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FOOD STANDARDS AND HUMAN WELL-BEING

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Food is a necessity of life but living beings, for example the humans, who are the consumers of food, are being handicapped by the fact that food is also a perishable commodity. In order to meet with the ever-increasing demand of the population explosion of today's world food has to be produced at the expense of valuable resources. One may define food as a palatable substance which when metabolised by living beings, produces an array of materials and energy in different forms, that would enable them to manifest the characteristics inherent to living beings which essentially distinguish themselves from the dead. A food could either be a solid or a liquid in its form but is invariably made up of one or, more commonly a mixture of, six components known as 'nutrients'. Each nutrient possesses a characteristic and an unique chemical composition that gives it a set of inherant properties, which qualify it to perform at least one specific and significant body function of the living beings. Out of the six nutrients the first three namely, the Carbohydrates, Lipids (Fats and Oils) and Proteins mainly provide the energy necessary for living. The all important dietary fibres which are known to facilitate proper digestion of food and reduce the incidence of alimentary tract diseases of humans are also provided by Carbohydrates. The Proteins in addition are essential for growth and tissue replacement. Water the fourth nutrient is the life sustaining solvent and medium through which vital body functions are performed. One could survive for several days or perhaps weeks on-end without food, but would sooner perish without water as a result of dehydration. Vitamins and Minerals are the last two of the six nutrients. Though they are required in very much smaller quantities than the rest, Vitamins and Minerals nonetheless are essential for the regulation of body functions. Vitamin and Mineral deficiencies are quite well known to bring about various disease syndromes not only in man but also in his farm animals.

A human being should ideally consume food which would provide at least the adequate (but not excessive) quantities of the six essential nutrients mentioned above required to supply sufficient energy and building materials necessary to maintain life so that he could remain healthy and perform normal biological functions smoothly and continuously. A wholesome food that meets the above criterion is known as a 'balanced diet'. A balanced diet should provide a man with sufficient energy, not just to keep him alive but also for any specific individual to carry out his normal day-to-day activities. It has been estimated that about 1 Kilocalory (K cal) of energy is required to just keep a human being alive. This figure has been arrived at by measuring the energy required by a normal human being at 'complete rest' or 'asleep' to perform the involuntary body functions such as breathing, continuity of heart beat and blood circulation, maintenance of body temperature, functioning of the brain and so on. This measure which is known as the 'basal' or 'resting metabolism' rate has been found to increase from adults to growing young children to infants. More work the people do more energy do they require depending on how strenuous the tasks are. It has been estimated that an average healthy human being requires about 1700 K cal of energy a day for normal body functions.[1] This should increase as required by the demands of individuals engaging in light to strenuous daily activities. If the basic 1 K cal/minute energy requirement for resting metabolism of people and more over the additional energy required for today's hectic activities of man are to be met satisfactorily he should be pure and wholesome and free from any risk of being laced with contaminants irrespective of whether they are microbiological or chemical which if present in the food at or over certain specific levels as determined by scientific research could be injurious to public health.

Therefore, the need arises to ensure that the food one consumer is pure, wholesome and devoid of contaminants. This necessitates the acceptance that a given food item, inclusive of processed, prepared and raw food, should meet with certain material requirements, in terms of properties, characteristics, values etc, so that the consumption of such food on the one hand is safe and provides the expected energy for wellbeing of the consumer on the other. These requirements expressed verbally or in writing depend upon the purpose for which the individual food item has been intended for use, be it for infants or invalids. The level of acceptance of these requirements would stretch from a local situation, to national status and from there though international boundaries to universally adopted criteria, because of international trade. The requirements for a good, pure wholesome food may vary from the colour of a ripe and sound fruit to the fat content of milk powder for infants, to sugar content in the food intended for diabetics, and they are layed down (specified) as required by user demand or law. If such requirements for a food item were found to be satisfactory in use, and were documented, intended and decided upon to be put into practise to achieve an expected end - purpose, that document becomes what is called a 'specification' for that particular food item, and may be also called a 'food specification'. A food specification when 'recurrently' used to achieve and 'end-purpose' eventually becomes a 'standard food specification' or more simply a 'food standard'.

Therefore, the necessity for food standards stems out of the need for the recurrent use of specification required for different food items in order to ensure that those specifications are constantly met in practise at the user's-end. In other words food standards are simply a means by which a purchaser of food is ensured that what he buys is what it is supposed to be at each and every purchase. It is also a guarantee to ensure that the purchaser had neither been subjected to any forms of deception or frand with regard to the food he purchased nor had he received a short measure, Food standards have also become essential in order to prevent unnecessary spoilage and waste of good food on the one hand and also to minimise or completely eliminate the outbreak of food-borne diseases on the other; all of which individually and collectively contribute to heavy economic losses both at the national and international levels, consequently. It is obvious, therefore, that food standards are necessary at all levels of food production, be it processing, packing, food hygiene, storage, safe handling, transport, marketing and so on.

Speaking of food standards, a point of interest to be noted here is that the earliest recorded 'controls' (standards as they are known to us today) in the human history on merchandise were originated and intended for the simple purpose of 'keeping people honest.' Cheating and shortchanging each other in their daily trade transactions were the order of the day among people from time immemorial with no conspicuous shifting in frequency to what is being the practise today. The principle aim of the earlier 'controls' was then to protect the consumer and watch his interests, and today these same controls are being applied universally with a broader sense of vision than they had been at any time in the human history.

With the advancement of food technology and other allied fields of science the diversity of food preparations has become so large so that the demand for checks and controls for food, has increased. This is simply because of the ease with which the food could be adulterated and as a consequence, avenues for cheating and misleading, defaulting and decieving the consumer by misuse and misinterpretation of specifications of food has increased by many folds than ever before. Therefore the significance of food standards has become much more evident today for the wellbeing of human beings in general in the complexity of the modern society. Thus the constantly increasing choices and selections of what people regard as the necessities of the modern living have to be fulfilled to the consumer satisfaction, culminating in the protection of the consumer as the ultimate goal.

Food standards in any country are based on and regulated by the appropriate governmental laws and regulations which are enacted from time to time by the legislature. The first general pure food law to be published in an English speaking country is belived to be 'The Adulteration of Food and Drinks Act - 1860'

of the United Kingdom.[2] The objectives of any legal measures taken by any country with regard to food control policies are purely and basically, to provide the consumer with solid legal grounds to guide him and enabling him to select at his will a healthy, wholesome and nutritious food (diet) from a wide range of safe foods availabel for sale, at very competitive and economical prices. The compositional or recipe food laws that were in vogue upto a several decades ago are now been deregulated and replaced the world over by the more comprehensive pieces of legislation concentrating on the more signeficant and practical safety and labelling regulations. With regard to the specifications layed down for each food, uniformity is being adopted universally.

Such uniformity and consensus with regard to food standards around the globe has been made possible, primarily through the work of the Codex Alimentarius Commission which is an international body established in the early 1960's under the auspicies of the Food and Agricultural Organization (FAO) of the United Nations (UN) and the World Health Organization (WHO). Experts in food standards representing governments world-wide sat together in a joint committee in pioneering the work of the Codex Alimentarius Commission. A conference co-sponsored by the UN/FAO and WHO took place in 1962, where a timely proposal for the establishment of a joint FAO/WHO. Food Standard Programme was endorsed by the conference. The principal role of the Codex Alimentarius Commission is to implement the joint FAO/WHO Food Standards Programme, which is aimed at facilitating international trade in food stuffs while ensuring for all consumers a sound, wholesome product free from adulteration; correctly labelled and presented. The Codex Alimentarius itself is primarily a substantial collection of food and commodity standards for almost all raw, semi-processed and processed foods. They are adopted in their entirety or as applicable to national situations when they are used as guidelines for the formulation of food standards. The Codex standards are presented in a uniform format where all the relevant factors such as essential composition and quality factors, Food additives, Contaminants, Hygiene, Labelling etc. in addition to the general criteria are given under separate headings.[3] The Codex Alimentarius renders a valuable service in guiding the developing countries in the food standards formulation.

A code of ethics for International Trade in Food has also been adopted by the Codex Alimentarius Commission, which was established with a view to protect the people of developing countries from food-related health hazards and from fraud, as it is a recognized fact that there are many such countries around the world which are not yet in a position to come up with the necessary prerequisites.[4] The Codex Food Standards are based on sound scientific know how acquired by years of experience of the work of experts in the field of food throughout the world. It is not surprising that food standards of many countries are derived from the Codex Alimentarius and further the 'Food Act's and any subordinate or related legislation specially in most developing countries have provisions set out in them which are essentially the same as the underlying principles of the Food Standards Programme implemented by the Codex Alimentarius Commission. As layed down as one of the roles of the Codex Alimentarius Commission, the purpose of food standards is then.

'To protect the health of consumers and to ensure fair practises in the food trade'.

We living in the world today and those humans yet to be borne are all dependants on food standards to stay healthy as they are an essential part of human well being eternally.

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FOOD ADULTERANTS AND THEIR DETECTION

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The story of adulterated food is an old one. The relevant ligislation on food enacted in Sri Lanka before the second world war ie., Bread ordinance and Milk Regulations which related to the sale of Bread and Milk respectively. In 1949 Food and Drugs Act was introduced in Sri Lanka. The same was replaced in 1980 by the Food Act No: 26 of 1980. The present Food Act covers the manufacture, sale, distribution and import of Food and is applicable to the whole Island. A number of Regulations framed under this Act are being implemented to ensure the safe food for the consumers. The minimum quality requirements for most of the common foods are specified in these regulations. The sale of adulterated food is an offense and liable for heavy fines and/or imprisonment.

