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Ingenuity of Indigenous Food Habits

The theme of this edition of *Vidurava* is on food technology and food safety standards. Digressing from this theme for a moment let us retrace some historical episodes of Sri Lanka's traditional food consumption habits, which have earned very interesting comments from ancient travelers and explorers. Indigenous knowledge of nutritive value, palatability, culinary properties, medicinal value and methods of food preparation and preservation of a variety of food substances drawn from the country's unique biological diversity has been an unprecedented experience for the ancient visitors to Sri Lanka. While the early British civil servants like J.W. Bennett (1843) and Sri James Emmersion Tennett (1859) wasted no time in observing and documenting the biological diversity of the country, they had taken pains to study the great variety of foods prepared and consumed by the local population. These writers have also described several ways in which food had been prepared and stored. These include a variety of ways in which uncooked food stuff had been dehydrated, smoked or treated with salt or kitchen ash for the purpose of preservation and later use.

Robert Knox, the 17th Century voyager, who for almost 20 years was in captivity in the Kingdom of Kandy describes in his memoirs a number of plants that were in use as food and medicine. In some instances he had tried to explain the methods of preparation of food from leaves, roots and fruits of plants. Describing the manner of partaking food, Knox says "They always wash their hands and mouth both before and after they had eaten". Symbolically this statement implies the hygiene consciousness of the Sri Lankans in partaking of food, which apparently was an unusual experience for the Englishmen of that era.

This reference to our great cultural traditions is brought in here to show the richness of Sri Lankan food consumption habits and how and why we as a nation should be proud of a unique indigenous culture.

Asoka De Silva

Post Harvest Technology of Fruits and Vegetables

Dr K.H. Saranandа

The handling technologies involved in a harvested commodity until it reaches the consumers hand is termed as post harvest handling. When a harvested produce reach the consumer a certain portion of it is lost due to weight lost, losses due to mechanical damage, post harvest diseases, senescence etc. The quantity lost is referred to as post harvest loss. Post harvest losses in developing countries are reported to be excessively high ranging from 20 – 40%, while the value for developed countries remain around 10% or less.

Why is post harvest loss so important?

In marketing of fruits and vegetables, the increase in price of goods produced by the farmer is mainly due to profits made by the intermediaries and the cost of transport. In addition the price gap between farm-gate price and consumer price widens further due to post harvest loss. Hence reduction of post harvest losses can lead to the offer of a more reasonable price to the farmer as well as for the consumer.

Post harvest losses include both quality and quantity loss. The poor quality of fruits and vegetables available in the market is a serious problem for consumers. In addition, often the nutritive value of fruits and vegetables is badly affected when they reach the consumers.

Post harvest loss of a commodity cannot be reduced by adopting improved post harvest technologies alone, because the effect of the pre harvest factors such as crop management, field sanitation etc. also contribute to crop losses. Well managed orchards or vegetable fields produce high quality fruits and vegetables which have a potential for longer post harvest life.

Proper timing of harvests

Fruits must be harvested at correct maturity stages in order to get a higher quality ripe fruit. Fruits can be divided into two major groups based on their post harvest behavior, as shown in the following table.

Banana, mango, papaya, avocado, jak fruit, and anoda belong to climacteric group, while citrus, rambutan, mangosteen, pineapple, and grapes belong to non-climacteric group. Of the two groups harvesting non-climactectric fruits at ripe stage is very important because these fruits do not proceed towards ripening changes after harvest. However, climacteric fruits can be harvested at the unripe stage, but they must be properly matured to ensure a higher quality ripe fruit.

Climacteric	Non-climacteric
Increased respiration during ripening	Continuous decline in respiration
Peak ethylene production during ripening	Very low ethylene production
Ethylene production can be triggered	Ethylene production cannot be triggered
After harvest ripening changes takes place	No ripening changes after harvest

Fruits can be harvested using maturity indices developed for each fruit in order to get the maximum quality. Early harvesting lead to poor quality ripe fruits and their post harvest losses are also higher than fruits harvested at the correct stage of maturity. Fruits must be harvested in the morning of a sunny day when dew disappears.

In harvesting the use of improved picking poles prevent damage to the fruit. Fruits must be harvested into a rigid container, and fruits must never be allowed to touch the soil. Contact with the soil can cause minor injuries, and these injures serve as entry points for microorganisms.

Vegetables such as okra, ma, beans, and luffa should be harvested at the tender stage. If these vegetables are harvested at the mature stage, rapid toughening take place due to formation of fiber. Vegetables such as carrot, radish, knolkol, beet, cabbage should be harvested at their specific maturity stages. Early harvesting of such crops results in poor yield while delayed harvesting cause very high loss due to cracking of root or stem.

Proper packaging and storage of crop produce

All fruits and vegetables should be sorted and graded before marketing. Grading can be done based on size. Insect damaged and disfigured produce must be discarded.

Fresh produce should be packed in rigid, ventilated, shallow containers. For this purpose plastic crates can be used. These crates protect the produce from mechanical damage and temperature build up. Produce transported in plastic crates have a reasonable post harvest life than those transported in polysack bags. Almost all vegetables in our country are transported in polysack bags, which is the major reason for excessive post harvest losses.

Commodities packed in plastic crates must be carefully handled without dropping them, and such packages must also be protected from direct sunlight and rain.

Mature fruits ripe naturally at ambient temperature within a few days time. However, the time taken for ripening can be shortened by artificial ripening methods. For this purpose fruits are sprayed with Ethral solution (1ml per liter of water) and kept covered for 24 hours. Ethral

treated fruits ripen giving very good quality while resembling naturally ripen fruit. There are no toxic effects with this method of ripening.

Occurrence of post harvest diseases is also a common problem in ripe fruits. Most of these diseases originate in the field before harvesting time. Field sanitation, pruning, and spraying of fungicide can be recommended to control such diseases in the field. If harvested fruits are carefully transported without damage the occurrence of diseases is negligible. Fungicides should never be applied to harvested fruit to control post harvest diseases.

Quality of fresh produce can be maintained longer if they are stored at refrigerated temperatures. Banana can be stored at 14°C, and rest of the produce can be stored between 10 – 12°C. If fresh produce are to retain quality in refrigerated storage, they must be harvested at the correct maturity stage and be free form mechanical damage.

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Relative humidity of the storage facility must be maintained at 80% or above to prevent desiccation.

If fresh produce are handled using improved post harvest handling procedures post harvest losses can be reduced considerably enabling the supply of high quality produce for consumption. In addition adoption of proper post harvest technology reduces the price gap between farm gate-price and the consumer price.

Dr. K.H. Sarananda
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Nutrients and energy claim of foods we eat

Component	Claim	Conditions not more than
Energy	Low	40 kcal (170 kJ) per 100 g (solids) or 20 kcal (85 kJ) per 100 ml (liquids)
	Free	4 kcal per 100 ml (liquids)
Fat	Low	3 g per 100 g (solids) 1.5 g per 100 ml (liquids)
	Free	0.5 g per 100 g (solids) or 100 ml (liquids)
Saturated fat	Low	1.5 g per 100 g (solids) 0.75 g per 100 ml (liquids) and 10% of energy
	Free	0.1 g per 100 g (solids) 0.1 g per 100 ml (liquids)
Cholesterol	Low	0.02 g per 100 g (solids) and 1.5 g saturated fat per 100 g (solids) 0.01 g per 100 ml (liquids) and 0.75 g saturated fat per 100 ml (liquids) and 10% of energy of saturated fat
	Free	0.005 g per 100 g (solids) and 1.5 g saturated fat per 100 g (solids) 0.005 g per 100 ml (liquids) and 0.75 g saturated fat per 100 ml (liquids) and 10% of energy of saturated fat
Sugar	Free	0.5 g per 100 g (solids) 0.5 g per 100 ml (liquids)
Sodium	Low	0.12 g per 100 g
	Very Low	0.04 g per 100 g
	Free	0.005 g per 100 g

Food Standards and Labelling

Malini Mallawaratchie

Introduction

Every consumer expects the food he eats to be of a high quality standard especially with respect to its safety. This has resulted in food standards being formulated by the government with an established food control system to ensure that these standards are adhered to. Such standards are mandatory in Sri Lanka under the Food Act. There are also voluntary food standards such as those formulated by the Sri Lanka Standards Institution. These always comply with the Food Act and its regulations, and thus there is no conflict in food standards. In addition there are international food standards, company standards and standards of other countries which our exporters have to adhere to. Food labelling and advertising are also governed by a regulation. This article elaborates on the food standards in operation in Sri Lanka and gives details of the laws governing food labelling.

