Always use sufficiently fresh and high quality oil
| Oxidised oil | Packaging is too permeable to oxygen; use packaging with higher barrier properties
Brown colour | Too high frying temperature | Reduce frying temperature
| Potatoes too high in sugars | Buy correctly stored potatoes*

### 2 MATERIAL IN NATIONAL CONTEXT

The following products and processes are linked to specific SADC countries and can be used as examples of specific processing technologies as covered in the training material. Some of the processing technologies used during their manufacture are given in brackets.

1. (Steamed) bread (baking)
2. Mango achar (preprocessing, mixing)
3. Maize, sorghum, millet milling (size reduction)
4. Peanut processing (separating, roasting)
5. Coconut drying and shredding (dehydration, size reduction)
6. Oil processing (separating)
7. Drying of fruits, fish, vegetables, e.g. sundrying of tomatoes (dehydration)
8. Pickling of vegetables (addition of acids)
9. Pineapple processing (separation, pasteurisation)
10. Beverage production, e.g. fruit juices, beer from sweet potatoes, sorghum (addition of acids, natural)
11. Dairy processing, e.g. amazi (addition of natural acids, pasteurisation)
QUESTIONS AND ANSWERS ON THE MODULE

Why is it important to preserve foods?
A: To enable to keep food in a nutritious and safe state for consumption by people who cannot grow their own food and during times when the food is not readily available.

Name three groups of reactions or organisms which can negatively affect the safety of foods.
A: Micro organisms, chemical and biochemical reactions.

Are the influences of the groups mentioned in (ii) always negative? If not, identify at least one product in each group where the reaction has a positive influence on the food.

List at least seven processing methods that can be used to preserve foods.
A: Heating, drying, freezing, sugaring/salting, acidification, smoking, chemicals

Discuss when and how foods can become contaminated with microorganisms.
A: How: during harvesting, slaughtering, preparation for processing, after processing. How: from air, water, hands, surfaces, soil, the outside of the product.

Give an example of a biochemical reaction which can be beneficial to a food, but which will decrease food quality when left to continue too far.
A: Ripening of fruit, aging of meat
**Why must raw materials and food products be handled carefully?**

A: To prevent damage, loss of moisture, growth of microorganisms, deterioration through chemical and biochemical reactions.

**Why are foods cleaned? List at least three methods for cleaning?**

A: Foods are cleaned to reduce microbial load and remove foreign material. Cleaning can be done by washing, brushing, steam, high velocity air, vacuum, magnetic removal of metals.

**What does separation of foods entail and give an example of each?**

A: The removal of a solid from a solid, e.g. skins from fruit or shells from nuts, the removal of solids from liquids or the other way round (filtration of juice or preparation of juice) or removal of air from a liquid (e.g. the removal of air from juice by vacuum).

**What is disintegration of foods and give examples?**

A: The reduction of large pieces of foods into smaller particles. Examples: milling of grains, pulping of fruit, reduction of oil droplets through high speed mixing, dicing of vegetables, cutting of meat.

**Give three examples of mixing of foods.**

A: The preparation of dough, the flavouring of milk, the addition of sugar to juice, the beating of egg white.

**Name four degrees of heat preservation and explain the differences.**

A: Sterilisation (the complete destruction of micro organisms through heat), commercial sterilisation (The destruction of all harmful and other micro organisms to such an extent that any remaining organisms will not grow during storage), pasteurisation (the destruction of micro organisms through
milder heat treatment, such that known pathogens are destroyed and will not grow during subsequent storage, but other harmless micro organisms will spoil food after a certain period of time), blanching (a mild heat treatment applied mostly to fruits and vegetables to destroy enzymes)

**How are heat treatments selected?**
A: By determining the time and temperature combination required to inactivate the most resistant pathogens and spoilage organisms and by determining the heat penetration characteristic of the food.

**Name the three heating mechanisms of foods and explain the difference.**
A: Conduction: heating of food where the heat is transferred from one particle to another in a straight line in solid foods, e.g. meat; convection: heating of food through the movement of the food, e.g. a liquid; radiation: heating of food through transfer of heat by waves.

**Which grain is best suited to make flour and how does its composition influence the baking of bread?**
A: Wheat is the only flour whose protein component, together with the correct amount of water, develops into an elastic network which can hold gas and set in a spongy texture in an oven.

**Which three characteristics influence the suitability of wheat to form bread flour?**
A: The variety of wheat, the protein content of the flour and the milling conditions.

**What is the purpose of the milling process and how is this normally done?**
A: To separate the wheat endosperm (source of flour) from the germ and the bran and to reduce the endosperm chunks to fine powder. This is achieved
by passing the wheat kernels through a series of rollers and sieves. The various streams from different sieves can be combined by the miller to yield different flours.

**Name the four ingredients that will produce a basic loaf of bread.**

A: Wheat flour; salt; yeast; water.

**Which types of leavening agents are used and what are their function(s)?**

A: Yeast or chemical agents. They form gas either through fermentation of sugars (yeast) or chemical reactions (chemical agents) which become trapped in the gluten (protein) network and result in the rising of the dough.

**Why are other ingredients added to the flour?**

A: As food for the yeast, to improve dough formation, to improve dough handling, to retard retrogradation (ageing) of bread

**What are the roles of the following ingredients in bread?**

a) **Fat or oil**

b) **Milk**

c) **Other cereal grains**

A:  

a) To improve flavour and to help slow down the staling process

b) To produce a bread with a softer texture (instead of, or in combination with water)

c) To produce breads with different tastes and textures

**List the three important steps in baking of bread and give a short discussion of each.**

A: Mixing: to affect uniform distribution of all ingredients, to introduce air bubbles, to develop the gluten structure; leavening: to allow time for gas
formation and fixation, more important in the case of yeast; baking: expansion, coagulation of proteins, gelatinisation of starch, evaporation of water, browning of the crust and flavour development.

