GRINDS360°

HOME ECONOMICS

FOOD SPOILAGE/ PRESERVATION (DOMESTIC)

SANDRA CLEARY

FOOD SPOILAGE/PRESERVATION (DOMESTIC) - 1.3.9

- Spoilage of food may result because of the following:

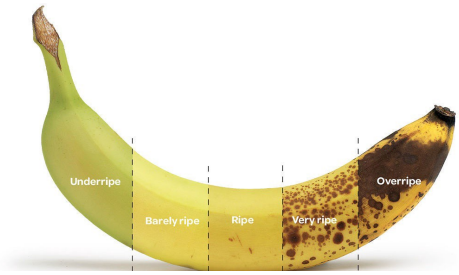
ACTION OF ENZYMES

- Enzymes are complex chemical substances which control essential metabolic processes in digestion (animal enzymes). Enzymes are also present in food. They cause spoilage.

A: RIPENING OF FRUIT/VEGETABLES

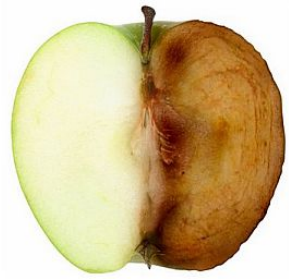
- Enzymes in fruit and vegetables are still active after harvest and cause fruit to ripen (eg) : Green Bananas → Yellow Bananas. However, these same enzymes will eventually bring about decay (eg) : Black/Brown Bananas.

Ripening Process →



B: BROWNING OF FRUIT/VEGETABLES

- When fruit and vegetables are cut, the cells are ruptured and the enzyme oxidase is released, this enzyme reacts with O_2 in the air and browning results (eg) : Brown Apples.



← Result of Browning

C: HYDROLYTIC RANCIDITY

- Some foods may spoil in the freezer as enzymes present in the food can still work at -18°C which us unusual.
- Bacon, Rashers, Oily Fish (lipid foods) can spoil in the freezer as a result of hydrolytic rancidity.
- Lipids in the food react with enzymes, bacteria and moisture also present to cause this spoilage.

D: ENZYMES IN FRUIT/VEGETABLES

- Enzymes in Fruit/Vegetables can spoil them in the freezer.

CONTROLLING ENZYMATIC SPOILAGE

- **Blanch Fruit/Vegetables before freezing** (eg) : plunge chopped carrots into boiling water for 3 minutes or peas for 1 minute (known as blanching). Then refresh the vegetables in ice cold water which stops the cooking process. This inactivates (denatures) enzymes and prevents spoilage in the freezer.

- **Acid** : Add lemon/lime juice or alcohol to fruit salad, avocado (guacamole). The acidic pH prevents the action of oxidase so browning is prevented.

- Heat : Stewing fruit (eg) : stewed apple will inactivate enzymes.

- **SO_2 E220 (Sulphur Dioxide)** : can be used to prevent enzymatic browning in frozen chips and fruit juices (eg) : Fruice, Zqueeze.
  Note : E200's – Preservatives
- **Low Temperatures** : for fruit and vegetables as they are transported from one country to another in ships can slow down ripening/decay of fruit and vegetable.

HW → 2011 Q1(B) HIGHER LEVEL (12 MARKS) 3 @ 5 Marks Each

(a) Discuss the causes of food spoilage in relation to the action of enzymes. **(15)**

NB : JAM MAKING

(b) Name **one** method of home preservation that involves the application of heat **and** explain the principle involved. **(16)**

NAME : (4M)

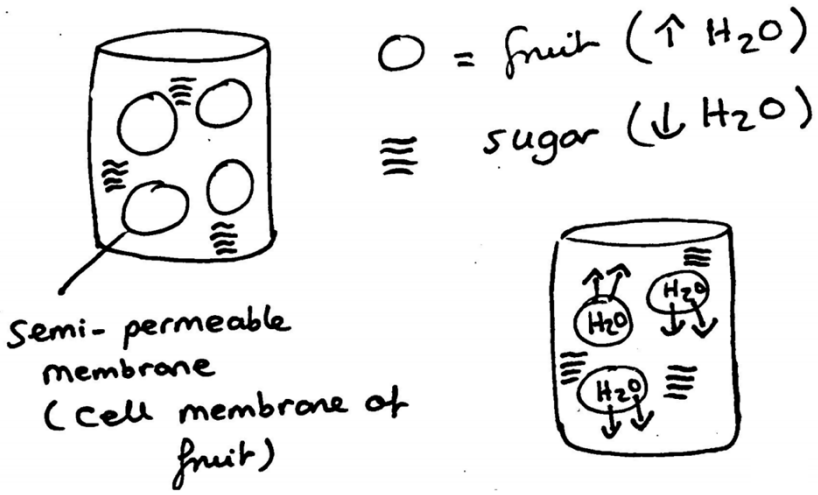
- Jam Making

UNDERLYING PRINCIPLE :