Food standards in Sri Lanka

Food Standards under the Food Act No: 26 of 1980

Food is regulated in Sri Lanka by the Food Act. No: 26 of 1980 (amended in 1990) under the Ministry of Healthcare and Nutrition. The food standards issued as regulations gazetted under this Act are mandatory, i.e. they have to be complied with by anyone manufacturing, importing, distributing or selling food in Sri Lanka. These standards, covering many products and processes are revised by the Food Advisory Committee of the Ministry of Healthcare and Nutrition, and gazetted regularly when they become law.

Food standards under the Food Act are used by food inspectors, food and drugs inspectors and public health inspectors throughout the island to implement the food control system in the country in order to ensure the safety of food. Failure to comply with these requirements prompts legal action by the government. These Authorized Officers coming mainly under the purview of the Provincial Administration carry out inspections of food processing factories, food retail outlets and even hotels and restaurants to ensure compliance with the law. Analysis of samples of food seized by them is done either by the laboratories of the Government Analyst's Department, the Medical Research Institute, or the laboratories under the Health Ministry located in Kaluthara and Anuradhapura. The Colombo and Kandy Municipalities have their own laboratories.

Food standards under SLS System

Food standards under the Sri Lanka Standards Institution are mostly voluntary standards. They are for food products and processes, and specify the officially recognized levels of quality, safety,

composition, packaging and labeling regulations that are appropriate for the Sri Lankan market. These national standard specifications for food products are drawn up by Working Groups appointed by SLSI consisting of senior technical persons from government organizations with expertise in the particular field of the standard being formulated, and finalized with a consensus of the relevant food processors. Draft standards are available for public comment prior to approval by the Sectoral Committee on Agriculture and Food Products, and finally endorsed by the Council of the Sri Lanka Standards Institution.

SLS food standards as formulated above, form the basis for awarding the SLS certification for products, and for the compulsory import inspection scheme implemented by SLSI. The SLS certification has been found to be the most effective way of implementing food standards by SLSI. Food manufacturers should satisfy the SLSI that the food product's design, production, safety, hygienic conditions and quality control are such that it conforms to the Sri Lanka Standards consistently. SLSI monitors the manufacture of SLS marked products continuously.

Food standards

Mandatory standards under the Food Act

Table I gives details of the present mandatory food standards effective in Sri Lanka under the Food Act.

Recently gazetted food standards of interest are the Food (Labelling & Advertising) Regulations 2005, the regulations and standards governing bottled drinking water, the standards for iodized salt, and the control of import, labeling and sale of genetically modified foods.

Bottled drinking water

Registration of bottled drinking water was made mandatory to ensure that the consumer gets safe water when he buys a bottle of drinking water. The manufacturer of bottled drinking water should obtain a certificate of registration from the Chief Food Authority. The premises where the water is bottled should also be registered. Recommendation for granting this certificate is at present given by the SLSI in the form of a report. The bottle should display the registration number issued by the Chief Food Authority on the label. Most registered bottled drinking water also have the SLS mark.

Iodisation of salt

Lack of iodine in the diet had led to increased incidence of goiter in the country. Though there were standards for iodized salt earlier, the limits for iodine were reduced in these new standards based on local scientific research. According to regulations only iodized salt can be sold in the country. Salt (sodium chloride) should be iodized with potassium iodate, potassium iodide or calcium iodate to give a final product with less than 6% moisture content, more than 97% sodium chloride content and an iodine content of 15 – 30 ppm. Instructions to store the product away from sunlight and heat, and to use it without washing should also be given on the label.

New food standards under Food Act

Table 2 lists the draft standards under the Food Act which are due to be gazetted in the future. Some of these products have mandatory standards at present, which will be ineffective when the new standards are gazetted.

Table 1: Present Food Standards under the Food Act No: 26 of 1980

Gazette No:	Date	Regulations	Topic
560/13	02/06/1989	Food Regulations –1988	Food hygiene
615/11	19/06/1990	Food (Preservatives) Regulations	Preservatives
673/18	22/11/1990	Food (Standards) Regulations 1989	Baking powder, Sugar confectioneries Cereals, pulses, flours & cereal foods, Fats & oils, Spices, condiments & seasonings
673/8	01/08/1991	Food (Standards) Regulations 1989	Milk & milk products
788/7	14/10/1993	Food (Labeling &Miscellaneous) Regulations Part II & Part III.	Part II. Antioxidants & food colours Part III. General prohibition & regulation of sales
823/16	16/06/1994	Food (Standards) Regulations 1989	Butter, ghee, cheese, yoghurt, curd, ice cream, malted food (malted milk powder)
834/8	31/08/1994	Food (Bread Standard) Regulations 1994	Bread
1175/13	27/02/2001	Food (Prohibition of Potassium Bromate in flour) Regulation 2000	Flour:prohibition of Potassium bromate
1323/1	12/01/2004	Food(Sweeteners) Regulations 2003	Sweeteners
1376/9	19/01/2005	Food (Labeling & Advertising) Regulations 2005	Labeling, advertising
1405/3	11/08/2005	Food(Iodization of Salts) Regulation 2005	Iodisation of salt
1420/5	21/11/2005	Food (Irradiation) Regulations 2005	Irradiation of food
1420/4	21/11/2005	Food (Bottled or Packaged Water) Regulations 2005	Bottled natural mineral water & bottled drinking water
1456/22	03/08/2006	Food (Control of Import, Labelling & Sale of Genetically Modified Foods) Regulations 2006	GM foods
1472/19	23/11/2006	Food (Colouring Substances) Regulations 2006	Food colours
1503/8	27/06/2007	Food (Vinegar Standards) Regulations 2007	Vinegar

Table 2: List of Draft Food Regulations

- Cereal, pulses, legumes & derived products
- Fats & oils
- Fish & fish products
- Fruits, vegetables & products
- Meat & meat products
- Milk & milk products
- Spices, condiments & seasonings
- Sugar & sugar products
- Tea, coffee, cocoa & products
- Infant formula milk in powder form
- Contaminants in food
- Food additives (General)
- Preservatives
- Antioxidants
- Emulsifying & stabilizing agents
- Flavouring substances and flavour enhancers
- Food hygiene (General)
- Food (packaging materials and articles)
- Food (registration of premises)
- Preparation & distribution of cooked food

Standards under SLS Certification

SLSI operates voluntary standards and systems certification and compulsory import inspection schemes. Sri Lanka Standards (commonly known as SLS standards) are generally voluntary standards. They are adopted by food processing companies which permit the products to bear the SLS logo to assure consumers that the food product is manufactured under an effective products quality assurance system to meet the given SLS Standard. Purchasers of SLS marked food products are given the assurance by an independent body (SLSI) that the food item is produced under a system of supervision and control for continuous compliance with the relevant Sri Lanka Standards. Presently there are 125 standards for food products, 27 standards for primary products, 14 for food additives, and 43 for methods of test/analysis. Twenty five codes of practice for hygienic manufacture of specific food products provide useful information for carrying out the specific processing industry.