What is Food Adulteration? Eventhough there is no proper definition, but can be explained as follows. "The addition of foreign matter to any food to increase the bulk by which to get more profit". Also in certain cases it may be the removal of certain portion of a food eg. extraction fat from milk. We cannot exclude the "artificial" preparation of foods such as preparation of turmeric powder using wheat flour and artificial colouring matter ie. 100 percent adulteration . The preparation of foods using artificial ingredients and label them as natural products could also be considered as Food Adulteration. By all these means the end result is an enhanced profit.

These adulterants may be harmless or harmful. eg. addition of flours to turmeric is harmless while the addition of paddy husk to chillie powder or the preparation of sugar/flour confectioneries using non permitted colouring matters such as Metanil Yellow (yellow) and Rhodamine B(red) are harmful to the human body.

A survey of different types of foods in Sri Lanka would reveal the various adulterants present in those foods.

1. Ground Spices

This includes mainly chillie powder, turmeric powder, condiment powder, pepper powder etc. The common type of adulterants are wheat flour, rice flour, corn flour, brick powder, powdered paddy husk, saw dust, and poonac.

The detection of these foreign substances are carried out by the determination of total ash content, Acid Insoluble Ash content and finally the microscopic examination. The addition of flours to any of these speces will definitely bring down the total ash content proportionately as the flours do not contribute for the ash content. On the other hand the total ash and subsequently the acid insoluble ash content will be raised if the spices are adulterated with paddy husk, saw dust or brick powder.

The confirmation of the presence of these foreign matters as well as the spices is done by microscopic examination. Since all these are plant matters (except brick powder which is rich in Silica crystals) the characteristics tissues and other microscopic structures could be identified under the microscope. The values obtained for total ash content and acid insoluble ash content could be justified by microscopic estimation of the foreign matters.

2. Starch/flours

One of the common food items found to be adulterated in the local market is arrowroot. It has been reported that maize starch is the frequent adulterant. Less frequently Manioc starch (tapioca starch) has been

used to adulterate arrowroot. Of course the adulteration is the 100 percent and the detection of these foreign starches are only carried out by microscopic examination because the starch grain has its characteristic shape, size and hylum.

The rice flour found to be adulterated with wheat flour. Also it is reported that Kurakkan flour to contain rice flour and/or wheat flour. The detection of these foreign starches are only done by the microscopic examination.

3. Ground Coffee

The adulteration of ground coffee with roasted rice flour, roasted ground nut husks, roasted tammarine seeds are not new to the analyst. The detection of these foreign matters is done by the determination of total ash, water extractives and the caffeine content. The presence of rice flour will lower the total ash content while the presence of other vegetable matters will lead to the increase in the extract. Also it is accepted that the caffeined content of ground coffee should be not less than 1.25 percent. The addition of foreign matter will definitely lower this value and hence it is easily calculated the percent foreign matter. The final confirmation of the presence of coffee and other foreign matters will be carried out by microscopic examination.

4. Oils & Fats

The important oils in the Sri Lankan market are coconut oil, gingelly oil and less commonly ghee. The main adulterant in coconut oil is palm oil. On the other hand it is very common that the quality of coconut oil available for the consumers is far below the quality standard required by the Food Miscellaneous Regulations 1989. ie high free fatty acid content.

Lower quality coconut oil is the most common adulterant present in gingelly oil. Also it is known that the cotton seed oil has been used in the adulteration of gingelly oil. The occassions of use of paraffin oil as an adulterant have been reported. The detection of these foreign oils and other matters are carried out by the determination of two important parameters namely saponification value and iodine value. Ofcourse the high free fatty acid content is detected by simple titration with a standard alkali after dissolving the oil in neutral alcohol. The Saponification value and Iodine value are characteristic of any oil.

	Coconut Oil	Gingelly Oil	Palm Oil
eg. Sap. Value (av)	255	200	200
Iodine Value (av)	8	100	50

If gingelly oil is adulterated with coconut oil the saponification value of the resultant mixture should be in between 255 and 200 depending on the proportions of each type of oil, ie. the higher the coconut oil content the higher the saponification value. On the other hand the Iodine value lies between 8 and 100. ie. the higher the gingelly oil content the higher the iodine value.

When only two oils are present the proportions of each type of oil could be calculated conveniently using saponification and Iodine values of the mixture. At the same time the qualitative tests to detect the presence of these oils are carried out.

It has been reported that Ghee (mostly used as an Ayurvedic ingredient) is adulterated with palm oil, lard tallow or paraffin wax. There were occasions of the artificial preparations of ghee using palm oil (specially stearing portion) and non permitted colouring matter-metanil yellow. The purity of ghee is assessed by the determination of the special parameters called Reichert, Polenske and Kirshner values. (The definition of these values are beyond the context of this text). These values are characteristics of ghee and the deviation from these values will show the presence of foreign matters.
eg. If butter is adulterated with margarine by the determination of the above three values it is possible to calculate the percent butter fat in the sample.

The presence of paraffin wax is detected by Holder's test and the unsaponifiable matters (wax) could be estimated.

Other than these classical methods it is possible to determine the purity of these oils & fats using the Gas Liquid Chromatography.

6. Vinegar

Food Regulations requires Vinegar to contain a minimum of 4 percent acetic acid. Vinegar could be prepared either naturally from the fermentation of coconut today (or malt) or artificially by the dilution of acetic acid.

Obviously the most common adulterant is water. The acetic acid percentage is obtained by a simple titration with standard alkali solution. By labelling the artificial products as natural vinegars or by using a label with pictorial representations of coconut trees etc. to imply the product is natural is not uncommon in Sri Lanka. This is an indirect way of adulteration by which the consumer is mislead. The secondary constituents such as ketones, aldehydes and ester etc. which are the by-products of the natural fermentation process are useful indicators in the differntiation of the natural and artificial vinegars. The alkaline oxidation value, Acid oxidation Value, Ester Value and Iodine Value, of vinegar are used to differentiate between the two types.

The use of formic acid in the manufacture of Vinegar has been detected. Even the mineral acids may be present in vinegars. The qualitative tests are carried out to determine the type of acid present in the vinegars. ie. Acetic, formic & mineral acids.

7. Honey

Honey is another ingredient for Ayurvedic preparations. The most common adulterant is sugar syrup. One can differentiate the natural honey and sugar by the determination of dextrose / fructose ratio.
Also the presence of sugar syrup is detected by identifying HMF which is only present in sugar syrups.

8. Sugar and Flour confectioneries

Eventhough these food items are not adulterated, it is useful to consider the non permitted colouring matters present. The two non permitted colouring matters used in these industries are

1. Metanil Yellow (yellow colour)
2. Rhodamine B (Red Colour)

The detection and identification of these colouring matters are done by the extraction, followed by paper chromatographic seperation.

Metanil yellow can be defecteed by the addition of few drops of dilute mineral acid (such as hydrochloric acid or Sulphuric acid - Battery acid) to the food. The change of colour from yellow to pink shows the presence of this colouring matter.

9. Milk and Milk Products

Milk is a liquid obtained from the complete emptying of the udder of a lactating cow. The main constituent of milk is water (87.5 percent) while protein, fat, carbohydrate (lactose), minerals and vitamins are other ingredients. According to the Food (Standards) Regulations 1989 the cows milk should contain a minimum of 3.5 percent fat and 8.5 percent of Milk Solids other than fat.

There are number of types of liquid milks available in the market with different minimum levels of fat and milk solids other than fat.

It is well known that the milk is adulterated with the addition of water. On the other hand the extraction of fat from milk is also an adulteration. The adulteration of milk can be defected quantitatively by the determination of fat and total solid content.

10. Ready to drink beverages and cordials

According to Food (miscellaneous) Regulations 1986 ready to drink beverages prepared with fruits should contain a minimum of 5% fruit juice, and cordials should contain not less than 25% fruit juice. On the other hand it is also possible to prepare these two drinks artificially using water, sugar colouring matters

and artificial flavours. But they should be labelled as 'artificial'

It has been found that the artificial preparations are labeled as natural or use labels with pictorial representations of fruits of fruits to imply them as natural products. This is misleading the consumer. It could be considered as adulteration because the consumer is not getting what he wanted.

By the adition of more water the fruit content will be lowered, hence the product is adulterated. The detection of the fruit content is carried out by the determination of the Potassium and Phosphorus content. By comparing these figures with the recorded levels one can calculate the percent fruit juices present in a particular, product. Also it is possible to defect the natural and artificial flavours by gas liquid chromatography.

The other problems with these two types of drinks is the use of saccharin as an artificial sweetner. According to Food (Non - nutritive Sweetners in Food) Regulations 1990 saccharin is not allowed in any food. The sweetening power of saccharin is 550 times that of sucrose.

So the use saccharin is profitable, and it has been found saccharin in some of the ready to drink beverages specially in certain "drink packets". The quantitative detection of Saccharin is done by extraction with diethyl other followed by titration with standard alkali using bromothymol blue as an indicator. The qualitative tests are carried out to confirm the identity of extracted saccharin.

Adulterated food in the Sri Lankan market is not very uncommon. The above given is a brief outline of certain common food items. Under the Food Act No: 26 of 1980 a number of Regulations are framed and they are in effect now. The consumers must be vigilent against the food adulteration. The chairman of the local body, Medical Officer of Health of the area, the Public Health Inspector are the Authorised officers under the Food Act. Any complain regarding any food should bring to their notice without any delay.

However the legal action alone cannot irradicate such malpractices. The consumer as well as the producer must be given a knowledge on the food standards etc. This could be done through the media such as news papers, Radio and Television. Audio visual programmes are the most successful in the education of public. Which is lacking in Sri Lanka. This knowledge could also be given to the school children by way of conducting seminars, public lectures etc. The public awareness on the quality of foods is of greater importance. This will lead to the manufacture of quality foods. It should be born in mind of every citizen that every one is a consumer.

The legal action against the food adulterations and the consumer / producer education would lead to guarnteed quality foods to the people.