- The underlying principle of all methods of food preservation is to remove one or more of the conditions necessary for growth (ie) : Food, Warmth, Moisture, Correct pH, Correct O_2 Level.
- The underlying principle of Jam Making involves removing :
  - 1 : Moisture.
  - 2 : Warmth.
  - 3 : pH.

1) REMOVAL OF WATER BY OSMOSIS (4M)

- Osmosis is the movement of water from an area of high concentration to an area of low concentration across a semi-permeable membrane.



- **NOTE** : Water moves from inside fruit cell to outside therefore no moisture present for microbial growth.

2) WARMTH IS AFFECTED (4M)

- Fruit is boiled in jam making @ 104°C to soften it and destroy micro-organisms present on the fruit (eg) : yeast and mould. The heat also inactivates (denatures) enzymes in fruit which could cause decay in storage.

3) pH IS AFFECTED (4M)

- When making jam, 1:1 ratio is used (ie) : fruit and sugar are used in equal quantities. Sugar is a sweet, acidic, crystalline substance.
- The acidic pH of sugar upsets the growth of micro-organisms.
- **Note** : a minimum of 65% sugar concentration is essential to prevent microbial growth.

Note : To make a good 'well set' jam, sugar, pectin and an acid (if fruit is low in pectin) (ie) : lemon juice, will be needed.

CRYSTALLISATION

- Crystallisation usually occurs due to over concentration of sugar.
- In jam making, this should be avoided, it can happen if the fruit to sugar ratio is greater than 1:1.
- Crystallisation is desirable in some foods (eg) : making fudge, where more sugar is present in the fudge mixture than the surrounding liquid (evaporated milk) can absorb, therefore crystals form.

CAUSES OF FOOD SPOILAGE

1) LOSS OF MOISTURE

- During respiration in fruit and vegetables, water is lost into the atmosphere via their skins but this water is replaced by water absorbed through their roots.
- When Fruit/Vegetables are harvested, they continue to lose water but this time it is not replaced. As a result, skin becomes wrinkled, salad greens go limp, rhubarb begins to bend.
- Water is also lost from the surface of food when it is exposed to air (eg) : fresh meat, fish, cheese, bread etc

2) ACTION OF MICRO-ORGANISMS

- Food spoilage can also occur due to :
  - **Bacteria** (Fish, Milk etc.)
  - **Yeast** (Jam)
  - **Mould** (Bread etc.)

(See handouts on mould, yeast and bacteria for greater detail)

3) ACTION OF ENZYMES

- Due to overipening and hydrolytic rancidity (see page 1 of this handout for detail).

4) INCORRECT STORAGE TEMPERATURE

- E.g. milk will go sour if unrefrigerated, bacteria will multiply in food if not refrigerated at 3 degrees centigrade.

5) PHYSICAL DAMAGE OF FOOD

- E.g. fruit may be bruised if not transported carefully, fruit may be damaged from adjacent plants on a tree.

NOTE: SEE SAMPLE ANSWER ON CAUSES OF FOOD SPOILAGE IN EXAM QUESTION BOOKLET.

PRESERVATION (HOME)

Functions :

a. To reduce waste.
b. Less expensive than commercially preserved foods (in most cases)
c. Provides variety in the diet (eg) : Chutneys, Jams.
d. Free of artificial preservatives.

PRESERVATION

- The object of preservation is to take food at it's point of maximum palatability and nutritive value and keep it at this stage, instead of allowing it to undergo natural changes which make it unfit for consumption.
- These changes can be brought about by the action of enzymes in foods and microbial activity on food.

METHODS OF PRESERVATION

1) Heat Treatments (eg) : Jam Making, Bottling, Canning.
2) Addition of Chemicals (eg) : Vinegar, Sugar, Salt.
3) Removal of one or more Microbial Conditions (eg) : removal of O_2 in vacuum packing, removal of moisture in freezing.
4) Irradiation (eg) : using rays of Caesium Cobalt.
5) Fermentation (eg) : Altering the state of the food (ie) : Grapes to Wine. Alcohol is a preservative. Wine can last for many years.