SLSI also offers voluntary systems certification for food industries based on GHP (Good Hygienic Practice), GMP (Good Manufacturing Practice), HACCP (Hazard Analysis Critical Control Point) system, and more recently, the international ISO 22000 Food Safety Management System. Certification for ISO 22000 by SLSI is accredited by a world recognized organization, RvA, Netherlands. Certain Sri Lanka food standards (see Table 3) have been made mandatory by the Consumer Affairs Authority.These food products should have the SLS mark to be in the market. Inspections are carried out by the Consumer Affairs Authority officers. SLSI also implements a compulsory import inspection scheme for 33 food items (see Table 4). SLS officers sample and test imports of these products for compliance with SLS specifications before release by Sri Lanka Customs into the local market.

Global food standards' role in Sri Lanka

The FAO / WHO Codex Alimentarius Commission has published international standards for most food products, and codes of practice for food processing industries. These standards (commonly known as Codex standards), finalized after intensive international consultation and concurrence, form the main quality reference for standards formulation in Sri Lanka by both the Food Advisory Committee and the Sri Lanka Standards Institution.

Codex standards are updated regularly based on world trends and developments in technology. Harmonizing our local food standards with these global standards has

Table 3: Mandatory SLS Standards for Food Products

- ***Beverages.* non-alcoholic:** Fruit cordials, fruit cordial concentrates, ready to serve fruit drinks, synthetic/artificial cordials
- ***Dairy products* :** Butter, condensed milk, milk powder
- ***Fats & Oils :*** Coconut oil, corn oil, edible soybean oil, groundnut (peanut) oil, margarine, palm kernel oil, palm oil, palm olein, palm stearin, sesame oil, sunflower seed oil
- ***Fish and fish products :*** Canned fish
- ***Flour and bakery products* :** Biscuits
- ***Fruit and vegetable products :*** Jams, jellies, marmalades & preserves, tomato sauce/ketchup
- ***Miscellaneous product :*** Brown sugar, chilli sauce

Table 4: Food Products - SLS Compulsory Import Inspection Scheme

Skimmed milk powder	Palm kernel oil	Jams, jellies, marmalades and preserves
Full cream milk powder	Corm oil	Fruit squashes, fruit syrups and fruit cordials
Condensed milk	Sesame oil	Fruit concentrates
Butter	Margarine	Ready-to-serve fruit drink
Soya bean oil	Canned fish	Tomato sauce
Groundnut oil(peanut oil)	Canned fish curry	Chillie sauce
Palm oil	Brown sugar	Ice cream
Palm olein	Noodles	Milk added drinks
Palm stearin	Rice noodles	Bottled water
Sunflower seed oil	Sweet biscuits	Natural mineral water
Coconut oil	Rusks	Synthetic/artificial cordials

now become important with the development of global trade, and the signing of many bilateral trade agreements which need common standards.

In food standard formulation in Sri Lanka by both the Ministry of Health and the Sri Lankan Standards Institution, the standards adopted by India, Malaysia, Singapore, Thailand etc. play an important role as reference material, because these countries have food products and problems that are common to Sri Lanka. In addition, many of our imported food products come from the region.

Food labelling

The Food (Labelling & Advertising) Regulations 2005 is applicable to all prepackaged food offered for sale or advertised for sale in Sri Lanka. A label on a prepackaged food gives a declaration of the food in the package. The regulations specify, in terms of content, language, letter size and format, the information that the label should carry. Readers who wish to design a label for their food product should read the gazette (No: 1376/9 of 19th January, 2005) carefully as the information provided in this article is only a brief summary of the main features.

The **main panel** of a food package (the part of the label most likely to be displayed for detail sale) should contain the following three items:

1. The common name in any two of the three languages, in bold type letters, clearly and conspicuously
2. The Brand / Trade name which should not mislead the consumer and could be in any one of the three languages.
3. The net contents in international units i.e g/kg or ml/l.

The **common name** is the name by which the food is commonly identified. The size of the letters for the common name should not be less than one third the size of letters used for the **brand name**, with a minimum height of 3 mm. The brand name is specific for the company. Other information which should be conspicuously printed on the label in bold type letters not less than 1.5 cm (not necessarily on the main panel) include the following:

1. Permitted food additives by name or INS number
2. Instructions for storage and / or use, if any
3. Name and address of manufacturer
4. Name and address of packer or distributor in Sri Lanka
5. Batch number or code number or decipherable code marking.
6. Date of expiry (in any two of the three languages)
7. Date of manufacture
8. Date of manufacture and date of repacking (for bulk imports and repacks)
9. Complete list of ingredients in descending order of their proportions by common name.
10. Country of origin (for imported food)
11. Any other stipulated declarations.

The said gazette also specifies the height of letters for different declarations depending on the area of the main panel (the height increasing with the area of the main panel), the formats for the dates of manufacture and expiry (DD/MM/YY or YY/MM/DD) to ensure that

consumers are not misled by using only two digits for the year, e.g. 06/05/07 could be the 6th of May 2007 or the 7th of May 2006.

Some of the other major features of these regulations are that the consumer should not be misled by the label, by words or by pictures to assume that the food is connected to another product, and there should be no recommendation by a medical practitioner etc. or of any health claims. Promotions related to energy, protein, cholesterol etc. could be only made under specified conditions. The use of the words "Artificial", "Natural" and "Pure" on a label are clearly defined in these regulations.

Labelling GM foods

Under the recently gazetted regulations, the Chief Food Authority's (CFA) approval is necessary to import or manufacture any genetically modified organisms (GMO) as food for human consumption, any food containing GMO's, any food produced from GMO's or containing ingredients from GMO's. Only such approved GM products can be transported, distributed, stored or sold in Sri Lanka. Approval is given by the CFA if the food is not injurious to the consumer's health and does not differ nutritionally to the disadvantage of the consumer from

the usual food as proven by a comprehensive report on studies done. The other information required include, the modification done on DNA and protein, the process, the countries where the product is sold and the manner of presentation and labeling. Approved GM products could be marketed with suitable labeling. Products proven to have less than 0.5% of genetically modified ingredients are exempt from labeling.

Mrs Malini Mallawaratchie

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"Pure" and "Natural" in food labelling

No label relating to any article of food shall, in the description of such article of food bear the work "pure" or any other word implying that it is pure, unless such article is of such character, value, composition and merit as prescribed by regulations made under the Act, and contains no additives of any kind.

No label shall, in the description of any food product, bear the work "natural" thereon unless, such food or food product consists of unmixed, unadulterated or unprocessed product with no additives. It may however be subjected to pasteurization, chilling or freezing; and

Such food or product is produced from biological material as distinct from synthetic material.

Food Technology past and present

Dr K.K.D.S. Ranaweera

Evolution of food habits in man

Man evolved from tree-dwelling apes who lived on a diet of fruits and seeds. Later, with a drastic change of climate, apes are believed to have climbed down to the ground where they began to supplement diets with bark, young shoots, edible roots and small animals like ants, termites, frogs and insect grubs. In other words, they changed their diets from a herbivorous nature to an omnivorous style. Gradually our ancestors changed their food habits and consequently began to hunt larger animals. Later, man used more effective methods to attract animals towards their settlements by providing a bait for the animals so that they could hunt them in the vicinity of the settlement. As the next step, ancestors trained domesticated dogs to help them in hunting. Subsequently, they domesticated animals like sheep, goats and pigs. Domestication enabled man to access a wider range of plants and animals. Hence, about 10,000 years ago man started changing his way of life from foraging to farming. In order to survive the ancient man had to harness nature. In frozen climates he used ice to freeze meat. In tropical climates, instead of freezing he dried foods in the sun. Our indigenous people "Veddhas" preserve meat in bees honey.

Grain, bread, ***Thalapa*** and/or porridge were the basis of food consumed by our ancestors. For example, in ancient time, Egyptians roasted grains of barley, wheat or millet to prepare bread. Later, they found strains of wheat from which they were able to prepare dough directly from raw flour. They also found the way of producing beer and later applied the knowledge in bread-making as well. The knowledge in food science widens fast as food technology advances. For example, in the canning process, food is heated to kill all microorganisms and then the food is sealed to cut off the supply of oxygen and thereby prevent the entry of new microbes. Another example is the knowledge of commercial growers who ship fruit over long distances without many losses. They pick the fruit while it is still unripe and treat it with ethylene gas to ripen but not spoiled when it reaches the market. Consumers who buy fruit that is still unripe may speed up the process of ripening by enclosing the fruit in a small bag. This traps the ethylene that is given off by the ripening fruit.

