THE MAIN TYPES OF FOOD CONTAMINANTS

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I would first like to define the term contaminants in relation to food. These are substances that get added on to food at any stage of its production before its ultimate consumption. Contaminants can be considered as unintentional additives to food and are distinguished from permitted additives by the absence of an intention that they be present when the food is consumed. Permitted additives on the other hand are used to achieve a specific result in the food.

I will confine myself only to chemical contaminants leaving out the microbial contamination of food completely. Unlike in the more advanced countries of the world, the problem of food contaminants has not been considered very seriously in countries like Sri Lanka. This is explained easily by the fact that countries like Sri Lanka have still not got over the problem of gross adulteration of food whereas in the more advanced countries one comes across gross adulteration rather very infrequently. Gross adulteration like addition of saw-dust to powdered spices, burnt extraneous vegetable matter to ground-coffee, mineral oil to vegetable oils, etc., are serious problems in Sri Lanka and hence with the available resources not much thought has been given to the problem of chemical contaminants in food.

An attempt was made a few years back by the Food and Agricultural Organization of the United Nations to conduct a survey of food contaminants in four countries in Asia namely India, Nepal, Pakistan and Sri Lanka. Speaking only about Sri Lanka this was not much of a success mainly due to the constraints of manpower, equipment, etc.

The main types of contaminants of food are:-
1. Metallic contaminants
2. Pesticide residues
3. Mycotoxins

Reference should also be made to contaminants like dirt, debris, insects, rodent infestation, etc., but though chemists are called upon to assess evidence of such contaminants it is more a food hygiene problem.

Metallic Contaminants

The main contaminants that we come across in Sri Lanka are lead, arsenic, cadmium, mercury, copper, tin and lately chromium.

Lead: is a cumulative poison and its presence in food can be due to a variety of reasons. Water pipes made of lead used to be a source of lead contamination but this practice has now largely disappeared. In addition to the internal combustion engine's contribution to lead in the atmosphere, use of impure chemicals in the manufacture of domestic equipment as well as use of cheap quality metals in the manufacture of the above equipment play their part in the addition of lead to the food chain. Use of lead solder in the canning industry and lead based paints and colours are other sources.

Arsenic: Earlier impure sulphuric acid used in the manufacture of sugars, tartarates, etc., was a major

source of arsenic in foods. Arsenites used in the control of weeds and herbs was also a contributory factor. These practices are now not prevalent and arsenic present in soils is now a primary source and as such the level of arsenic found in food is very low. An exception is certain types of marine products especially those derived from crustaceans.

Cadmium: Cadmium plated vessels were a primary source for cadmium in food but due to the discontinuation of this practice nowadays cadmium gets into food mainly through the discharge of industrial wastes and through the soil.

Mercury: Gets into the food chain either due to the use of organo-mercury fungicides or the discharge of industrial effluents containing mercury into waterways. There was much concern in the early 1970's after it was discovered in Japan that fish in certain areas had excessive levels of methyl mercury.

Copper: Entry into food is mostly through copper containing fungicides and possibly through copper utensils. The presence of copper in food could contribute to the destruction of Vitamin C.

Tin: The source into food is obvious, namely the tin cans. It gets absorbed into the food only when oxygen is present, so that good airtight canning will prevent absorption into food. Acidic foods also tend to absorb tin.

Pesticide Residues: Ever since the end of the second world war, the use of pesticides in agriculture has become a *sine qua non*. The use of these chemicals *per se* cannot be called harmful for without their use the achievement of present day food yields would not be possible. It is only due to bad farming practices particularly in the less developed countries that have led to the presence of more than desirable levels of these contaminants in food. Farmers do not adhere to the instructions given to them by the Agricultural authorities, for instance after the application of a pesticide, a minimum period is fixed before which harvesting should not be done.