NB: UNDERLYING PRINCIPLE OF PRESERVATION

- In Domestic preservation and most methods of commercial preservation, the underlying principle of preservation is: to remove one or more of the condition necessary for microbial growth
  - Food.
  - Warmth.
  - Moisture.
  - O_2 Level.
  - pH.

DRYING

- (eg) : Breakfast Cereals, Packet Soups (removal of water)

FREEZING

- Removal of water and altering warmth.

PICKLING

- Removal of water (Osmosis)
- Acidic pH.

CHUTNEYS

- Same as above.
- Plus, boiling Chutney (100°C)
-

CANNING/COMMERCIAL BOTTLING

- Removal of O_2.
- Heat is altered.
- Sometimes pH.

JAM MAKING

- Boiling @ 104°C.
- Acidic pH (Sugar)
- Removal of water (Osmosis)

- Jam will only set if there are sufficient quantities of :
  - Pectin.
  - Acid.
  - Sugar.

1) PECTIN

- Non Starch Polysaccharide.
- Found in the outer walls of **Ripe Fruit**.
- Gelling agent which helps jam to set.
- Acid (eg) : Lemon Juice can draw out Pectin from the walls of fruit (eg) : Strawberries.
- Excellent sources of Pectin are cooking apples, lemons, blackcurrants, gooseberries.
- Medium sources of Pectin are apricots, **plums**, **raspberries**.
- Poor sources are **rhubarb**, **strawberries** and cherries.
- Commercial Pectin is sometimes used when fruit has a low Pectin content (eg) :
    - Sureset Sugar (Sugar + Pectin)
    - 'Certo' → Liquid Protein.

2) ACID

- Acid (eg) : Lemon Juice/Citric Acid is added to fruit :
    - To help extract natural Pectin from fruit.
    - To improve the flavour of fruits lacking in acid.
- **Note** : Allow 30ml of lemon juice to 2kg of fruit with poor setting qualities.
    - **Example** → 2kg strawberries, 2kg sugar, 2tbsp lemon juice.

3) SUGAR

- At least 65% sugar concentration must be used, minimum 650g sugar to 1000g fruit.
- Usually 1 : 1 ratio, fruit : sugar.
- Sugar acts as a preservative.
- Affects the setting quality of jam.
- **Too little sugar (less than 65%)** → Fermentation may occur, poor set, mouldy jam.
- **Too much sugar (more than 1:1 ratio)** → Dark sticky jam, crystallisation.

RULES FOR MAKING JAM

- Always use a heavy based saucepan to prevent the jam from burning.
- Rub a little butter inside the base of the saucepan. This helps reduce the amount of scum formed.
- Always use fruit that is just ripe (high in Pectin)
- Always dissolve sugar gently before boiling jam otherwise crystallisation will take place.
- Use at least 65% sugar concentration otherwise jam will go mouldy/poor set.

- Always preheat glass jars in an oven (use a 'false bottom' like cardboard) before filling with hot jam otherwise glass will shatter.
- Jam which contains fruit pieces should be poured into a tilted jam jar to prevent fruit from floating to the top.
- Always allow the jam jars to cool down before placing damp cellophane over the top of the jar.
- Place the waxed side of the wax disc on to the hot jam.
- Jam jars should be spotlessly clean without any chips or cracks.

TESTS FOR SETTING POINT

A: COLD PLATE TEST

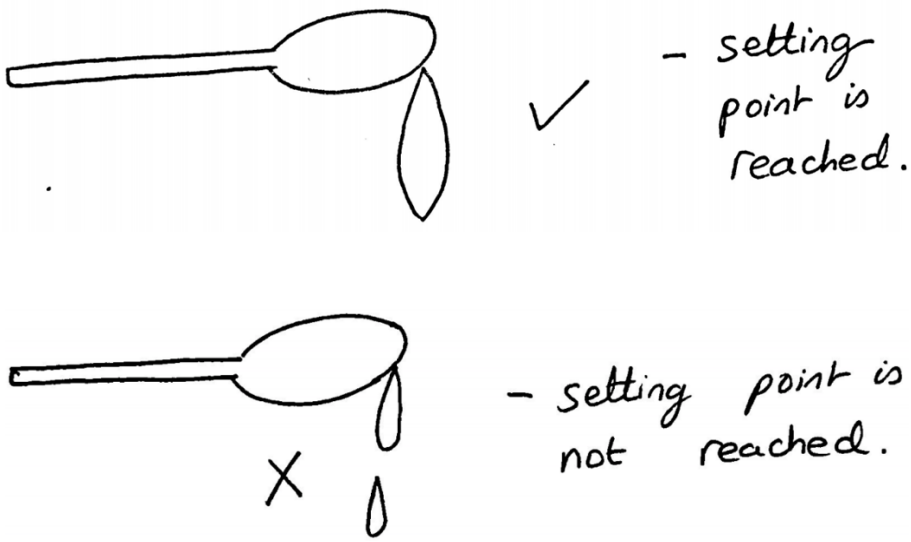
- Put 1 teaspoon of jam on a cold plate. When setting point has been reached, the surface of the jam will wrinkle when pushed with a finger.