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GLUTEN PROTEINS HOLD KEY TO BREAD QUALITY

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Sixteen strains of curiously short, stiff-strawed, heavy headed wheat plants were sent to World Collection of Small Grains in Beltsville, Maryland by an agronomist who was assigned to General MacArthur's head quarters in Japan immediately after the second world war. Norman E. Borlaug, working at the International Maize and Wheat Research Centre (CIMMIT) in Mexico used these lines in his hybridization programmes to improve the wheat crop. Newly developed semi-dwarf varieties distributed by CIMMIT in the 1960's to India, Pakistan, Afghanistan, Mexico, Turkey and other developing countries sparked the Green Revolution which was later followed up with similar rice varieties developed at International Rice Research Institute, Philippines. Despite some negative side effects of green revolution, it helped countries often threatened by starvation grow into modern, self-sufficient, and in some cases, food exporting nations. Norman Borlaug was perhaps the first agricultural scientist to win a Nobel Peace Prize, which was awarded to him in 1970 for his contribution to peace and development through Green Revolution.

Unique Products From Wheat Grain

Wheat products are becoming more and more important in our daily, lives. When it comes to breakfast, bread is every working house wife's choice. For increasingly diet conscious urban dwellers, the bakers produce a vast array of breads from whole wheat (more fibre) to more airy Italian or French white breads. Besides a number of types of sandwich breads and rolls, there are other products from east, west and the new world such a tortillas, won-tons, pitas, bagels, croissants, couscous and the popular pizza. There are dozens of different kinds of cakes, cookies, doughnuts, crackers, and biscuits as our snacktime and dessert specialties. The flour crust on the fried fish, cutlet or patties add taste and colour to these products.

It's not only to the kitchen that wheat finds its way in our homes. Iron, thiamine and riboflavin extracted from wheat bran are more expensive and valuable than the cheaper synthetic vitamin or mineral substitutes. The shampoos containing wheat-germ oil and cosmetic powders made with wheat flour are common in the market. Today's most common building material - plywood makes use of wheat glue. However, the future of new wheat products is going to be predominantly in the food industry.

Why do we have to depend solely on wheat flour to bake our bread ?. Wheat is the only grain that can be made into a dough that rises and produces light, sluffy baked products. The most important dough making components in wheat are it gluten proteins. the presence of glutens enable the wheat flour to produce strong but pliable doughs.

History of the Wheat Crop

Bread has been one of the first words in the vocabularies of ancient civilizations. Scientists have unearthed kernels of wheat from the ruins 6700 years old ancient village of Jarmo in Iraq, which laid buried in the fertile plain of the upper valley between Euphrates and Tigris. Egyptian murals uncarthed from tombs along the Nile depict the whole process of cultivation of wheat from sowing to harvest by sickle. Roman and Greek mythology also has much to say about wheat. Although early civilizations heavily depended on wheat, it was probably not for bread as we know it today, because original forms of cultivated wheats had seeds too tightly enclosed in hulls that pounding, perching or boiling would have been necessary to release the seeds. Such technology destroys the gluten which enables the dough to rise. Nevertheless, it will not be surprising if one day an archaeologist finds clues to milling technology that would have enabled our

ancestors to mill such primitive forms of grain, for they have created such wonders in the past leaving us to ponder even today.

There are about 20 closely related species which make up the genus of Triticum to which wheat belongs. The chromosome numbers vary from 14 in diploid primitive forms to 42 in hexaploid bread wheats having six sets of chromosomes. The intermediate tetraploids have four sets of chromosomes. It is believed that the bread wheat originated by the crossing of a diploid form with a tetraploid. Tetraploid wheats even now grown for special products such as mackaroni's have higher protein content and could be the possible sources of genes for increasing the protein level in common wheat.

Nutrition Value

Nutritional content of wheat depends on the climate, variety and many other factors. Wheat in general contains more protein than rice or corn and averages to 13.6% . The major component is carbohydrate averaging about 72.5% which gives a steady supply of energy.

The fibre in our bread along with those from other foods is undigestible but beneficial inhelping to lower the risk of heart disease and colon cancer. It helps to control diabetes too. The wheat folur contains about 2% fibre whereas the bran, the fibrous covering of the kernel contains more than 7% fibre. The bran is removed in milling except in whole wheat flour which is a rariety in our country due to monopoly of certain companies that import whole grains of wheat for milling. The bran contains not only fibre in greater amounts, but also the bulk of the B vitamins and trace minerals.

The seed's embryo or the germ contains nearly all of the oils which are predominated by poly unsaturated fatty acids, mainly linoleic. These acids are the precursors of prostaglandins, which help the body to regulate its hormones. There are a number of vitamins and minerals which we get in relatively large quantities from wheat. There are the B vitamins thiamine, niacin and riboflavin which help in the fat, carbohydrate and protein metabolism and their effiecient use by the body. The trace metals like magnesium and potassium are useful for the proper functioning of the cardiovascular system, particularly the heart. Selenium helps in the protection of cell membranes.

Gluten too has It's Quality

Improved nutrition and quality of baked products depend on the quality of the flour itself and also on the process baking. The flour quality can be imroved by the use of advanced milling technology on the grains of improved varietes. Not only the total protein, but also the gluten part of it has captured the interest of plant breeders developing new cultivars. Gluten is composed of 100-200 peptides joined in numerous combinations that affect the nutritional as well as physical properties of the protein. The two main constituents in gluten are gliadins and glutanins. Recent developments in analytical procedures related to protein chemistry have enabled scientists to detect high quality genotypes early in the breeding process. For example, reversed-phase high performance liquid chromatography help the breeders to identify gliadins which relate to baking quality in small samples, as small as half the size of a single seed. Thus, they can use the endosperm part without the embryo to analyse the gleadins and use the part containing embryo to raise plants from seeds having high quality gliadins for multiplication.

During the period of green revolution less attempts were made on the improvement of quality. In striving for high yields the protein seem to have decreased. This is because the increased yield was achieved through increased carbohydrate content in the seed which requires less photosynthates to produce than a unit of protein or fat. Nevertheless, there is substantial variability within bread wheat for protein quantity which is now extensively used by breeders.

High-tech Research for Quality Improvement

Recently biotechnologists sucessfully transferred a part of the rye chromosome that confers its high pro-

tein in seed to bread wheat. This part of the chromosome has genes conferring resistance to rust disease as well. Due to higher protein in these wheat lines the area under wheat having the IRS rye chromosome has increased in many countries. However, recent research has shown that the quality of protein from wheat seeds carrying IRS rye chromosome is not of high quality as pure wheat protein due to the presence of Secalins which are differnt from the wheat proteins gliadins and glutenins. Research is now underway to decrease secalin production in these high protein wheats.

Using chromatography techniques scientists have separated glutanins with different molecular weights. Results have shown that the glutanins of high molecular weights give greater strength and elasticity to dough, making better breads and rolls. These properties unable the protein to remain unaltered during the process of kneading. Further investigations have revealed that the disulfide bonds of glutanins can link one part of the protein chain to another part of the same glutanin chain. The disulfide bonds also help to attach one glutanin to another, glutanin thus making a mesh of interwoven threads of protein enabling the bread to 'rise' better. Identification of glutanin binding probes which comprise of specific antibodies has enabled scientists probe further into the structure of glutanings. This method is faster than others and is more accruate for testing the quality. Future research will be directed at modifying the glutanins to suit the requirements of bakers. At the moment, the difficulty is the lack of information on the details of disulfide bonds which impart greater strength to glutanins. Computer simulation is one way of overcoming this problem.

Standards Also Change with Time

For wheat grain importing countries like ours, it is important to know the standards that identify the quality of the flour by testing the grain. The price is determined by the hardness or softness and test weight, the weight of a unit volume of grain.

Conventional methods of testing by colour, shape and surface structure are no longer good indications of quality due to the presence of a large number of cross-bred varieties in the international trade. Nowadays, the classification into standard classes is not a guarantee of the quality of the grain.

Hard wheat is good for bread while white soft wheat is preferred for making cakes, biscuits, cookies, snacks, pastries etc. Unfortunately, there is very little choice for Sri Lankan bakers. With the fast sophistication of food industry in Sri Lanka, availability of different quality wheat flour will be a requirement in future, According to currently emerging technologies, near-infrared radiation is becoming a more objective and dependable method for testing the hardness of wheat consignments. Another possible alternative is particle size classification of milled flour. Distribution of particle size in milled flour is different in wheats of diverse origin and in wheats from different varieties and this can be related to the quality.

The challenge to scientists in the developing world is not only to develop good standards for identifying the quality of wheat that is being imported in large quantities from wheat growing developed world, but also to attempt the transfer of genes responsible for the breadmaking qualities of wheat to rice plant and other cereals that are widely grown in our countries. It is here that our officials responsible for disbursing research funds have to take bold decisions on funding biotechnology research, as no developed country will help us in research that will lead to drastic reduction of wheat imports from their own countries, as wheat holds the key to their economic strength.

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FOOD FOR THE FUTURE : NUTRITIONAL ISSUES AND CONSIDERATIONS

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We are still striving to erase hunger and malnutrition. The global picture is a varied one. Estimates around the world have demonstrated the inequity of distribution of food resources between the developed and developing countries.

Although there is enough food to be shared around, one observes the mountains of butter, skimmed milk and wheat accumulating in developed countries, and cereals perhaps fed to animals, whilst millions starve in the Sahara and go hungry in Southeast Asia.

But even within Southeast Asia, the food scarcity is unevenly distributed. The rich have plenty to eat and those below the poverty line go hungry.

"Food for the Future" would not mean the same for East and West, for the underprivileged and the privileged. The rich foods emerging from industry rather than agriculture in developed countries pose innumerable problems such as obesity, atherosclerosis, coronory heart disease and diabetes. These foods do creep into the supermarkets in our region and tempt the privileged, who too would suffer the same fate of overnutrition as enumerated earlier.