However, either due to ignorance or greed, farmers do not adhere to these requirements. Another unhealthy practice is to mix cereals and grains with pesticides to achieve a longer storage life and coating fruits like tomatoes and gourds with these pesticides. This practice is so widespread nowadays that it has been said that it is better to buy slightly spoilt fruits and vegetables and be sure no pesticide contaminants are present. The main types of contaminants one is apt to come across in Sri Lanka at the present time are the organophosphorous pesticides, the carbamates and paraquat and to a lesser extent diaquat. The general importation of organochlorine pesticides into our country has been stopped for sometime and this is a very good thing as the organochlorine pesticides are the most persistent and tend to build up in the fat of animals. However, a small amount is still brought in by certain state agencies for specific purposes. When correct farming practices are adopted, since the organo phosphates are degraded quickly the levels of residue found at the time of consumption are well within prescribed limits. Limits for the levels of pesticides that may be present in agricultural products like fruits and vegetables have been fixed by Codex, the latest publication being in 1986.

The pesticide Formulary Committee, appointed under the Pesticide Act (of which I am a member) has also very recently laid down limits for these levels. ADI's or acceptable daily intakes have also been laid down by Codex.

The commonest pesticides, weedicides, etc in use at present are Methamidophos, Monochrotophos, Quinalphos, Fenthion, Dimethoale, Malathion, Carbaryl, Carbofuran, Paraquat, Diaquat, etc.

Mycotoxins: These are toxic products of certain microscopic fungi (moulds). The most important of these are the aflatoxins, discovered in the early 1960's. The aflatoxins are liver poisons which are said to be carcinogenic. Aflatoxins are produced by certain strains of *Aspergillus flavus* and *Aspergillus parasiticus*. These fungi are ubiquitous. The occurrence and magnitude of aflatoxin contamination varies with geographical and seasonal

factors and also with conditions of growth, harvesting and storage ie. environmental factors such as humidity and temperature. Crops in tropical and sub-tropical countries are more prone to the growth of the mould. Generally mould growth is during storage but can also happen while the crops is on the plant if there is damage by insects.

A large number of plant products can serve as substrates for the growth of fungi and subsequent toxic formation and thus direct contamination of human food is possible. Also when animals ingest contaminated food not only do they get poisoned but may pass on the toxins to humans through meat, eggs, milk, etc. Quite a large portion of data on the aflatoxins have been obtained from studies on animals.

There are 17 compounds designated as aflatoxins but the term aflatoxin usually refers to the four compounds Aflatoxin B_1, B_2, G_1 and G_2. They are distinguished on the basis of their fluorescent colours in ultraviolet light, B standing for blue and G for green, the subscript denoting their chromatographic mobility. Cows fed on feed contaminated with aflatoxins B_1 and B_2 excrete metabolites in milk called aflatoxin M_1 and M_2. Aflatoxins are intensely fluoroscent in long wave ultraviolet light and this is the basis of their detection and estimation using thin layer chromatography.

Use of resistant varieties of seeds of pesticides and fungicides and careful drying and storage can reduce fungal infestation and thus reduce aflatoxin production. These procedures do not totally eliminate the fungal growth and since ordinary cooking and processing methods of food do not ensure complete removal, techniques for decontamination have been developed. In cereals and seeds it is only in a small proportion of the material that the toxin is concentrated and these are often discoloured. Segregation and separation of undersized seeds/nuts, those that have visible mould growth, discoloured seeds/nuts can significantly reduce the level of toxin. However, it must be noted that aflatoxins can be present without detectable fungus. Chemical degrading with oxidising agents like hydrogen peroxide and storage under ammonia are some current decontamination methods but are used only in the case of animal feeds.

As said earlier, since ultraviolet light destroys the toxin a good method of decontamination would be exposure to morning sunlight and in fact it has been found that one of the best methods of decontaminating coconut oil is exposure to sunlight. Since distribution of toxin in a given unprocessed commodity is very uneven it is essential that proper sampling be done for any monitoring programme to be effective.

The other mycotoxins are the zearalenonesand the ochratoxins. In passing I may mention two other contaminants that could assume importance in future. One is polyvinyl chloride-actually its monomer-in relation to its migration in to food from packaging materials and the other is the polychlorinated biphenyls which are important industrial chemicals.