B: TEMPERATURE TEST

- Place a sugar thermometer in the boiling jam. If the temperature reaches 104°C, the setting point is reached.

C : FLAKE TEST

- Take a spoon of jam out of the saucepan. If the jam falls from the spoon in a broad flake ..



POSSIBLE PROBLEMS IN JAM MAKING

- Too little sugar (less than 65% sugar concentration) → jam will not set.
- Glass jars may shatter if not preheated.
- Crystallisation may occur if sugar is not dissolved before boiling.
- Fruit will float to the top if the jar is not tilted at a 45° angle when pouring in jam.
- Scum will form if butter is not rubbed on the base of the saucepan.
- A vacuum will form if cellophane is placed on hot jam jars.
- Overboiling jam darkens colour and results in a sticky jam.

REVISION – CARBOHYDRATE HANDOUT

INVERSION

- Occurs during jam making. Sucrose (disaccharide) in sugar is split into glucose and fructose (invert sugar) when heat, sugar and acid combine.
- The presence of invert sugar in jam ensures jam will be in a smooth gel and crystallisation will be prevented.

CRYSTALLISATION

- Crystallisation is generally due to over concentration of sugar. Sugar heated with acid, invert sugar is produced. Too little acid and short cooking time of fruit and sugar on their own → crystals will form (usually the shape of granulated sugar crystals)
- Too much acid, sugar and fruit cooked on their own too long → long needle shaped crystals.

PACKAGING MATERIALS IN JAM MAKING

GLASS JARS

- Sterile.
- All labels removed.
- No cracks or chips.

WAX DISCS

- Placed 'waxed' side down on hot jam.
- Forms a seal.

CELLOPHANE

- Usually dampened before being stretched over top of cool jam.

RUBBER BANDS

- To hold cellophane in place.
- Do not use very old rubber bands as they perish.

LABELS

- Stuck on to the outside of jar with type of jam and date made.

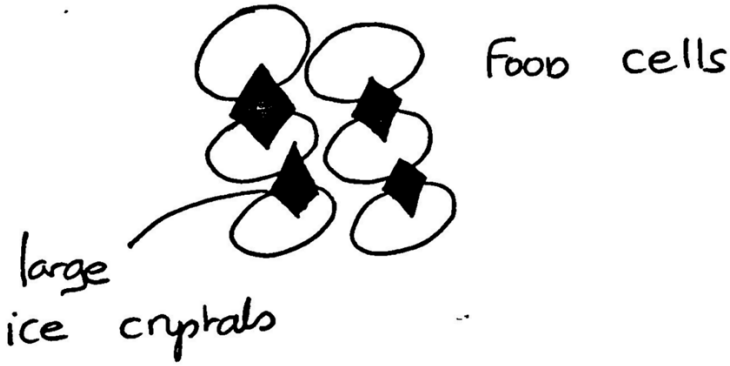
METHOD OF PRESERVATION: FREEZING

UNDERLYING PRINCIPLE

- Enzymes and micro-organisms are inactivated by extreme cold (-18°C)
- Ice crystals replace water so there is no water available for microbe's metabolism.

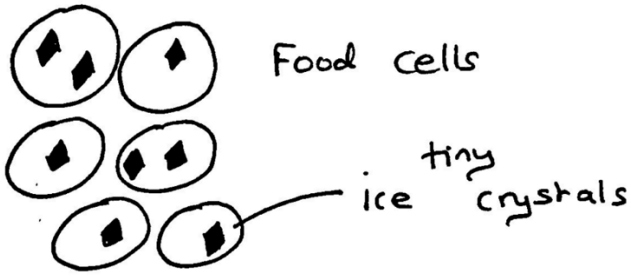
A: SLOW FREEZING

- Slow freezing -18°C, large crystals are formed which can break/rupture cell walls on thawing, reducing the quality of the texture and allowing nutrients to escape.