But that is not what is foremost in our minds today. Since we should be considering hunger rather than overnutrition. My task on this occasion is specific to consider the nutritional issues of "Food for the Future."

In this region, in many countries such as India, Myanmar, Bhutan, bangladesh, Nepal, Indonesia, Sri Lanka and Thailand, people have enormous nutritional disorders. We constitute a quarter of the world's population. Yet this human capital lacks its real potential. 10.5 millions of children are born with a low birth weight; almost 100 million suffer from protein energy malnutrition; nutritional anaemias affect millions of pregnant mothers; blindness due to Vitamin A deficiency is seen in nearly 10 million children; and the mental sequelae of Iodine deficiency, seen in about 17 million people in this region, cause disability which cripple thousands of children, men and women. Their potential to be useful citizens in the countries of their birth is destroyed.

The common factor running through the developing countries in this region is poverty and poverty begets hunger and malnutrition. It is in this background, that the forecasts for the future have to be made. Food has to be produced and distributed in the required quantities which could be purchased by all those who need it.

If my brief is to consider the nutritional issues then I have to rise beyond my role as a health educationist. There was a time when malnutrition was treated solely within the walls of health institutions. Today nutrition considerations pervade a whole series of multidisciplinary approaches. And I will find time, only for a brief overview of food strategies for the future. My accent will be on food for the hungry.

Food Production

57% of the undernourished people in the world live in Asia and the Pacific. As a result of poverty they have poor access to food. It is a fact that those who produce food seldom consume it but sell it to balance their basic requirements. The poor farmer also lacks the capital for modern technology. The return that he gets for his produce is poor. Some agricultural practices have turned out to be harmful. Arable land is limited.

Sri Lankan data shows that calorie intake rises with the size of landholdings. Only 15% of households in rural

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areas are landless. Then landlessness alone cannot predict poverty and undernutrition even in rural areas.

Modern technology has rapidly improved food production. High yielding varieties of wheat and rice composed what was called 'the green revolution'. The rich farmers had acess to fertilizers and pesticides. They also had the modern farming "tools" and techniques.

Nevertheless, developing countries too are expected to be sufficient for their requirements. We hear enconiums in countries of this region for self sufficiency in rice. Yet others have to find foreign exchange for food imports. Natural disasters and political instability have affected their food production from time to time.

Food Industry

Food Industry is not underestimated. In developed countries processed foods fill the market for the convenience of consumers. In developing countries, the urban populations may create a demand for food in a convenient and reliable form but at low cost. For the rural poor, their indigenous crops could be placed on a market for processing and would be income generating and even a source of employmnt.

Food Consumption and Food Prices

Some countries like India have adopted intensive agricultural technology. Yet they have not conquered their problem of poverty. FAO has for many years tried to build in nutritional considerations into agriculture and food production.

The Norwegian study in Sri Lanka showed that the cultivation of rice by the farmers in the river basin of Kirama Oya in southern Sri Lanka had a positive effect on improving family income. Rice is important nutritionally as well as culturally. Rice is also considered an important cash crop in the area. It can be stored easily and can mitigate seasonal fluctuations in food availability. Improved child nutritional status was associated with the higher paddy yields with the irrigation scheme in the area and an increased consumption of rice.

There are similar reports from other countries e.g. the integrated rural development in India where a milk cattle scheme provided monetary assistance to purchase milk cattle as an income generating asset. Family income and food supply improved there with resulting improvement of nutritional status in children.

These two examples among several other projects in the world prove the importance of income generating projects in improving food consumption among families. More food then must be equated with greater resources of materials and money available to the majority of people.

However, this is not always so. There must be an effort to obtain the correct type of food. If increased income is translated into the purchase of non-food goods, the availability of food is limited. This has happened and programmes have failed with lack of attention to such details as the purchase of the correct foods as mentioned. Among an educated population, nutrition may be a consideration in a decision on household expenditure. Among others, more expensive nutrients may be fancied sometimes. In the Sri Lankan study in Kirama Oya, it was claimed that the fair level of women's education influenced the choice of food. Thus if women have some control over household expenditure, food would be given adequate and correct consideration.

Other studies too in Sri Lanka by the Food and Nutrition Policy Planning Unit, have brought out the role of women's education in improving nutritional status. Further, women headed households showed better nutrition than others. The intrahousehold distribution of food is important as well as the awareness that individual family members are vulnerable to malnutrition such as pregnant women and children. Sometimes the wage earner gets the giant share at the expense of children. It would appear rational to them that he must be the stronger to maintain his earning capacity. This may be true enough. But the needs of growing children cannot be neglected.

Next, the effect of an increased output of food must influence the market supply so that there is a price reducing effect. This has to change food consumption patterns within households. Hence the price of food requires consideration.

FAO and the World Food Council have for many years suggested the build up of nutritional considerations in agricultural development. But in many countries, such planning is not necessarily given a thought.

Household Food Consumption Patterns

40% of Sri Lankan households do not consume the required calories. Food accounts for 74% of the total expenditure of households across the entire population. It approaches 80% for the poorest 20% of households (D. Sahn). It relates to the link up of poverty and hunger in a poor country. Sometimes, there is also a higher price paid per calorie and this reflects a shift towards more prestigious foods. This is very much the scenario in the urban area.

Next, intra household food distribution is important. In any culture, mothers serve themselves last. But it has been observed by Edirisinghe *et al.* that in Sri Lanka, although she eats last, she serves herself along with the other members of the family. This observation could not be universally applied. Perhaps, this would be obtained in an educated setting. In poor families, it may be that the preschool child is deprived, mostly because he himself makes no bid for food. He is anorexic, retiring and not agressive. The older ones are hungry and grab more than their fair share. In Sri Lankan studies, it has been observed that across the lowest socio-economic sector, the families with educated mothers had the least manifestation of malnutrition.

To mitigate this, on site feeding is proposed for the poorest of the poor. But such programmes are often nullified because the reaction then is to refrain from eating at home. Thus it ceases to be supplementary feeding and the diet continues to be inadequate.

Whilst on the subject of food prices and food consumption, an item of recent interest has been a new indicator providing an early warning drought monitoring system in areas of food shortages. This is of importance in the area of nutritional surveillance in view of the need for buffering of the poor to structural adjustment programmes. The market place is used as a sentinel site. A food related index which is appropriate to the vulnerable groups would be the price of staple at the local market. This approach is based on evidence that sharp increases in the price of food lead to lower food consumption by the poor and hence a worsening of the nutritional status. Personally, it strikes me as a laudable proposal advocated by the ACC/SCN.

Livestock Production

Livestock products can swell protein supplies especially eggs which not only provide income to small farmers like women but also are relatively inexpensive. However infections can cause heavy losses. Veterinary services can control disease and help in providing food for the future.

Some governments have embarked on importing cattle for breeding exotic animals that finally fail to adapt to local climatic conditions. Breeding systems are better adapted for local animals. Strategies should support the cultural requirements of the community.

Developing countries should expand their interest on this line utilizing crop residues and wastes for animal feed.

Fisheries

Fish provides an important source of animal protein. In coastal areas, fishing has been a livelihood for generations. The traditional fisher folk are poor and undernourished. Improvements in fishing technology are not available to them. Although in some countries of this region, this is most advanced as in Japan, in many countries these resources are dwindling. Thailand has effectively developed inland fisheries. However, most developing countries require the knowledge and expertise for the optimum use of these resources. Industrial effluents, fertilizers and pesti-

cides pollute not only lakes and rivers but also the seas around the coasts.

The best use of this resource has not been utilized in feeding the populations of this region.
What is the role of *food subsidies* in providing food acess to people?

The example of Sri Lanka is illustrative. For many years there was a system of rice rationing which ensured a just distribution of the local staple. This has been described by well renowned nutritionists as a nutrition intervention which has been unsurpassed in Sri Lanka. However, this had terrific economic repercussions. 15% of government expenditure in Sri Lanka went to food subsidies -- on rice, wheat flour and sugar.

Thus the food stamp scheme was evolved resulting in a substantial governmental saving. About 50% of the population are beneficiaries. It is not entirely satisfactory because there are leakages viz. higher income households have benefited to around one-third of the subsidy outlay. Further, some malnourished families have not received any benefit.

Examination of the choice of foods shows that rice was the most popular. Other foods were wheat flour and bread, coconuts and sugar. Although milk foods were offered for the exchange of stamps, these were not so valued.

Another problem has been that with inflation the real value of food stamps has diminished. In summary, the impact of food stamps has been marginal, from the earlier observation of 1,364 calories to 1,540 calories among the bottom 20%.

Thus there is great scope for improvement of the design of the programme. However, this could incur political opposition.

Food subsidies could be considered as temporary though important means to ensure that the poorest of the poor can obtain their nutritional requirements. To be cost effective they must be well targeted.

In many countries, subsidized foods are available to the poor through fair price stalls. Such programmes have to go on for a while in developing countries.

Food Aid has been the subject of much discussion and was an important agenda item at the SCN in the years when I was functioning as an Adviser there. Presently it amounts to over US 2.6 billion dollars a year.

In my consideration of nutritional issues, it must be stated that food aid has a definite impact on nutrition. Food aid in cereals has declined and is perhaps at its lowest level but is marginally above the target of million tonnes set by the World Conference in 1974.

There can certainly be no controversy about emergency food aid which has flown into many countries affected by natural or manmade disasters. FAO reviews World Food Security and has proposed a moral commitment to governments, non-governmental institutions and individuals for ensuring adequate food for the future.

Food aid can reduce the market price of food for the poor. It can provide the means to market intervention programmes. Two such useful programmes are *food for work* and supplementary feeding (Kennedy and Pinstrup Anderson).