**Name any two savoury ingredients that may be added to bread.**
A: Cheese, fried onions, dried tomatoes, herbs.

**Name any two sweet ingredients that may be added to bread.**
A: Sugar, cinnamon, dried fruit.

**How does frying differ from other heat processing methods?**
A: Cooking of product is achieved in a short period of time due to large temperature differences between oil and product as well as small product particle sizes; frying fat or oil is taken up by the product and becomes a significant part of it; the outer layer of the fried product is crisp; the heat transfer medium, i.e. fat, is subject to quality changes (deterioration); mechanical problems of frying large masses of products need to be overcome.

**Describe the physical changes which occur in foods during frying.**
A: Water evaporates from the product and is partly replaced by oil; the temperature of the product rises to the desired temperature; the surface of the product is dried and heated so that desired browning and crisping can occur; the dimensions of the fried product change; part of the fat is removed from the frying system with the food; the removed fat must be replaced; the product changes in density during frying and either floats or stays submerged.

**Which four general factors affect oil uptake in the fried product?**
A: Frying temperature, frying time, product (dough) viscosity, fat source.
Which visible changes that may occur in oil, indicate that the oil must be discarded?
A: Discolouration from yellow to brown/black; excessive foaming of the hot oil; excessive smoking of the hot oil; thickening of the oil, i.e. no longer pours easily, but becomes viscous.

List the factors that may lead to oxidation of cooking oils.
A: Presence of oxygen; high frying temperatures; long frying times; repeated heating; presence of moisture; cooking both proteinaceous and starchy foods in the same oil; type of heating method used (e.g. gas or electricity); type of oil used (e.g. sunflower, olive, etc).

Explain the difference between chilling and freezing.
A: Chilling refers to storage of food at temperature above freezing point (usually between –0 °C and 16 °C) whereas freezing is the storage of food below -2°C. Food usually only freezes at –2 °C and not like pure water at 0 °C.

Which of the two methods provides the longer shelf-life?
A: Freezing

Why should raw materials preferably be transported and stored at chilling temperatures, i.e. what are some advantages of chilling?
A: Chilling reduces microbiological and biochemical changes and thus preserves the quality and safety of the food

What are the most important (principal) requirements of refrigerated storage?
A: Controlled low temperature, air circulation, humidity control.

What is the advantage of freezing?
A: Most deteriorative reactions are stopped or very slow during freezing and thus a frozen food can be preserved without large changes to size, shape, texture, colour and flavour.

**Name three changes each which occur during a) chilling and b) freezing, which can influence the quality of the food.**

A: **Chilling:** feeding of animals and growth conditions of plants will influence the keeping quality of meat and fruit respectively, low temperatures can cause refrigeration damage to certain fruits and vegetables, flavours can be exchanged between different foods during storage, fruit and vegetables can loss firmness and crispness, meat can change colour and lose moisture, fats can become rancid.

**Freezing:** partially frozen food will deteriorate because solutes become concentrated and can, e.g. cause negative colour reactions, ice crystal formation can cause damage to cells and result in high drip loss during thawing, specific foods must be stored at certain freezing temperatures for optimum shelf-life, intermittent thawing and freezing can result in loss of moisture (drying out), loss of texture and even microbial growth, which negatively affects safety and quality of the product.

**Name five objectives for using salt in foods.**

A: Flavouring ingredient, preservative, texturising agent, active processing ingredient, enhancer of anti-oxidants, quality grading, reduction of freezing point

**Name two examples each of natural, fermentation and synthetic acids.**

A: Natural: lemon juice, tartaric acid; fermentation: citric acid, vinegar, (lactic acid); synthetic: phosphoric, acetic, (malic).

**List ten functions of acids in food processing.**
A: Depress sweetness, clarify and stabilize fruit juices, control rate of thermal destruction of micro organisms and enzymes, influence the properties of colloidal systems, scavenge harmful metals, make possible the utilisation of micro organisms and enzymes, improve texture, inversion of sucrose, prevent flavour reversion of edible oils, increase flavour intensity, aid extraction of pectins and pigments, increase effectiveness of benzoate (preservative), stabilise ascorbic acid.

**What is the relation between acid level and pH?**
A: The higher the acid level, the lower the pH and vice versa

**Describe the use of acid in a food product of your choice**
A: (Choose product from fruit, vegetables, dairy, meat, soft drink, confectionery, deserts, aspic, baking, etc. See Fundamentals of Food Processing Operations from pp159-166)

**List the eight effects of smoking on meat**
A: Drying, fixing colour, tenderising action from temperature, creation of gloss or finish, desirable flavour, imparting of antioxidants to the fat, imparting of preservatives to the product, reduction of microbial level.

**Name four methods to apply smoke to meat.**
A: Through burning of wood (hot smoke), electrostatic deposition, cold smoke and liquid smoke.

**List ten general requirements for food containers.**
A: Non toxic and compatible with the specific food; sanitary protection; moisture and fat protection; gas and odour protection; light protection; resistance to impact; transparency; tamper-resistant or -evident; ease of opening; pouring features; reseal features; ease of disposal; size, shape and weight limitations; appearance, printability; low cost; special features.
**What is a hermetic closure?**
A: A seal which is absolutely impermeable to gases and vapours or other components, including the seams.

**List the various packaging materials and discuss the features of one of them.**
A: Metals, glass, papers, plastics and films, laminates, edible films. E.g. glass: chemically inert, breakable, heavy, sensitivity to thermal shock, can be coated.

**What are some benefits of packaging?**
A: Physical protection of the product, convenience, advertising, appealing to the eye, shelf-life extension, prevents recontamination, prevents loss of flavour and colour.