B: SLOW FREEZING

- Fast freezing -25°C (home), -30°C → 33°C (commercial)
- Tiny ice crystals are formed within the food cells. They melt during thawing and no cell damage is done.



Note: Only 1/10th of a freezer's capacity can only be filled with fresh food, otherwise the temperature will rise and slow freezing takes place (within 24 hours)

- Short term cold storage 3°C - 5°C (ie) : a refrigerator.
- When food is frozen @ -25°C, the temperature is reduced to -18°C for storage (saves electricity)

SUITABLE FOODS FOR FREEZING

- Raw and cooked meats/fish.
- Fresh fruit and vegetables.
- Reheated foods (eg) : Lasagne, Shepherd's Pie.
- Baked foods (ie) : bread/cakes.
- Uncooked dough and pastry.
- Sauces, soups, stews, pancakes.
- Puddings and cold sweets.
- Advance cooking for parties.
- Breadcrumbs/stuffing.
- Prepared baby foods.

UNSUITABLE FOODS	REASONS
Bananas	Go black
Lettuce/cucumber/salad greens	They go limp
Milk, cream, yoghurt	Separate
Mayonnaise	Separates
Whole eggs	They expand and shell breaks
Whole tomatoes	They expand and burst
Whole melon and pears	Texture goes mushy
Whole potatoes	Go black

FREEZER BURN

- Toughening and discolouration of food when exposed to ice in the deep freeze.
- Caused by tear in packaging.
- Usually occurs on protein foods (eg) : meat and fish.

ADVANTAGES OF FREEZING

- Simple, safe method of preservation.
- Much waste is avoided.
- Useful in emergencies.
- Bulk cooking and freezing saves time, fuel and increases leisure time.
- **Best method** of preservation as foods retain colour, flavour, texture and nutritive value.
- Provides a greater variety of food in the diet.

DISADVANTAGES OF FREEZING

- Initial cost of buying a freezer.
- Cost of packaging.
- Maintaining the freezer.
- Bulk cooking takes up a lot of time.

FRUIT (FREEZING)

Fresh fruit, especially soft fruits – raspberries, blackcurrants etc. freeze very well and require little preparation before freezing. Since their harvesting season is confined to just a few weeks in summer, freezing enables you to enjoy delicious soft fruits at any time of the year.

The general rule for freezing soft fruit is to pick it on a dry day, when just ripe and in prime condition. You should freeze the fruit immediately after picking if at all possible. Discard any damaged fruit. If you cannot freeze the fruit within a few hours of picking keep it in the fridge until you are ready. When you buy soft fruit for freezing try to obtain it from a grower to avoid delay between picking and freezing. The only preparation required for soft fruit is to remove damaged fruits top and tail gooseberries and remove unwanted stalks. It is not necessary to wash soft fruit before freezing unless it is dirty from mud splashes etc.

FREEZING (HOME)

Fruits can be frozen in a number of ways - loose frozen, with or without sugar; frozen in syrup or in dry sugar. It should be remembered that sugar is not necessary to actually preserve the fruit it can be added for taste, and it helps to retain colour and strawberries. It is of special interest to those who need to control sugar in their diets.

(a) Loose frozen

Simply pack the fruit into polythene bags or other non-metal containers. You can also spread it out on trays or plates and leave to freeze solid before packing into bags. This method suits all soft fruits

(b) Syrup

The prepared fruit is packed in a cold syrup. The syrup is made by using 250 to 500 grams of sugar in half- litre of water. You can then pack about 300 grams of fruit with 175 mls of syrup. Leave about 25 mm headspace for expansion in the container. Freezing in syrup suits apricots and Peaches but it can be used for soft fruit as well.

(c) Dry Sugar

In the early days of frozen food storage, the dry sugar method was considered most suitable for soft fruit. It is still a popular method but since fruit freezes so well without sugar it is not actually necessary. The fruit is tossed in caster sugar - about 50 grams of sugar to each 500 grams of fruit - and then packed in polythene bags, boxes or waxed containers.

Note : Fruit Purée may also be frozen. 500g fruit, 4tbsp water → simmer → sweeten → freeze.