An example of this was seen in the Mahaveli Development Programme in Sri Lanka where the duration of supply of Food for Work was shown to be related to the nutritional status of the settlers. Thus a flow of Food Aid for two years was recommended to maintain a state of nutrition which was earlier found to be much lower than the national average.

There are such reports from other countries too. The Bangladesh and IFPRI study however suggests that there is need to analyze this policy although the programme definitely revealed a reduction in indebtedness during the food-for-work period.

Certainly food aid must take questions of cultural acceptability of food and leakages into the local markets as points for consideration.

Supplementary Feeding Programmes have also been reviewed by ACC/SCN with the discussion paper by Beaton and Ghasseimi. In Mexico, it had been shown that perhaps a critical increase of 100 grams in birth weight was achieved through antenatal supplementation of mothers. In India too, the birth weight of infants born to mothers supplemented in the antenatal period was higher than those of infants born to other mothers.

However, much criticism is levelled at these programmes because of leakages and poor targetting. The beneficial effect cannot then be demonstrated. Supplementary feeding programmes have to go on until an alternative can be suggested. Their withdrawal could well precipitate more serious prevalence of malnutrition.

Food Technology

In earlier years, there was the emphasis given to proteins in food. Protein deficiency was highlighted. The protein Advisory group turned its mind to single cell proteins. Industry turned its interest to producing fish protein concentrates and their like. However, work in this region, specially in India, showed that in fact, there was only a marginal calorie deficiency in the diets. By correcting the calorie deficit, malnutrition could by eliminated.

Most countries in this region are on cereal legume based diets. This is culturally acceptable to most of the religious communities in the region.

The combination of rice and legume provides for an adequate array of amino acids which may be lacking in either alone (for e.g. lysine which is missing in rice is available in legumes).

However, specially for children, they pose a problem of bulk. Technologies that are simple yet reducing bulk would help to feed children the quantities that will meet their deficiency.

Formulated foods have been produced at commercial, village and home level. Multimixes have been advocated on simple culinary techniques. What is done at village level is the production of such mixes of ingredients by local milling as in Thailand. Even commercially, extrusion processes have produced cheap formulations within the purse of poor working women.

The International Soybean Programme (INTSOY) has popularized the extrusion cooking of beans followed by breaking down of the oil bearing tissues. The nutritional value is preserved without scorching and the antinutritional trypsin -- inhibitor factor reduced by 90%. It is also free of the beany flavour. This protein rich meal with 6% residual oil minus 90% of trypsin inhibitor can fortify wheat flour. Soya rich bread could be baked. This work has been popularized in both India and Sri Lanka.

Further, this soya meal can be mixed with maize which can be grown in Sri Lanka unlike wheat. There are proposals to make bread following several such recipes using locally grown cereals and pulses.

The accent in the past in agriculture was rice production. There is new thinking in promoting legumes and pulses.

Work in Baroda in India by John and Tara Gopaldas has been aimed at reducing bulk in gruels made for children by adding an amylase rich food (ARF). A catalytic amount of ARF, a germinating cereal flour added to a hot thick gruel was acceptable to children 6 - 24 months of age.

Calsberg Research Laboratory has produced weaning food with improved energy and nutrient density from germinated barely.

These applicantions of food technology have practical application in solving growth problems in infancy this region. For instance, in Sri Lanka, malnutrition commences after the sixth month in infancy due to poor infant feeding practices. Low cost weaning foods have tremendous application in this context.

The concept of a formulated or blended food was developed in order to provide the special dietary needs

of the infant over six months based largely on a mix of vegetable proteins. This was developed by the Central Agricultural Research Institute in Gannoruwa and the feasibility trials regarding use were done in our unit at the Lady Ridgeway Hospital for Children. The composition and nutritive values are as follows and a vitamin formulation was added.

Raw Material Composition (%)		Proximate Composition (%)	
Rice flour	48.8	Moisture	4.82
Soya flour	30.4	Protein (N x 6.25)	20.69
Green gram flour	10.0	Fat	8.40*
Sugar	10.0	Fibre	1.28
Vitamin mineral premix	0.8	Total Ash	2.57
		Carbohydrates (By difference)	62.20
	100.00		100.00

*(2.5% Linoleic acid)

Net protein utilization was 79. This was used on basis attending our "Well Baby Clinic" (follow up afer birth) and found to be satisfactory.

Several other formulations would be available from international recipes. The initial growth failure could be stemmed with the use of such foods.

Food Fortification

Micronutrient deficiencies in this region such as iron and iodine can be swept away in one swing by food fortification.

Fortification of a carrier like salt is possible by spraying with iodine whilst in the crystallizing process. In Sri Lanka, there is a cultural practice of washing kithchen salt before use and thereby any coating of salt with iodine could be lost before use. However, it could be well incorporated into salt whilst crystallizing, and this technology has been used in a project area with endemic goitre. However, unless all salt is so prepared, it is difficult to demonstrate results even in a project area covered with an education programme. The poor who really need iodine will still choose the cheaper packet of noniodised salt.

Endemic areas of goitre in India and Nepal are also working with iodised salt to solve large problems of endemic goitre and cretinism.

However projects of iron fortification though laudable in preventing nutritional anaemia in pregnancy have not been as popular.

In Brazil, Vitamin A deficiency was solved by the fortification of sugar. However, there has been no such interest in this region, though other Vitamin A programmes such as megadoses and educative programmes on the value of dark green leaves and yellow fruits and vegetables are constantly receiving attention.

Food Contamination and Safety

Food for good health must not only be available in sufficient quantity its nutritional content must be adequate. It must be safe for consumption by safe guarding it from contamination with infection, with herbicide and pesticide residues, pollution during production, processing storage and distribution.

The causation of food borne diseases include mycotoxins and additives which are carcinogenic agents. Diarrhoea initiates and intensifies malnutrition. Agricultural and economic implications of food production include the development of protein rich foods based on peanuts, cotton seeds, soya and other plant sources for the alleviation of malnutrition. Basically, good harvesting, drying, handling, storage, transportation and distribution procedures prevent the formation of mycotoxins.

Food safety also includes clean food vending through migratory and street vendors, hygienic take away food parcels and mass catering ventures.

The work of Codex Alimentarius, FAO and WHO extend to food standards for industry, labelling for better information and choices, and prevention of dumping of contaminated or substandard foods.

WHO estimates that only a fraction of global food borne disease is recognized. Water certainly is increin-

inated as the source of transmission of diarrhoea. But food is now considered as a source of diarrhoea. This aspect has been amplified with poor and unscientific deep frreezing. Chicken and other poultry can harbour salmonella inside the carcase if not correctly frozen. Storage of cooked products along with raw meats can be another cause of contamination. Food habits have changed even in the developing world, resulting in food borne disease due to mistakes in handling and storage, for example of fast foods.

Contaminated animal feed can also lead to an increase in food-borne diseases.

Health education on food handling and the standards expected by consumers must be well publicized. The provision of food inspectors and legislation on food safety cannot be prioritized in poor countries. On the other hand, chemical contamination can be prevented by enforcing legal standards. In actual fact, the hazards in food are mostly the result of poor food handling rather than by chemical agents. Primary health care workers need to educate families not only on nutritional aspects but also on food hygiene.

Almost every form of food processing including chilling and deep freezing marginally reduces the content of vitamins, proteins and fats. But processing makes larger amounts of food edible. Hence finally the disadvantages are offset by the advantages. Variety in the diet ensures good nutrition. The public outcry against preservatives has introduced the risk of earlier spoilage. Good packing reduces the risks of bad food handling. However costs of better packing prevent its wider usage. Foods of this nature are widely available for the affluent but would not be relevant to those living marginally in hunger.

Women and Nutrition

Today's programme designed by FAO has been around women. Our chairperson and the women scientists have been selected to compliment the role of women. It is an opportunity too to stimulate women farmers. I have recently written about nutrition for women the specific needs through their lifespan women are not only reproducers, they are the producers of food in all aspects and in many ways.

The resurgence of interest in traditional values such as health foods has recaptured an interest in breast feeding. Human milk is the first food for the human species and its value is unique. Thus in any discussion of food and nutrition, human milk must have pride of place. But it is the nutritive value that tends to be assailed by modern industry. This is not the occasion to enumerate all its advantages. Let its emotional and immunological value suffice if not its economical value for the whole world. Imagine for a moment if human milk did not meet the nutritive requirements of generations of infants, what a crisis would occur;

A working woman with access to enhanced economic resources could provide nutritious foods, especially the more expensive protein sources. It need not necessarily be so, if she spent her money on find clothing and prestigious processed foods, not of nutritive value. This same economic strength could be used with advantage in decision making at home level. She could with acquisition of knowledge of nutrition spend her money wisely on better food and nutrition for the family. She could even improve her culinary skills for better storage, preservation and household processing of food for the nutritious benefit of her family.

It is the woman who often looks after the home garden and the kinds of food poor people eat. In their absence, this resource would be lacking leading to poor family nutrition. They grow tomatoes, egg plant, gourds, pumpkins, various kinds of beans, yams, green leaves. They provide a rich source of Vitamins A and C, additional amino acids and calories. Women plant cassava in Nigeria and Indonesia and this is a good source of calories to fill that gap in the average developing country diet. Cassava is the best crop for poor soils; it grows with minimum or no attention. Traditional cooking practices such as grating make cassava more protein rich than urban nutritionists realize.

Women in rural areas have also been gatherers of wild plants and fruits, which can be a most vital reserve in times of drought.

Women are engaged in fishing in revers and streams. Women dry fish, smoke vegetable and animal produce and even trade these in open markets.

Women are primarily responsible for small animals such as chickens, ducks, goats, and even pigs. They are kept in the home compound.

Milk is also handled by women. They make curds, whey and cheese, and may not only engage in trading these but use them for bartering for food. This is a useful practice for poor communities because certain individuals may favour producing a particular commodity; whilst others have another preference. It is a practice that could be encouraged within a community.