Today, there is a wide range of methods available to maintain and enhance the shelf life, appearance and taste of food. Consumers with busy life-styles who cannot afford much time on food preparation and cooking can buy ready to eat type of food products which require

only a little time for preparation and cooking. Rational combination of these methods with modern distribution networks makes seasonal crops available year-round in supermarkets and grocery stores all over the country, region and the world at large. Food processing operations involved in the food industry can be grouped into four categories; preparative operations, conversion operations, preservation operations and ancillary operations

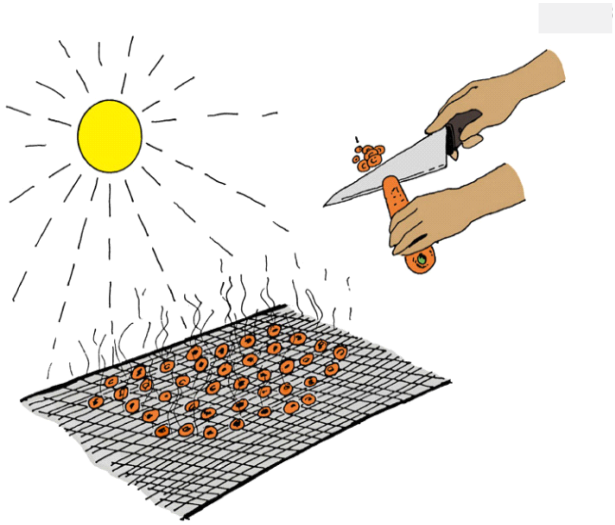
Our ancestors observed that, fruits left out in the sun remained wholesome for long periods. In ancient times, the sun and wind would have naturally dried foods. Evidence shows that Middle East and oriental cultures actively dried foods as early as 12,000 B.C. in the hot sun

Food processing operations

Preparative operations employed in the food industry include a wide range of operations which include operations like cleaning, sorting and grading. For example, in a vegetable farm processing may involve only picking, sorting and washing fruits and vegetables before they are sent to the market. **Conversion operations** practised in the food industry consist of size reduction and screening of solids, mixing, emulsification, filtration, membrane separation, centrifugation, extraction and crystallization. Some processing methods convert raw materials into a different form or change the nature of the product. For example, in the manufacture of sugar from sugar beets or in the manufacture of cheese, conversion operations modify the raw materials into different products. **Preservation operations** are intended to keep foods without any spoilage. Food spoilage is any change that makes food unfit for consumption and includes chemical and physical changes; e.g. bruising and browning; infestation by insects or other pests; or growth of microorganisms like bacteria, yeast, and moulds. Foods before consumption may have made a long journey from the farm or processor to consumer. This journey may extend beyond national boundaries, oceans or continents taking days to months. Therefore irrespective of the processing or preservation method used **ancillary operations** like proper packaging of food is very essential to make sure that food remains wholesome.

Some food preservation techniques destroy enzymes and proteins present in raw foods, which are responsible for chemical and physical changes that take place naturally after harvesting. Food preservation techniques also help to overcome the moisture or temperature conditions which favour the growth of microorganisms. As microorganisms multiply and grow, they break down food constituents producing unpleasant changes in taste, texture and appearance, and may cause food-borne illness at large. The changes we can observe or recognise are considered as spoilage. Now let us try to understand about some preservation techniques which are commonly used worldwide.

Traditional techniques in food preservation



Our ancestors observed that, fruits left out in the sun remained wholesome for long periods. In ancient times, the sun and wind would have naturally dried foods. Evidence shows that Middle East and oriental cultures actively dried foods as early as 12,000 B.C. in the hot sun.

Each civilization or community would have its own specific methods to dry fish, wild game, domestic animals, vegetables and fruits. A fire was used to create the heat needed to dry foods and in some cases smoking them as well. Drying is the oldest method of preserving food and it is quite simple when compared with other methods.

Food can be dried in several ways including sun drying and oven drying. For a good-quality product vegetables and fruits must be prepared for drying as soon as possible after harvesting. They should be blanched, cooled and laid out to dry without delay. Foods should be dried rapidly, but not too fast that the outer areas becomes hard before the moisture inside has a chance to evaporate.

Sun drying is a traditional method where foods are dried naturally under the sun. Solar drying is cheap, but is not so easily controlled as in the case of dehydration with sophisticated means. Drying by direct exposure to the sun has a number of disadvantages like exposing the produce to dust and atmospheric contamination, insect infestation etc. Therefore, cleanliness and sanitation are essential conditions to be maintained when foods are dried.

Almost all kinds of fruits need some treatment before drying. When fruits like apples, pears, banana or other light-coloured fruits are cut and exposed to the air, the flesh turns brown rapidly due to oxidation. If oxidation is not stopped, it will harm the texture, flavour, aroma and appearance of the fruit. Therefore, fruits of this type need to be treated with an antioxidant in order to prevent browning reactions. Sprinkling the fruit pieces with an ascorbic acid solution can be very helpful to stop browning. Sulphuring is the best antioxidant treatment for preserving colour. Sulphuring also helps to prevent loss of vitamins A and C. Sulphur itself is not a preservative but it discourages insects and microbes which can cause spoilage. Blanching is used to destroy enzymatic activities which otherwise cause undesirable changes in vegetables and some fruits prior to further processing. Almost all vegetables need to be blanched (scalded in boiling water for a short time before drying). A few vegetables like mushrooms, okra and onions need no blanching before drying. Most fruits do not need to be peeled before drying. But some fruits with tough and waxy skins need to be cracked first. Fruit should be cut into uniform pieces or slices so that it will dry more evenly and thin pieces dry faster than thick counterparts.

Advanced drying technologies

In some countries including Sri Lanka, heat generated by burning fire wood or agricultural waste is used for drying commodities like copra and root crops. In this connection, oven drying is the most practical and cheep way to succeed with dehydration. It protects foods from insects and dust and does not depend on the weather. Foods dried in this manner are more susceptible to scorching at the end of the drying period. Oven-dried foods usually are darker, more brittle and less flavourful than foods dried by a dehydrator. On the other hand, foods can be dried on trays in an electric dehydrator which is operated with an electrical heat source and ventilation system. Electric dehydrators are used to dry foods indoors. Electric dehydrators maintain low temperatures and use less energy than an oven and the quality of the product is better than with any other method of drying.

Freeze-drying

In freeze-drying, frozen food is placed in a special vacuum cabinet. There, water escapes from the food by sublimation, a process in which ice changes from a solid directly to a vapour bypassing the liquid status. Freeze-dried foods retain their original flavour, texture and nutrients upon rehydration but must be packaged in moisture-proof, hermetically sealed containers. Freeze-drying is an expensive process used for such products as instant coffee, dried soup mixes, strawberries, mushrooms and shrimp.

Osmotic dehydration - a tool for improving food product quality

Osmotic dehydration (or dewatering impregnation soaking) is another way of removing water from commodities. It is a useful technique for concentration of fruit and vegetables. It gives rise to at least two major simultaneous counter-current flows; a significant water

flow out of the food into the solution and a transfer of solute from the solution into the food. Osmotic dehydration is achieved by placing the solid food, whole or in pieces, in aqueous solutions of sugars or salts of high osmotic pressure. It is used in various traditional preserving methods including salting of meat and fish and candying of fruit. In modern food industry, osmotic dehydration is used not as a preserving method but as a tool for obtaining intermediate and end-products of improved quality.