* TURN the freezer down to -25°C a couple of hours before freezing fresh food.

Vegetables

1. Prepare as for cooking, peel and cut into medium pieces. Leave small vegetables, e.g. carrots, whole.
2. Because the enzymes in vegetables cause deterioration, even at -18°C, it is essential to blanch vegetables before freezing in order to destroy enzymes. Blanch in boiling salted water for required time. (See chart below.)
3. Plunge blanched vegetables into ice cold water to cool. Drain well.
4. Open freeze, if wished, *or* pack in polythene bags *or* waxed cartons, removing all the air. *

Bread and cakes

1. May be frozen as dough or as baked bread. The latter gives a better result.
2. Pastry freezes well, both cooked and uncooked.
3. Pack bread and plain buns in polythene bags. Decorated confectionery should be open frozen, then packed in rigid containers, e.g. plastic margarine boxes.
4. Batch baking saves fuel. Make two or more of each item and freeze one.

Blanching vegetables for freezing

Vegetable	*Time*
Asparagus	2-4 min.
Aubergines, sliced	4 min.
Beetroot, small whole	5-10 min.
Brussels sprouts	3-4 min.
Cabbage, young	1½ min.
* Carrots	3-5 min.
* Cauliflower florets and broccoli	3 min.
Celery	3 min.
Corn on the cob (medium)	6 min.
Courgettes, sliced	1 min.
* French and broad beans	3 min.
Mushrooms sautéed in butter	1 min.
Onions, small	4 min.
Parsnips, turnips	2-3 min.
* Peas	1 min.
Peppers	3 min.
Potatoes, chipped (frying oil)	2 min.
Spinach	2 min.

1. Blanch vegetables in 4.5 l/1 gallon of water to each 450 g (1 lb.) vegetables.
2. Place them in a colander or wire basket and lower into boiling water, timing from the moment it returns to the boil.
3. Plunge colander into ice cold water to cool, drain well, pack into containers, label and seal.

N.B. Always blanch in small amounts.

Blanching – plunge vegetables into boiling water for a short time to denature enzymes which may cause decay in the freezer.

Length of food storage in freezer

	Months		Months
Bacon	3	Fruit	6-12
Beef	8-12	Lamb	6
Bread	1	Minced meat	3
Cakes	3-6	Offal	3
Chicken	12	Pork	6
Eggs, separated	6	Poultry, (except chicken)	6
Fish, oily	4	Pastry, cooked	6
Fish, pies, etc.	2	Pastry, raw	3
Fish, shell	2		
Fish, white	6		

NOTE: Always leave head space between the top of the vegetables and the wire tie.

REASON: The head space allows for expansion during freezing.

10-20mm approx.

RULES FOR FREEZING

- Only freeze food in 'prime' condition.
- Blanch vegetables before freezing.
- Do not put warm food in the freezer.
- Allow 'head space' for foods to expand (specially foods high in liquid)
- Turn the freezer down to -25°C a couple of hours before freezing.
- Never fill the freezer with more than 1/10th of its capacity with fresh food (within a 24 hour period)
- Pack and label food carefully (see 'Packaging Materials') – use food in rotation.
- Store food in the freezer for the recommended time (eg) : bacon for 3 months or less, chicken for 12 months or less.
- Remove air from packaging with a straw before tieing the bag.
- Open freezer as little as possible.

NB : NEVER Refreeze food that has already thawed.

PACKAGING MATERIALS

- Freezing has a drying effect therefore protect food well.

- Packaging **should be** :
  - Strong.
  - Cannot Tear or Split.
  - Airtight.
  - Vapour Proof.
  - Water Proof.

- **Careless packaging** may result in Freezer Burn :
  - Loss of Colour.
  - Loss of Flavour.
  - Loss of Texture.

- **Suitable packaging** includes :
  - Polythene Boxes.
  - Polythene Freezer Bags.
  - Heavy Duty Freezer Foil.
  - Foil Containers.
  - Waxed Cartons/Tubs.
  - Freezer Wire Ties.

LABELLING

- Always label contents of the freezer using freezer pen or freezer crayon.
- Label packet with weight, date and contents.

REVISION

Star marking on the outside of

(a) freezers

(b) frozen food boxes/packets

Indicates: (i) length of storage time

(ii) temperature of storage

* - 6°C (storage 1 week)

** - 12°C (storage 1 month)

*** - 18°C (storage 3 months)

**** -18°C to -25°C (storage up to 1 year with some exceptions)