Fuel is expensive but is crucial for culinary purposes. It is often the limiting factor for efficient purification of food, including that of infants of children. It cannot be overstressed that a household cannot economize on this procedure but rather reduce or combine the varieties that are cooked for a daily meal.

Alternative technology suggested for conservation include fuel efficient stoves, hay boxes, biogas, solar cookers and local adaptation of pressure cooking.

Simple culinary technology that preserves the nutrition value of foods must be a further point of importance in this area. Soaking of legumes obviates any unpleasant beany taste. It also reduces the time and fuel spent on boiling. Roasting and rolling with a 'pin' removes the husk of green gram and reduces the possibilities of indigestion. Many varieties of cassava have hydrogen cyanide which is removed by granting, drying or leaving the pan open when boiling.

Parboiling of cereals preserves certain nutrients that are otherwise lost in pounding and milling. One-sixth of the total rich rice produced in the world is parboiled. Thiamine is thus retained. Drying in the sun hardens the outer coat and makes it resistant to insects. On the other hand, if moisture is retained, aflotoxins can be produced.

Fermentation of cereals, beans, starchy roots, fruits and vegetables is common in Asia and the Pacific. These processes improve the nutritional value and digestibility. Toxins are reduced or destroyed.

Changes are coming slowly. The first Asian household nutrition appropriate technology (proceedings compiled by Ron Israel -- sponsored by Sri Lanka Government, IUNS, AID, UNICEF and INCS) brought together suggestions for technological improvement and research in the areas of family food gardens, food storage, processing, preparation, preservation and culinary technology, weaning foods and appropriate supplementation technolgy and food sanitation. Recommendations were developed on policies and programmes, training, information exchange and networking. On this occasion, Jelliffe and Jelliffe remarked: 'Recent years have shown increasingly that many long establised practices in rural communities have benefits which have been under-appreciated. For example, the traditional rather unkempt-looking multi-dimensional gardens in many tropical areas represent not only important sources of many additional nutrients to the family but also can help with income generatrion, can be self-sustaining as regards soil fertilization, can supply some food for domestic animals and can help improve the attractiveness of the surroundings. They are, in fact, self-sustaining scientific systems based on hundreds of years of practical experience. Modern science and traditional science are complementary. This is the case with regard to what has been termed "household appropriate technology." That is the technology needed to improve the small-scale production of foods in hime gardens, for storage, preparstion, cooking and serving of foods at the family level. For example, the huge losses of cereal grains and legumes to rats and insects after harvesting can be greatly diminished by scientific, low cost improvements to small traditional home granaries -- the effects of which can then be tested scientifically.'

'In addition, domestic "task analysis" can employ the scientific methods previously used by industry and cultural anthropologists to assess a village mother's

activities, especially time and hard labour, in the complex sequence that goes into collecting, preparing and storage of appropriate food mixtures for young children in poor circumstances.' Capital intensive technology will not help them for decades. It is the community control over local resources which must be nurtured to give women self-reliance. Thus policies and programmes seeking to improve the nutrition status of the world's poor must acknowledge the significant role that is played and can be played by women at the domestic level. It is when 'Cinderella evolves from her ashes' that being freed from household drudgery, she can have better access to education, health and family planning.

The time is ripe now for third world researchers to look at their own traditional cultures that can produce innovations in a style appropriate to a non-industrial society. Community developmental models are rediscovering the potentialities of folk knowledge.

What is more opportune is to give women the training to redesign the traditional mechanical devices. Women have creative skills and they must be included in modifying these tools that will reduce their own workload. They could contribute to reduce post harvest losses through rodents, insects and moulds.

Future Strategies for Food

My thoughts have already intermingled the present with the future; continuing in the same vein and focusing first on women and nutrition considerations, one has to create awareness among women on their future role. Most of the families who need help are already living to the limit of their resources. Extension workers may have enthused and motivated them. But they need 'seed money' to provide the initial subsidy to allow the new ideas to take root in the community. This is where *poverty alleviation* programmes such as that in progress in Sri Lanka could produce income generation without creating too much dependence but stimulating local initiative and full community participation.

Nutritionists who try to improve the ancient arts and sciences must not lose sight of the connection between the various technologies. The development of a home-based weaning food is dependent on existing fuel resources and food hygiene in the home. In fact, education on all aspects of food hygiene in preparation and storage must reach all levels of society.

Addressing women farmers, the advocacy of using green leafly vegetables as a potent source of Vitamins A and C is dependent on adequate water for its bloom. Home gardening may not be easy to introduce and requires a relatively long-term investment of labour which has to be shared within the family, perhaps within the community. But it is a key intervention for food for the family and provides a basis for self-reliance, self care and is away from crisis-oriented actions. A garden of 500 square metres will contribute a significant amount of household needs in a multifaceted fashion.

Task analysis must be emphasized in making household nutrition technology as a pragmatic component of nutrition education. In some quarters there is resistance to training women in nutrition and it is looked upon as a stalemate. It is an interdisciplinary intervention combining the work of home economists and social scientists. The time and energy women spend on these food related activities must be studied in their correct perspective of the social obligations and life of the family. Some of these activities are seasonal, such as harvesting. Brandtzed reports that women spend hours on food processing, pounding and cooking. Therefore modern practical inputs into this area must compose a part of nutrition education of farmer communities.

There is an overemphasis on food taboos. Sai sums up as follows: "Although taboos and avoidances are interesting, it is not clear that they have an adverse influence on overall nutrition." Nevertheless, it is not unwise to include in nutrition education, aspects of food in pregnancy and lactation, the use of collostrum and dispel fears in the minds of mothers about aspects of infant feeding.

Women farmers toil unpaid and perhaps acknowledge only on occasions such as today -- the World Food Day 1990, FAO, Bangkok. Women farmers need the new

thchnology and cannot be excluded from participation in the modernization process of agriculture. As in Taiwan young women must be intergrated into rural development and agriculture. Women are less likely to siphon off income towards non-essentials and prestige enhancing goods.

Kumar states that in small-holder agriculture, programmes that recognize the importance of women's activities in agriculture, their knowledge and their decisions, productivity and gains increase. If women's roles are not recognized, women become marginal participants in the agricultural process as they are not able to increase their productivity. We therefore hail today's recognition of women farmers as a signigicant step FAO has taken towards the future. Agricultural planners have to organize appropriate training for women as well as support services in order to provide opportunities for productivity of food in their small way.

Sientific developments promise great strides in increasing the world food supply. Genetic engineering will revolutionize food production. But the question is whether food at that price will be available to the hungry in the developing world. Certainly a switch over to the scientific advances may be out of reach of poor countries.

Inter cropping and mixed cropping could favour nutrition. It has been stated that the most significant nutritional impact of agricultural research would be in changes in food prices and food availability rather than through the nutrient composition of grains (Swaminathan). Though international developments of high yielding varieties have produced improvements in the protein content of rice, countries like Sri Lanka lack fertilizer. Price hikes in fertilizer cannot always be matched with subsidies for poor farmers. Hence the local proposition is to think of moderate yields with moderate inputs.

Even improvements of rice straw have great possibilities for animal fodder in pastoral communities.

Swaminathan proposes the enlargement of the concept of food security into nutritional security by a three pronged approach of higher productivity and lower price, appropriate changes in cropping and farming systems and planned nutrition interventions.

Population Demands

We have already stated that global food production is sufficient for the world's population. We are mindful of the inequity of distribution. The large population in this region have no reserves of cultivable land. Effective population policies have to keep the head count down to equalize the food requirements of the future. UNFPA forecasts however are pessimistic.

Large countries in this region like China and India with different political system have tried to avoid famine situations. India's success in self sufficiency have staved starvation but yet there is malnutrition. China has guaranteed some food to all.

Whatever the political system, governments have to be committed to a *food strategy*. The World Food Security is defined as ensuring that all people at all times have physical and economic access to the basic food they need.

In reducing malnutrition the following need attention:

i) efficient marketing and distribution systems in relation to food consumption and nutrition.

ii) reduction of post harvest losses.

iii) infrastructural needs for food storage, transport and distribution.

iv) stabilization of consumer prices.

v) market information system for farmers and consumers.

vi) food consumption programmes like "food for work", home gardens.

vii) food subsidy alternatives.

viii) nutrition education and training.

ix) integrated nutrition health packages.

x) food fortification programmes.

It was the World Food Conference in 1974 that highlighted the nutritional considerations in agricultural development. Until then the malnourished were left in the care of paediatricians like me. Now a host of disciplines have combined through the United Nations to save the hungry. Through the annual FAO World Conference compaigning against hunger and poverty, the world community responds to famine situations. But the chronically undernourished remain within our region and my shores.

The problems of the present command so much of our time, our patience, our efforts, that we might appear to be unprepared for future developments. There are many challenges many of us in this region will have to face. It is only by joining hands across the oceans that countries can resolve the questions for the future. It requires more than moral commitment. The hopes of the World Food Conference may then come true.

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Contd. on Page 17

From Page 11

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FOOD AND THE WELL BEING

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The importance of ensuring a nutritionally adequate diet for the well being of the human was understood by early man through experience and it has been further emphasized by different religious leaders a few thousand years back. During evolution of life, the availability and diversity of the foods in the environment played a key role in setting the evolutionary patterns of plants and animals. Food is a part of the human culture. The food culture include the type of food components derived from plants or animals, the storage, processing and cooking methods applied in their preparation and the patterns of consumption. Thus a change in cultural habits inevitably lead to changes of food consumption patterns. The diversity of food preparation and consumption patterns one observes today is the end result of such cultural changes.