Other methods of processing and preservation of food

Fermenting

Fermentation was not invented, but rather discovered. Some microorganisms, yeasts in particular, are capable of utilizing fermentable sugars as their respiratory substrate and convert them into alcohols. Likewise some other microorganisms can produce lactic acids. Wine, toddy, beer, yoghurt, curd, sauerkraut, kefir, ***Jaddi*** and native medicines like ***Arishta*** are examples of fermented products. Fermentation was a valuable food preservation method. It cannot only preserve foods, but also create more nutritious foods, and was used to produce more palatable foods from less desirable ingredients. Some anthropologists believe that mankind settled down and transformed from nomadic wanderers into farmers to grow barley to make beer around 10,000 BC.

Fermentation was not invented, but rather discovered. Some microorganisms, yeasts in particular, are capable of utilizing fermentable sugars as their respiratory substrate and convert them into alcohols

Pickling

Pickling is the process of preserving food by anaerobic fermentation in brine (a solution of salt in water), to produce lactic acid. Pickling also can be achieved by marinating and storing food in an acid solution usually vinegar (or even diluted artificial acetic acid). The resulting food is called a pickle. This procedure gives the food a sour taste. Pickling began as a way to preserve food for out-of-season use, and for use in long journeys, especially by sea. Vinegar is produced naturally from starches or sugars which are first fermented to alcohol by yeasts and the alcohol is then oxidized by certain bacteria to acetic acid. For example, wines, toddy and ciders are all routinely transformed into vinegars. Pickling of foods is a very popular preservation technique because the sour taste of the food in it is appealing. Containers had to be made of stoneware or glass, since the vinegar would dissolve the metal from pots and make the food toxic.

Pickle products can also be subject to spoilage from microorganisms, particularly yeasts and moulds, as well as enzymes that may affect flavour, colour and texture. Processing the pickles in a boiling-water can will prevent both of these problems.

Curing

The earliest curing was intentionally done for dehydration purpose. Early cultures used salt to desiccate foods. Curing by salting and drying has been the oldest, simplest, cheapest and most widely practised method of preservation of fish throughout the world. Salting was common and even culinary by choosing raw salts from different sources (rock salt, sea salt, spiced salt, etc.). In the 1800's it was discovered that certain sources of salt gave meat a red colour instead of the usual unappetizing grey. Consumers preferred the red coloured meat. Curing involves adding some combination of salt, sugar, spices, vinegar or sodium nitrite to animal foods. It was also found that nitrites are capable of inhibiting growth of microbes like *Clostridium botulinum*. Curing is used to preserve meat and fish, yielding common products such as bacon, ham, frankfurters and corned beef. Smoking, a

flavouring and preservation technique is another ancient technique that is commonly used along with curing. Smoking involves cooking meat or fish very slowly over a low wood fire. Curing and smoking preserve food by binding or removing water so that it is not available for the growth of microorganisms. There are several other curing methods used to process fish; Colombo curing, pit curing and mono curing.

The earliest curing was intentionally done for dehydration purpose. Early cultures used salt to desiccate foods. Curing by salting and drying has been the oldest, simplest, cheapest and most widely practised method of preservation of fish throughout the world.

Canning

Canning is comparatively a newer method of food preservation pioneered in the 1790s when Nicolas Appert, a French confectioner discovered that the application of heat to food in sealed glass bottles preserved the food from deterioration. Based on Appert's methods Englishman Peter Durand, used tin cans in 1810. Canning is the process in which foods are placed in jars or cans and heated to a temperature that destroys microorganisms and inactivates enzymes. This heating and later cooling forms a vacuum seal. The vacuum seal prevents other microorganisms from re-contaminating the food within the jar or can.

Today canning is used to preserve a wide variety of foods, including soups, sauces, fruits, vegetables, juices, meats, fish and some dairy products. Canning preserves food by heating it in airtight, vacuum-sealed containers. The can is filled with food and air is pumped out of the space remaining at the top of the can to form a vacuum. The container is then sealed, heated in a cooker called a retort, and finally cooled to prevent overcooking of the food inside the container.

Advanced food preservation techniques

Microwaving

Microwave energy is a natural phenomenon that occurs when an electric current flows through a conductor. Microwaves are a form of electromagnetic radiations that are very similar to sunlight and radio waves. The microwave oven was discovered as a spin-off from another technology. In 1946 Dr Percy Spencer, a self-taught engineer, discovered that the candy bar in his pocket had melted when he was testing a new vacuum tube called a magnetron. Later when he placed some popcorn kernels near the tube he observed the popcorn sputtering, cracking and getting thrown out all over the lab.

A microwave oven uses **microwaves** to heat food. Microwaves are radio waves. In the case of microwave ovens, the commonly used radio wave frequency is roughly 2,500 megahertz (2.5 gigahertz with a wavelength of 12.24 cm). Radio waves in this frequency range have an interesting property; they are absorbed by water, fats and sugars. Water, fat, and other substances in the food absorb energy from the microwaves in a process called dielectric heating. When they are absorbed they are converted directly into atomic motion — heat. Microwave heating is most efficient on liquid water, and much less so on fats and sugars (which have less molecular dipole moment), and frozen water (where the molecules are not free to rotate). Microwaves in this frequency

range have another interesting property; they are not absorbed by most plastics, glass or ceramics. Metals reflect microwaves, and is why metal pans do not work well in a microwave oven. In a microwave oven, the air in the oven is at room temperature, so there is no way to form a crust.

The cooking chamber itself is capable of preventing microwaves from escaping into the environment. The oven door is usually a glass panel for easy viewing, but has a layer of conductive mesh to maintain the shielding. Moreover, the radiation produced in a microwave oven is non-ionizing. As such, it does not have the specific cancer risks associated with ionizing radiations such as X-rays, ultraviolet light and high-energy particles.

Food irradiation

Food irradiation is sometimes referred to as **cold pasteurization** or **electronic pasteurization.** Food irradiation is a processing technique where the food is exposed to doses of ionising energy or radiation either from ã-rays or an electron beam. At low doses, irradiation extends the shelf life of the product concerned. At higher doses, this process kills insects, moulds, bacteria and other potentially harmful microorganisms. According to literature, research findings of over five decades have shown that food irradiation is a safe and effective form of processing. Food irradiation has been approved in 40 countries including the United States, China, France and Holland.

There is a common misconception that irradiated food is radioactive. The radiation used to process foods is very different from the radioactive fallout that occurs after a nuclear accident. In food processing, the radioactive source never comes into contact with the food and the doses are so low that the level of radioactivity is generally undetectable. Exposure to ã-rays does not make food radioactive while electron beams are formed from electricity, and hence do not need radioactive material to work. In both cases organisms that are responsible for spoiling foods like insects, moulds and bacteria are killed. However, food irradiation cannot kill viruses.

Likewise, there are so many other novel food processing technologies like super critical fluid extraction, nanoencapsulation, use of probiotics, single cell protein based food production, high pressure food processing, genetically modified foods etc. Food packaging also plays a major role in current food industry. Packaging technologies involve a wide range of techniques and materials. Packaging not only protects the food product extending the shelf life, but also helps in displaying items for sale in an attractive manner.

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A food is a source of protein if,

No label or advertisement relating to any food shall state or indicate thereon that such food is a course of protein unless:

√ *The quantity that would reasonably be expected to be consumed in one day contributes at least 12 grams of proteins*

√ *At least 20 percent, (20%) of the energy value of the food is provided by protein; and*

√ *The label states the protein content in grams per 100g or 100 ml of the food*

Food Additives

M.A.J.Wansapala and I.Wickramasinghe

Food Additives are substances added intentionally to food stuffs to reform to certain technological functions. Different individuals may define these substances differently from different points of view. Hence, it is worth finding a more comprehensive definition of food additives which help us to understand the real role of food additives in the food industry.