As man moved from the food gathering habit to food producing habit 10,000 years ago, he started searching for methods of storing and preserving his produce for a more convenient life. He next moved into a period of use of tools and new technologies to change the appearance characters of foods towards much more attractive features. The populations that started migrating into urban centres got attracted more towards processed foods for convenience and as a means of saving time. With these changes in life styles of humans the culturally significant features of the traditional meals were replaced by commercial characteristics. Food production and processing is a commercial operation today. In present day food processing, concepts such as profiteering and imparting attractive sensory attributes occupy a more important position than nutritional quality and well being of the consumers. The high pace of activity, and decreased leisure of modern life that resulted from urbanization has attracted the man more and more towards ready-to-eat foods. Foood production has become a multinational profit oriented engagement today.

The role played by food in well being of humans is complex. It is necessary to examine many aspects of foods in understanding their role on the well being of the humans. The types of nutrients as well as the amounts of nutrients required by an individual need be understood initially. The concentrations of these nutrients present in different foods should be identified. Based on these information the optimal amounts of food items that could contribute required levels of nutrients to a meal need to be determined. This information alone is however not sufficient. The methods of assimilation of foods in our body, the interactions between the food components, and the therapeutic effects of the food components on the human body too need to be understood.

A food could be defined chemically, as a mixture of a few hundred thousand compounds in a predetermined proportion. These compounds forming into cellular or tissue patterns incorporate a variety of other features into foods.

The composition of foods and its metabolism by humans is understood scientifically today with the assistance of a variety of techniques developed by the chemists, the use of modern and sophisticated analytical tools coupled with developments in the science of nutrition. Based on these observations a synthetic diet containing 44 essential chemicals has been designed to meet all the nutritional requirements of the human body. However, the important issues to be addressed here include whether these chemicals do not react with each other and whether the chemicals bahave in the same way as from a natural foods, on ingestion.

With further developments in nutritional science, the scientists classified different chemical constituents in the foods based on the role they play in the human body. In this classification the food components are categorized into three groups as energy producing, body building and protective foods. With the introduction of this classification, the role of the food constituents that do not contribute directly towards the above functions lost their significance in our mind. At one time, the presence of fibre in foods was considered and unimportant feature as fibre does not contribute towards energy, body building or protective functions. The Western populations moved into the habit of consuming only those foods contributing one or more of the three nutrient groups. Research carried out later on the high incidence of colon cancer among the Western populations compared to the African populations made scientists realize the importance of fibre in diet. The fibre considered unimportant so far was found to play a vital role in the well being of the humans. The West is accepting rapidly the high fibre foods today. The ability of the fibre to keep some of the toxic food constituents bound without releasing in the gut and the slow release of certain nutrients at a rate best to be assimilated contribute much towards better health. The habit among Sri Lankans to consume highly polished rice (Containing little fibre) and attraction towards sensory attributes of food have established barriers in moving towards a better health through the foods. This inevitably results in unhealthy life.

As an alternative to the chemical concept of energy producing, body building and protective foods it may also be appropriate to reach for the nutritional needs through a food concept by inclusion of foods representing the six important groups, fruits & vegetables, meat & fish, dairy products, grains & pulses, yams & other starchy foods (carbohydrates), and eggs in the daily menu. Our traditional foods include components important for our well being, beyond what is described chemically under the three main food groups identified above. Recent research carried out in Sri Lanka has shown the presence of anti-cancer constituents in the bay leaves (Karapincha) which was considered only as a natural flavouring agent; the snake gourds (Pathola) and bottle gourds (Wetakolu) have been found to contain immunologically important anti-body generating constituents. Therapeutic value of the sulphur containing compounds in garlic is well recognized. Such constituents in foods play a vital role in developing resistance to disease causing germs and minimizing disorders leading to well being of the human beings.

It is believed that increase of food production and increase in purchasing power of the human divert them towards consumption of nutritionally rich foods for a healthier life. But, what is happening is contrary to this belief. Increase in income and increase in food production have in one hand has developed a tendency among humans to purchase more attractive and mostly less nutritious foods. On the other hand increased purchasing power has exposed the man to foods which are at times rich in antinutritional chemical constituents added purely to improve the sensory attributes of foods. Some of these constituents which harms the organs and change the normal metabolic mechanisms in our body reesult in nutritional disorders. Consumption of such foods, as well as large quantities of nutritionally rich foods have caused increased incidence of diseases of the affluent such as heart disease, diabetes, high blood pressure, obesity and cancer among the present day Sri Lankans. In the developed countries the people are adopting new controlled food habits in an attempt to move away from such diseases. The food technologists today are more concerned in producing foods containing less sugar, less salt, less carcinogenic substances and in developing technologies to minimize or remove such constituents from foods. Continuous vigilance and agitation by the consumers and introduction of more stringent food regulations have helped in diverting the populations in developed countries towards more healthy foods.

In planning new meals and menu as well as in processing new foods, a ratio of about 60% carbohydrates and 30% fat as energy sources is considered nutritionally best. The consumption of partly refined sugar, and unpolished cereals as well as partial replacement of

saturated fats in foods by polyunsaturrated fat have opened avenues for better living through nutritionally more acceptable foods.

The food consumed by a person should be appropriate for his or her level of life processes and the activities. During pregnancy, more food than what is needed for a normal life should be made available to meet the changes occurring in the body. More calories are needed to meet the daily requirements. The food also should supply more calories to be stored as fat in the body for future needs during lactation. To meet these demands higher consumption of energy producing foods, as well higher doses of folic acid and iron need to be supplied. During the growth of an infant, it is more appropriate to give breast milk rich in the protein lactalbumin than cow's milk rich in the protein casein. The lactalbumin provide constituents essential to generate anti-bodies for efficient immunie activity leading to a healthy life. Gradual introduction of solid foods to a child after 10 months lays the foundation early for a healthy life.

It is difficult to prevent children getting attracted towards foods with high sensory appeal displayed in the markets today. Such foods result in early exposure of the body to unlimited amounts of saturated fat as well as frequent ingestion of sugar. The latter leads to dental caries at an early age. Unlimited exposure of children to various chemical additives such as synthetic colours, and flavouring agents is not a good sign for a healthy life. At middle age, avoiding animal foods containing high concentrations of saturated fats and cholesterol would cause much benefits towards a disease free life. Similarly, it is essential specially for females to obtain their calcium requirements as far as possible through natural foods. Research has shown that metabolism of vitamin B_6 and folic acid is suppressed during use of oral contraceptives. During such period attention to consume more of these essential constituents through foods is vital.

Insufficient intake of food components essential for well being of the body through diet, due to economic or health reasons or due to heavy consumption of synthetic foods results in poor nutritional status. It is our duty to take steps to prevent undernutrition among children right from the early stages of life. One could observe the poor nutritional status of the children in most of the rural areas in the country. In Sri Lanka, growth charts of children are maintained in almost all the households, even in remote areas by the public health workers. Most of the charts very clearly indicate that the rate of growth of the children decrease around the age of one year. It is unfortunate that no effective attempts what so ever are taken by the parents or the State to save the children from this undernutrition situation. The damage that occurs due to undernutrition in building a healthy and intelligent nation is irreparable. It is our responsibility to avoid unernutrition among the population, specially the children.

Selection of appropriate foods to meet the requirements of different stages of life, from birth to death, is a must for the well being of the humans.

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FOOD PROCESSING AND SAFEGUARDING

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Milk curdles, meat and egg putrefy or get rotten mould is formed on bread, fruit juices ferment. This change in food and drink produces toxins or poisons caused by the presence of certain micro-organisms which in turn cause servere illeness often termed as food poisoning. These micro organisms like bacteria, moulds and yeeasts have one speciality-they grow and reproduce very fast. One milli-litre of fresh milk (about 16 drops of milk) has about 4,300 bacteria. With refrigeration, the count of bacteria remains a almost the same for 48 hours. But at 15^0 C centigrade this number grows to over 1.5 million in 24 hours, 35 million in 48 hours, and almost 10 times this figure in 72 hours.

People generally think that putrefied food can cause food poisoning. But the fact is that putrefaction does not ordinarily produce toxic substances. In many parts of the world rotten meat is considered a delicacy. Rotten eggs are eaten insome countries. Some foods in themselves contain prtrefactive bacteria. At the same time, food that looks good may not actrally be so, since some bacteria do not create any external change when they grow in meat, fish, vegetables dairy and poultry products.

In some cases when food goes bad, it produces only minor changes in colour, flavour, odour or texture. But in other cases changes are more substantial.

Most food and drink can be preserved for varying periods of time by refrigeration and some of these for longer periods in frozen conditions. There are, however, other ways to safeguard food and drink from the attack of micro-organisms-like smoking, salting and canning.

Just as living being not only survive but also thrive in a healthy and favourable environment bacteria also grow and multiply in a conducive atmosphere. If bacteria do not find the environment favourable they die. This is exactly what is done through the food preservation process.

Fresh fruits and vegetables can be stored in refrigerators for limited periods. But when foods are frozen, not only do they become less perishable, but their original freshness does not undergo much change. Frozen foods can be stored for long periods. For example, various meats can be kept good in refrigerators from one to three weeks, but can be preserved in frozen conditions sometimes upto eight months. Poultry products can be stored in refrigerators for a week, but preserved upto one year when frozen. Fish can remain fresh with refrigeration upto a week at most but by freezing it can be preserved upto one year. Fresh fruits and vegetables are living organisms.

They respire or breathe and while doing so give out carbondioxide and water. As a result heat is generated and that is why most fresh fruits and vegetables cannot tolerate long periods of refrigeration. Often their chemical composition undergoes a change.

Safeguarding the 'health' of food products through the process of freezing is not new thing. Frozen fish and meats were available in the United States towards the last quarter of the 19th century.

Whatever be the method used for the freezing process, the basic principle is to freeze food products as quickly as possible. The faster the method, the more fresh the food will preserve. Losses in nutritive value of frozen food and drink are negligible during the freezing process. Fruits retain their high vitamin C content. Fish, meat and cereals maintain their high nutritive value. Preservation of food and drink through excessive heat is done by pasteurisation or by canning.

Name fafter Louis Pasteur, the famous French chemist-cum-bacteriologist, pasteurisation in very simple terms means subjecting food items to high temperatures and maintaining them at that for long perods in order to kill moulds, yeasts, bacteria and other harmful micro-organisms. Normally the process of pasteurisation is applied to fruit juices, fruits and bottled fluid milk. Such food items are pasteurised in containers as well.

Canning, on the other hand, is normally done after the food is sealed in containers or cans. Foods are preheated before being put in cans or containers in certain cases only. In the process of canning, the sealed containers containing food are subjected to heat treatment so as to make the food sterile. Since heating can cause changes in the flavour, colour or 'look' of the food the heat process during canning is done at low temperatures.

Higher temperatures are required for processing non-acidic foods like vegetables, meat, fish, poultry and milk. These high temperatures ranging from 115 ^{0}C centigrade to 120^{0}C centigrade are obtained by heating under the pressure of steam.

There may be some loss of minerals or vitamins in the process of canning, but it has been noted that canned foods generally have a higher nutritive content and food value than fresh foods prepared at home. The reason is mainly that canning factories get food items directly from the source (whether it be growers, breeders or planters), and then process it under carefully controlled conditions with the minimum delay. Food procured from markets is seldom fresh, as it takes several days for fresh fruits and vegetables to reach us after they are harvested. This length in time elapse results in nutritive loss.

Sugar and salt are very important chemical preservatives. Anything containing 65 per cent or more sugar does not allow the growth of moulds, bacteria and yeasts. To make doubly sure of food preservation, products containing 65 to 70 per cent sugar (like jams, jellies etc.) are mildly heated in sealed cans or containers.

Salt is used as a preservative for meat and fish and certain vegetables. Although saltin itself does not destroy bacteria, it keeps the bacteria causing decay under control. When some vegetables are treated in brine (which is the other name for salt water) lactic acid is formed which starts a sort of fermentation action. This also helps in food preservation.

Smoking is another way in which food can be preserved. After salting, some foods like fish and meat are smoked by subjecting them to smoke created by the partial burning of wood. Smoke kills micro-organisms that come in its contact.

Besides sugaring, salting and smoking, the most common method employed in preservation is by the use of acids. The most commonly used acid for this purpose is acetic acid (vinegar). This is an essential ingredient in the preparation of salad dressings, pickles and achars. The discolouration of certain frozen fruits is stopped by the addition of ascorbic acid. The growth of certain micro-organisms is prevented in foods like carbonated beverages, pudding powders, gelatin desserts by the addition of citric acid, lactic acid (present in sour milk) or tartaric acid.

Certain chemicals like sulphur dioxide, sodium benzoate and antibiotics are also used in the food preservation process for certain dried fruits, fruit juices and for prolonging the cold-storage life of pultry etc. However, the use of some of these is prohibited in a few countries, like the United States and Canada.

The removal of water from food creates an environment in which microbes cannot multiply or grow, thus saving it from decay.

Today modern technology employs the use of dehydration which simply means the removal of water under controlled humidity and temperature conditions, unlike the old sun-drying or shade-drying system. Today many dried and dehydrated foods are available.

In certain cases, the water content is removed only partially and the product made into a concentrate.

The most common example is condensed milk which is just a concentrated form of milk with a partial water content and sugar added to help preserve it.

Preservation by fermentation is another method which is commonly used. Lactic acid is frequently used to ferment milk and yoghurt is the end product with which we are all too familiar.

We may refrigerate, freze, pasteurise, can, dry or dehydrate, salt, smoke, sugar, or ferment food and drink. All we are trying to do is to create unhealthy conditions for micro-organisms so that they cannot grow or multiply. We, in the process, safeguard our food and drink from spoiling on the one hand and prolong their shelf life on the other.

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SOME IMPORTANT ASPECTS IN PINEAPPLE *(ANANAS COMOSUS)* PROCESSING AND EXPORT

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Introduction

Pineapple (*Ananas comosus* cv. Mauritius) is one of the major fruit crops where exporters adopt the practice of using cold storage facilities to export fresh fruits under reefer container conditions. During the last few decades the exportation of fresh fruits of pineapple under the export development programme through sea transport was considerably decreased as a result of fruit core-deterioration and internal browning disorder. The initial symptoms of the disorders are formation of watery patches and yellowing spots in the core and flesh. These spots then coagulate and become brown. But the external appearance of the fruits appear to be unaffected or normal after removing fruits from the cold storage. Thus it was a common complain from the exporters since it was necessary to keep the fruits under reefer container conditions (10^0 and 80-85% relative humidity) for 2 to 5 weeks periods during transit. (Nanayakkara, 1991)[1]

Conditions Needed :

The fruits between 1.5 Kg to 2.5 Kg in weight are harvested when the basal part of the fruit turns into pale yellow colour. This stage of maturity is currently used by some air freight fruit export dealers. In practice when large quantities of well matured fruits are required all the harvested fruits are not at uniform maturity stage. About 5% of the fruits have to be rejected at packing time since they are either over mature or under mature. (E.D.B.,1989)[2]

The fruits are also harvested with a 15-25 cm long fruit stalk, in the field. The stalk of the collected pineapples are re-cut to 2cm to 5cm length and immediately the cut end is dipped in a suspension of 0.5g per liter Benomyl and packed immediately in paper cartons. The fruits are placed vertical. The fungicidal treatment prevents infections which can cause 'Thielaviopsis soft rot'.

Thereafter the boxes are sealed and stacked in shade. When sufficient quantities of boxes have been filled, they are loaded into covered trucks of vans and transported immediately to coldrooms in Colombo.

It is essential that the cartons of fruits are placed in cold storage as soon as possible after harvest, essentially within 6 hours. The cold room temperature is maintained at 8^0 C to 10^0C and the cartons are stacked on pallets to allow air circulation around and through the cartons.

When the cartons are stored at this temperature (8^0C - 10^0C) the fruits are subjected to a physiological disorder resulting in core deterioration with brown spots in the flesh.

However, when fruits are stored at low temperatures like 2^0C - 6^0 C the formation of above symptoms are slow, besides the occurence of common chilling injury.

The Requirements of Reefer Containers for Storage:

Reloading is done as quickly as possible to pre-cooled reefer containers to prevent the fruits from warking. There are two types of reefer containers available in Sri Lanka. First type is supplied by Ceylon shipping Corporation and it is 20 feet long. In this, air enters at the top and passes through the boxes by convention to be returned to the cooler - area at the bottom. Second type is supplied by a cargo company and it is 40 feet long and has an air circulation system where the air is delivered at the bottom of the container and taken out

at the top. These two types of containers require cartons which have differnt locations for ventilation holes. The stacking methods are also different. The ventilation and stacking methods for the different types of containers are demonstrated to exporters. The first type of container requires side ventilation holes in cartons and the second type requires ventilation holes at the top and the bottom of the cartons.

When the first type of cartons are sacked, the air can freely pass around them. When the second type cartons are stacked they are in a solid block, in such a way that the top hole in one carton coincides with the bottom hole of the carton above.

Pineapple Canning, Preservation and Uses :

The canning procedure of pineapple can be divided into three stages.

a. Preparation of the fruit
b. Preservation
c. Storage and transport

The juice collected during the process of removing the edible flesh from the peel is of the highest quality and flavor. The juice may be preserved in several ways, principle being the sterilization with minimum heating.

In every cannery there is a general pattern of fruit handling, and sequence of operations. These are continuous processes from the time of harvesting upto the finished product ready for the market.

For packaging pineapples, the compaines are always on the alert to develop new and appealing ways of presenting pineapple to the consumer. Within recent years, companies produce different varieties of canned pineapple products for the local market and export market.

Pineapple juice is canned as natural unsweetened juice, 12 -14%. Brix and pH approximately 3.6, and canned pineapple slices are made by consisting of whole cored slices of sound.

By Products :

Following pineapple by-products may be obtained from the fruit residues produced during the canning of pineapple fruits and from the leaves and stems.

1. Alcohol
2. Cattle feed
3. Organic acids
4. Waxes and sterols
5. Starch (from stems)
6. Pineapple proteases (bromelin)
7. Fibre (leaves)

Further Research Needs :

There is a need for investigators to be more difinitive when using the word "Maturity" in pineapple and to adopt a common terminology. The difference between maturity index which defines how a harvested fruit will behave physiologically and one which reflect the likely eating quality of a fruit when ripe, needs to be recognized. Large increase in production that is likely in Sri Lanka suggests that there is a need towards the development of cold storage facilities and harvesting techniques. With the development of these techniques, appropriate maturity indices and grading techniques should also be developed for sorting manually harvested fruits.

Present evidence suggest that long term storage of Mauritius pineapple may be difficult to achieve.

Studies should also be conducted rate of ripening, the development of core detrioration, internal browning and high and low temperature injuries are also to be studied particularly with stage of maturity at harvest.

Packages used in Sri Lanka are designed to suit medium temperature handling of this crop using a stacked handling system within a sub-tropical marketing environment. Such packages may need further modification if they are to withstand the high humidity conditions that prevail in a tropical marketing environment. Modification may also be necessary to make then suitable for use, in control atmosphere storage (CA) or hypobaric storage systems. Most pineapple

Contd. on Page 23

From Page 19

exports are currently moved by air. Hence mode of transport and techniques suited to sea transport need to be developed.

Conclusions :

These factors clearly show that there is an urgent need to overcome above disorders and thereby increase the fresh fruit production for exports in Sri Lanka through sea transport.

The amount of fresh frits and canned products exportation could be increased significantly by overcoming these problems and thereby increases the economic value of fruits under cold storage.