Definition of a food additive

According to food labelling regulation imposed in 1984, food additives are substances, not commonly regarded or used as food, which are added to, or used in or on food at any stage to affect its keeping qualities, texture, consistency, appearance, odour, alkalinity or acidity, or to serve any other technological function in relation to food. This includes processing aids in so far as they are added to or used in or on food as aforesaid, but does not include vitamins and minerals, herbs or spices (when used as seasoning agents), hops, salts, yeast or yeast extract, total products of any hydrolysis or autolysis of food proteins, starter cultures, malt or malt extracts and air or water. Food additives can be categorized into several classes; colouring agents, preservatives, antioxidants, emulsifiers, thickeners, gelling agents, stabilizers, flavours and flavour enhancers, acids and acidity regulators, anti caking agents, modified starch , sweeteners, anti foaming agents firming agents, and enzymes.

Table 1 : Permitted food colours

Colour required	Permitted food colours
Red	Carmosine Fast Red E Ponceau 4R
Blue	Indigo Carmine Brilliant Blue FCF
Yellow	Tatrazine Amaranth Sunset Yellow
Green	Green S Green FCF

Colouring agents

Although 2000 artificial colours are available in the market, only about ten colours are used as food colouring agents. Colour is one of the attributes which tends to improve consumer attraction. Most of the producers tend to earn profits through this additive.

It is reported that all artificial colours, flavours and odours are made from coal tar. These are highly carcinogenic. Foods which have bright colours, strong flavours or odours may have these harmful chemicals. Hence, addition of artificial colours is prohibited for raw and unprocessed meat, poultry, fish, fruits, vegetables, tea, coffee beans, ground coffee, coffee extracts, bread, creams, condensed milk, dried milk, cheese, butter and baby foods.

However the permitted food colours can be identified by their E- coding number. Presently the declaration of the E- coding number or name of the colour is essential for most of the food items and the regulation is governed by the relevant food authorities.

Preservatives

Preservatives are substances added to foods to inhibit the growth of bacteria, yeast and or moulds. Most of them are chemical compounds. Optimum activities of

Table 2 : Important food colours and their E- numbers

E-coding number	Colour	Applications
E-100	Curcumin	Margarine
E-101	Riboflavin	Sauces
E-102	Tatrazine	Soft drinks
E-110	Sunset Yellow FCF	Biscuits
E-120	Cochineal	Alcoholic drinks
E-122	Carmoisine	Jams & Preserves
E-155	Chocolate Brown	Chocolate cakes

E-number range for colours lie between E 100- E 108

certain chemical preservatives are controlled by external factors such as pH, temperature and the salinity of the medium.

Common chemical preservatives can be divided into seven (07) major groups.

(a) Sorbates
(b) Benzoates and para benzoates
(c) Sulphites
(d) Biphenyls
(e) Amines
(f) Nitrite and nitrates
(g) Propionates

Table 3 : Common chemical groups and their applications in

Common chemical group	Application
Sorbates	Dairy products, confectionary
Benzoates and Para Benzoates	Fruit pulp, soft drinks, jam
Sulphites	Fruit juices, dehydrated vegetables
Biphenyls	Surface treatment of citrus fruit
Amines	Surface treatment of banana
Nitrite and Nitrates	Meats and cheese Industry
Propionates	Bakery products

Activity of the sorbates, sulphite, benzoates and propionates is highly dependant on the pH of the medium.

Two types active species of sulphites can be identified at pH 3-5(i.e. HSO^-_4 and SO_3^{-2}). Undissociated skeletons of sorbates, benzoates and propionates are a prerequisite for their optimum activity. Maximum content of their undissociated form is shown at the respective pH values given in the table. Activity of biphenyls, Amines and Nitrate/ Nitrites depends on other parameters except pH.

Table 4 : Optimum pH for certain chemical preservatives

Group of preservative	Optimum pH
Sulphite	3-5
Sorvates	Below 6
Benzoates	4
Propionates	4-4.8

Effect of chemical preservatives on human health

Since preservatives being chemicals, excess amounts may lead to different physiological problems. Therefore the application of chemical preservatives has to be controlled by applying certain standards and limits. However, common limits or standard for all chemical preservatives cannot be applied at a global level. These levels are adjusted by the relevant authority in each country from time to time.

Sulphites and Nitrate/ Nitrites show maximum toxicity relative to others. Excessive amounts of sulphites create problems in the lungs, affect the respiratory system, while excessive amounts of Nitrite/ Nitrate may cause cancer due to its by product of nitrosamines.

However, preservation is an essential operation in order to obtain a good quality food product and maximum profits. But most people are reluctant to buy chemically

preserved food products due to the possible bad effects of preservatives. Therefore products labelled as "Natural" are preferred by consumers.

Certain parameters should be kept constant in order to maintain the natural condition of the food product. Hence a number of chemicals are added at different levels to food products to achieve this objective. Therefore food products with chemical preservatives at standard levels are often safer than the so called "Natural" foods.

Antioxidants

Many food constituents are adversely affected by oxygen in the air. Oil, fat and oil flavour compounds of food components are oxidized by the oxygen. Certain metals such as copper and iron are subjected to this process as catalysts. This is one of the reasons why iron and copper have largely being replaced in food processing equipment by stainless steel.

An antioxidant as the term implies, tend to prevent oxidation. Natural antioxidants present in foods include Vitamin C, Vitamin E, and certain sulphur containing amino acids. However, the most effective antioxidants are synthetic chemicals approved by the Food and Drug Administration for addition to foods.

Table 5 : Anti oxidants and their applications

E-Code	Antioxidant	Application
E -300	L Ascorbic Acid	Fruit drinks
E -307	α tochopherol (Synthetic)	Cereal based baby foods
E -310	Propyl gallate	Vegetable oil
E -320	Butylated Hydroxy Anisole	Cheese spreads
E -321	Butylated Hydroxy Toluene	Chewing gum
E -322	Lecithin	Low fat spreads

Auto – oxidation process of lipids is controlled by antioxidants. This process consists of three major steps; initiation, propagation and termination

Electrons of the free radical at the third level can be absorbed by the antioxidant and delocalised within the electron cloud of the antioxidant, and thereby control the chain reaction.

Effects of oxidation of fat

Market demand, consumer attraction and nutritive quality are highly affected by oxidation. It not only imparts the rancid flavour to the food but lowers the nutritive value of the foodstuff. Low molecular weight fatty acids, alcohols, ketones, and aldehydes, are the major by-products responsible for the objectionable flavour. Muscle proteins can be affected by free radicals which are the active components of the oxidation process, and their water holding capacity may be reduced due to this action. Consequently food becomes hard. The secondary products such as aldehydes react with amino acids forming brown coloured melonidine complexes. These complexes impart additional colour and flavour to the product. Oxidation of fat also badly affects the level of fat soluble vitamins.

There are certain types of chemicals which can help to prevent oxidation of fats and oils . Although they are not categorized as antioxidants they can diminish the rhythm of the reaction, e.g. citric acid, phosphoric acid and their derivatives.

Flavours and flavour enhancers

Flavour is the aggregate of the characteristics of the material that produces the sensation of flavour. It can make food more palatable and attractive. Seven primary flavours can be identified according to the Amoove theory.

All flavours are composed of highly aromatic materials specially selected to contribute the particular flavour and odour profile. They are categorized as follows;

(a) Naturally occurring plant materials

(b) Products derived from natural sources by physical means such as extraction, distillation and expression.

(c) Isolates or pure chemicals prepared from natural sources.

(d) Synthetic chemicals identical with those found in natural products.

Most of the compounds of last category are developed by the reaction between amino acid and simple sugar.

Table 6 : Primary flavours and their chemical equivalence

Primary Odour	Chemical equivalent	Substrate
Campharaceous	Camphor	Moth ball
Musky	Penadecanolactome	Angelica root
Floral	Phenyl ethyl alcohol	Roses
Pepperminty	Menthol	Mint candy
Ethereal	Ethylene dichloride	Dry cleaning fluid
Pungent	Acetic acid	Vinegar
Putrid	Butyl mercaptan	Rotten eggs

Flavour Enhancers

These compounds by themselves do not have the flavouring activity but can intensify or enhance the flavour of food. This property is dependant on the structure of the molecule, and the activity depends on the pH of the medium.

E.g.: Monosodium glutamate (MSG), Tricholonic acid, Ibotenic acid, Inosine 5 monophosphate (IMP)

Activity of a compound like IMP is dependant on the water content as well as the enzymic activities of the medium. Since IMP is a 5 nucleotide it is unstable for irradiation.
Certain compounds like MSG can cause cancer.

Sweeteners

Sweeteners have the notable characteristic of sugar. These compounds which can show the same property at different levels are known as sweeteners. The ideal sweetener would fulfil all the characteristics of sugar, with the exception of two attributes.

(a) Sugar substitute should not be fermentable by the micro-organism in the mouth
(b) It should have a low energy value

Depending on the sweetening capacity, sweeteners can be divided into two major groups.

(a) Intense sweeteners
(b) Bulk sweeteners

Intense sweeteners (e.g. aspartame, saccharin, acsulfame, thaumatin) have a sweetness many times that of sugars and are therefore used in small amounts. Bulk sweeteners have about the same sweetness as sugar and are used at the same sort of levels as sugar (examples of such sweeteners are sorbitol, mannitol, isomalt, hydrogenated glucose syrup and xylitol). However, it has been revealed that long-term use of cyclamates, which is an artificial sweetener, cause cancer in the stomach and other organs in the digestive system.

Modified starch

Starch which has been treated physically or chemically to modify one or more of its key physico- chemical properties is known as modified starch. Seven types of modified starches are available in the market.

Origin of modified starch can be corn, wheat, rice, potato, tapioca, etc.

Anti-caking agents

Anti-caking agents help to keep powders such as milk powder, tea, coffee, sugar, salt etc, flowing freely rather than sticking as lumps.

Starch, magnesium carbonate, silica, calcium silicate, stearic acid and sodiumaluminosilicate are considered as synthetic anti-caking agents while talc and bentonite are considered as natural anti-caking agents. .

Anti-caking agents can affect the physical properties of the food material. It does not act chemically. For example magnesium carbonate is used in icing sugar. They are generally harmless with a flat bland taste. Octadecyl ammonium acetate is used as an anti-caking agent in bakery products.

Thickening agents

These are substances that help to maintain the thickness of the medium. When thickeners are added to beverages they absorb the fluid and thickens the beverages. Breaking down the starches reverses the thickening action and almost all water in the beverage is available as free fluid for absorption by the body. Modified food starch or certain vegetable gums are examples of thickeners. When the thickening agent is a vegetable gum, it will continue to remain as cold water even during digestion. So this may reduce the fluid availability to the body. Commonly

Table 7 : Modified starches and their properties

We can find tartaric acid in grapes, pine apples and potatoes. Without the presence of these acids fruits may taste bland. Also food acids help us in food preservation and for jam and jelly setting. Also these acids have antioxidant and preservation properties.

used thickening agents are pectin, agar agar, lignin, algin and carageenan like gums.

All food gums are polysaccharides. They are odourless and tasteless and may have a nutritional quality besides the primary function. Also they help in digestion and may be used in laxatives.

Food acids

These are the only edible acids. Presence of these acids sharpens the taste of any food. All the fruits have these acids and give the typical taste of the fruit.

The naturally occurring food acids are citric acid, malic acid and tartaric acid. These are also called wholesome acids. Food acids are found in oranges, grape fruits, pineapples peaches and other seeded fruits.

Table 8 : Food acids and their sources

Citric acid is the commonly used food acid. All the other food acids are available naturally except phosphoric acid. Phosphoric acid is used commonly in aerated drinks along with carbon dioxide.

Emulsifiers

When preparing a food item we have to combine the natural components of food into a consistent and pleasing blend. The food components such as carbohydrates, proteins, oils, fat and water have their own properties and sometimes act counter to one another like for instance oil and water. To make the components compatible emulsifiers are used. An emulsifier acts as an interface between the conflicting components.

An emulsifier is a molecule with separate water and oil friendly ends where the oil droplets are surrounded by the emulsifier molecule. The oil core is hidden by the water friendly tails of the emulsifier. Milk is a classic example for an emulsion. Milk is a complex mixture of fat suspended in an aqueous solution. Egg is also commonly used as an emulsifier.

Emulsifiers are used in creams, sauces, and bakery and dairy products. They may be derived from natural products or produced synthetically.

Common emulsifiers are lecithin mono and diglycerides of fatty acids, esters of monoglycerides of fatty acids and phosphated monoglycerides.

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Lessons on Food Safety

P. Madarasinghe

Challenge before us

Hundreds of thousands of deaths have occurred in the past due to contamination of food and pollution of water resources' and this continue to happen even today. Despite the fact that the world has achieved great advances in modern technology, a notable increase is seen in the prevalence of diseases associated with food and water, and this situation is equally applicable to both developed and developing countries. This is supported by the World Health Organization reports which reveal that 1.8 million deaths have occurred throughout the world in 2005 alone. The majority of these deaths have been reported from developing countries, and infants and children are the most vulnerable to these diseases.

The pattern of prevalence of diseases in a country depends on the life style, food practices, health of the living environment etc. of the people, and fluctuations in the incidence of microbiological, chemical and physical factors. Today ensuring food hygiene encounters many challenges, the resolution of which have become increasingly complicated.

Weaning from natural foods

In the past there was plenty of fresh food and fruit for consumption available through the generosity of nature. However, with the increase in population, the yields of such foods became inadequate to meet the demands of the growing population. As a consequence it became necessary to increase the yields through adoption of various methodologies to satisfy requirements, and as a result the simple food style that had been developed until then had to be translated into a complex one. Accordingly artificial foods grown with chemical manure, insecticides, growth hormones, modern machinery and equipment, and manufactured using additives, colouring essence and chemical preservatives, packed in attractive containers began to flood the market instead of fresh food.

In the context of the existing life styles, these foods have become part and parcel of their day to day life, and the

responsibility to supply food requirements to millions of people around the world has gradually shifted from nature's traditional generosity to the hands of cultivators, manufacturers and supply institutions. Although rules and regulations have been formulated to ensure the safety and quality of foods under this gigantic food supply process, it has become evident that there are hazardous effects which have already come into existence and may continue to exist in the future along with the increasingly complex food supply process.

The "Minamata" Tragedy and its after effects

The 'Minamata' incidence in Japan brings to our memory the danger and complexity involved in a food supply process.

In 1950 the people living in 'Minamata', Japan had an interesting experience. They observed that the animals displayed an abnormal behaviour. The cats were seen jumping around unnaturally and died after struggling for sometime. The crows that were flying high in the sky too fell, while the fish in the sea died and were washed ashore.

In the meantime, a 5-year girl suddenly fell ill. Then she became dumb and unconscious and was finally hospitalized. Later her sister too went through the same

ordeal. Subsequently a survey was carried out by the authorities concerned that showed that a large number of people had suffered same symptoms.

Consequently, the Disease Control Committee of 'Minamata', took immediate action to prevent the spread of the disease, and isolated the persons with above symptoms. They also disinfected houses. However, most of the people living in the area left their houses on hearing about the illness, and wherever they went they were discriminated and ill-treated.

The number of patients increased by thousands and an Investigation Group from the Kumamotor University initiated a special investigation on the occurrence and the spread of this disease.

Studies on the affected people revealed that they had developed symptoms of loss of voice, numbness in hands and feet, loss of hearing and eyesight, difficulty to swallow, and leading finally to total disability. In the end they became unconscious and die as a result of the effects of the disease.

The investigations of the Committee revealed that most of the people affected were fishermen, who consumed mostly fish with their meals. This observation led them to believe that the disease was due to a food poison.

In the post-mortem examination of body parts of the dead animals, as well as studies on water samples and of geological structures had shown that the disease was due to metal toxicity and that the poison had entered the body of the fish through water, and the animals and people who consumed these fish had contracted the disease.

Source of pollution and magnitude of the disaster

The Committee which carried out the inspection found no difficulty in identifying the source of water contamination. It was confirmed that the toxicity was due to the discharge of the chemical methyl mercury into the 'Minamata' lagoon by the Chisso Corporation, which is an industrial centre manufacturing acetylene, acetaldehyde, acetic acid and vinyl chloride in the Minamata Province.

The most important observation was that methyl mercury at a later stage had a serious effect on children of this area causing neurological diseases. The parents of these children did not have the symptoms of this disease and the children too had never taken these poisonous fish for their meals. Normally the transfer of chemicals in mother's blood to the foetus is prevented by the placenta. However, methyl mercury behaves differently in expectant mothers, in that the toxic chemical passes through the placenta and cause serious effects reflecting the characteristic Minamata symptoms.

In the context of the existing life style, these foods have become part and parcel of their day to day life, and the responsibility to supply food requirements to millions of people around the world has gradually shifted from natures traditional generosity to the hands of cultivators, manufacturers and supply institutions

The disease that spread so rapidly accounted for about 2200 patients in Minamata within a few years. Of these 1984 patients had died and compensation had been paid by the Chisso Industries for more than 10,000 affected people. The unfortunate aspect of this situation is that the majority of the patients suffering from these diseases are infants and children.

Should Sri Lanka risk being another 'Minamata'?

There is evidence that calamities associate with toxic chemicals are on the increase in our country, although not of the magnitude of the Minamata disaster. This has been revealed from a study of statistics on the imports of insecticides to our country within the last several years as evident from the data summarized below.

A total of 6,704.49 MT of insecticides have been imported in the year 2005 to be used or sprayed on a land area of 25,262 sq. miles. These chemicals are deposited on crops and water bodies, and are gradually absorbed into our food. There are serious adverse effects due to absorption of these chemicals into our system. Although death may not be the end result it may lead to various complicated disease conditions, such as serious

liver dysfunction, kidney infections or malignant diseases associated with the stomach.

Import of insecticides in the recent past (in metric tons)

	2003	2004	2005
Insecticides	1684.4	1359.68	1921.81
Herbicides	2925.1	3273.74	3883.1
Fungicides	792.18	749.62	899.58

In addition to the absorption of certain chemicals to our system through the environment without our knowledge, a number of other different hazardous substances also enter into our system through artificial additives, anti-oxidatives and non-oxidatives.

The maximum levels of chemical additives that could be included in food have now been identified, while action has been taken to prohibit the use of dangerous chemicals.

For instance in terms of Food (sweeteners) Regulations 2003 under the Food Act No. 26 of 1980, artificial sweetners such as sorbitol, mannitol, lactitiol, asparatame, sucralose and sacharin can be used to sweeten foods, but restrictions have been imposed on the limits for such additives. Also it has been made mandatory for manufactures to include the warning label in legible letters that read "Not recommended for children", in respect of aspartame used as a sweetener, and the warning that "excessive use may cause purgative effects" in respect of chemicals such as sorbitol. However, the question is how far do consumers take an interest to read these warnings.

Microbiotics infections

It is important to stress that chemical hazards are not the only threats that consumers face when we discuss about the food safety. The microbiotic infections too cause several diseases.

It is significant that both developed and developing countries are often affected by these microbiotic infections. In United States of America alone the number of people affected by diseases associate with food infections in a year exceeds 76 million, while the number of patients hospitalized is around 325,000. The number of deaths due to such infections stands at 50,000.

The spread of new diseases associated with microbiotic infections has even in developed countries become the focus of attention for food hygiene analysts. The prevalence of Mad Cow disease in Great Britain in 1996, and the disease condition of E-coli 0157:47 that prevailed in the same year are few such examples. Around 6000 school children had been affected by these disease conditions.

In the United States of America more than 400,000 people have been hospitalized due to parasites in the pipe-borne water. In Malaysia about 900,000 pigs were killed due to a disease condition that originated with Nipah virus of pigs. In 1998 all the livestock farms had to be closed in Hong Kong, and the birds killed to prevent the spread of bird fever epidemic among the people.

Ensuing food hygiene and safety

The diseases associated with food has become a serious threat to the people, their personal economy, and to the economy of the country as a whole. The control of this condition needs the support and contribution from 03 main sections i.e. the State sector, food manufacturing sector and the consumer sector.

The State has contributed by formulating necessary rules and regulations for promotion of food hygiene, creating a system for proper implementation of such rules and regulations, and by the establishment of a laboratory service for detection of food poisoning and adulterations.

The food manufacturers should contribute through the supply of quality hygienic food from their farms to the table in compliance with good manufacturing practices.

The consumers too should be made knowledgeable and vigilant in selecting their food without being misled. The consumers should have an understanding about the risk of becoming victims to microbiotic infections and chemical disasters, and take preventive measures in the selection and consumption of such food, rejecting the places where such food items are offered for sale.

P. Madarasinghe
Assistant Director (Food Control)
Ministry of Healthcare & Nutrition

What have you learnt? Scan your own memory!

1. True? False?

(a) Post harvest losses in developed countries remain 10% or less while in developing countries the values are excessively high ranging from 20-40%.
(b) Post harvest losses of a commodity can be reduced by adopting improved post harvest technologies alone.
(c) Climacteric fruits (i.e. banana) should be harvested at properly matured unripe stage.
(d) Vegetables such as okra, ma, beans, and luffa should be harvested at the mature stage.
(e) Before marketting, insect damaged and disfigured fruits and vegetables must be discarded and the rest should be packed in rigid, ventilated, shallow containers.

2. True? False?

(a) SLSI monitors the manufacture of SLS marked products continuously.
(b) The premises where the water is bottled should also be registered.
(c) In food standard formulation, Sri Lanka follows the standards adopted by European countries.
(d) The common name should be mentioned clearly in one language.
(e) The Chief Food Authority's (CFA) approval is necessary to improt or manufacture any genetically modified organism.

3. True? False?

(a) Cleaning and sorting are not included in preparatory operations employed in the food industry.
(b) Osmotic dehydration is another way of removing water from food commodities.
(c) Pickling is the process of preserving food by acrobic fermentation in brine (a solution of salt in water) to produce lactic acid.
(d) The pioneer of food canning was a french confectioner, Nicolas Appert.
(e) Irradiated food is not radioactive.

4. True? False?

(a) Food additives are substances added internationally to food stuffs to reform to certain technology functions.
(b) Although 2000 artificial colours are available in the market, only about ten (10) colours are used as food colouring agents.
(c) Preservatives are substances added to foods to promote the growth of bacteria, yeast and or moulds.
(d) An antioxidant tends to prevent oxidation.
(e) Flavours are not aromatic compounds.

5. True? False?

(a) In 1950 the people living in 'Minamata', Japan observed that the animals displayed an abnormal behaviour.
(b) Methyl mercury at a later stage had no effect on children of this area causing neurological diseases.
(c) A total of 6,704.49 MT of insecticides have been imported in the year 2005 to be used or sprayed on a land area of 25,262 sq. miles (Sri Lanka).
(d) Chemical hazards are the only threat that consumers face when we discuss about the food safety.
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Answers

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School Science Society Programme at the NSF

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School Science Society Programme (SSSP) has been established to register School Science Societies (SSS) with the NSF with an objective of fostering students to acquire knowledge on latest developments in various fields of science and technology, to make them aware of scientific knowledge in day to day activities and to improve their standard of living.

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The registration has to be renewed annually and a sum of Rs.50/= should be paid on renewal. Renewal forms could be obtained from the Science Popularization Division at NSF or through the web.

Registration would be cancelled if any SSS uses the name of the NSF for its activities without prior approval from the National Science Foundation.

3. **Benefits to the School Science Society**

1) NSF will assist to organize various activities related to science and may provide funds required for the activity (up to Rs.10,000/- per programme per school), based on the proposal submitted. NSF will also assist the School Science Society by providing resource persons (leading Sri Lankan Scientists from Universities and Research Institutions).
2) A copy of Vidurava Science Magazine will be sent to all the registered School Science Societies.
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T/P: 011-2696771-3
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