CHAPTER - VIII

General Discussion
General Discussion

The present study on different aspect of food quality in some common edibles of the city of Guwahati and Shillong revealed some interesting facts.

Observations on characteristic microstructures of some edibles appear to be significant as far as the assessment of food quality is concerned. The ultrastructural features of *Coriendrum sativum* (coriander) leaves, *Brassica oleracia* (cauliflower) etc. for example, as revealed from scanning electron microscopic study suggest that abundance of stomata and highly folded nature of the surface increases its capacity to trap and conserve solar energy which determines the photosynthetic activity and consequently the nutrient quality. Similarly, the ultrastructural features of xylem in *Daucus corota* (carrot) and *Dolichos lab lab* (flat bean) is likely to serve as a reference for future study in relation to abnormalities if any, since, it is known that these features are related to quality and variety of concerned vegetables (Davis & Gordon 1982).

The folded nature of *Phaseolus vulgaris* (french bean) surface and the distribution pattern of protein bodies in sectional view; protein bodies in *Pisum sativum* (garden pea); distribution pattern of protein bodies in sectional view of *Abelmoscus esculentus* (ladies finger); folding and fibrous outgrowth on the surface of the same; starch bodies in *Solanum tuberosum* (potato); thick folding and pits on pointed gourd (*Trichosenthis dioica*) surface; distribution pattern of protein bodies in the cross-section of the same; grooves on the outer surface of tomato (*Lycopersicum esculentum*) along with general smoothness of the surface and the crystalline structures appeared in its cross-section are the normal microstructural features. The relevance of the observations lie in the fact that normal microstructural features can serve as a reference in determining the quality because, any abnormality due to environmental stress or pathogenic conditions is likely to be expressed in it.
The present observations on differences in toughness and smoothness of surface features of muscles in a number of fish species indicates that species to species variations may exist in fish as far as their muscle microstructure is concerned. It is suggested from the present observations that the types of fish may have to be selected on the basis of digestive capability of a consumer such as sick individuals, children and elderly people.

The present observations on preservations of fish and meat suggests that refrigeration beyond 24 to 36 hours may harden the muscle bundles to such an extent that even prolonged boiling may not soften the muscles to be digested easily. In this context, deep frozen broiler chicken available in the markets may not be ideal as far as its quality is concerned.

Besides the microstructural features, the analysis of essential elements from various edibles in this region appears to be significant. The low quantity of many essential elements in rice and other cereals appears to be a cause of concern. Similarly, the absence of chromium in most of the common edibles poses a threat to human health in long run in view of the importance of the element in glucose tolerance factor (Anderson 1998). The superiority of cheaper variety of rice over the high cost Joha rice as far as the elemental status is concern, is very interesting. Further, elemental content of rice is not very high. Hence, inclusion of varieties of legumes such as mung dal (*Phaseolus mungo*), kala dal (*Phaseolus radiatus*), arahar dal (*Cajanus cajan*), musur dal (*Lens culinaris*), channa dal (*Cicer arietinum*) in the diet is suggested in view of variations in the quality and the quantity of essential elements in them. The presence of considerable amount of a large number of essential elements in papaya (*Carica papaya*), sweet gourd (*Cucurbita maxima*) and flat bean (*Dolichos lab lab*) suggests that, these vegetables should form an important daily dietary component for optimal intake of essential elements. The dietary requirement of cobalt, copper, manganese and zinc may
be met from most of the common vegetables such as tomato \((Lycopersicum esculentum)\), *Pisum sativum* (garden pea), papaya \((Carica papaya)\), capsicum \((Capsicum longifolia)\), thorn gourd \((Momordica dioica)\), cucumber \((Cucumis sativus)\), sweet gourd \((Cucurbita maxima)\), ladies finger \((Abelmoscus esculentus)\), flat bean \((Dolichos lab lab)\) etc. Chromium, which is very important for human health could however not be detected in some of the common vegetables. The dietary requirement of this element may be met from cucumber \((Cucumis sativus)\), sweet gourd \((Cucurbita maxima)\), ladies finger \((Abelmoscus esculentus)\), drum stick \((Moringa olifera)\), flat bean \((Dolichos lab lab)\) etc. as revealed from the elemental analysis in the present study. Selenium, an important antioxidant is also not common in many vegetables. Tomato \((Lycopersicum esculentum)\), thorn gourd \((Momordica dioica)\), brinjal \((Solanum melongena)\), sweet gourd \((Cucurbita maxima)\), long bean \((Vigna sesquipedalis)\), drum stick \((Moringa olifera)\), flat bean \((Dolichos lab lab)\) and bottle gourd \((Lagenaria siceraria)\) may be important dietary sources for the element as revealed from the present study.

Besides the vegetables, several common fruits grown in this region and consumed by most of the people can contribute to the dietary requirement of a large number of essential elements.

As far as the consumption of fish is concerned, it is known that the people residing in the present study area consume a substantial amount of fish every day. Observations on the elemental content of different parts of some common fishes revealed that the small fishes contain considerable amount of many essential elements. The detection of high amount of several essential elements in some parts of small fishes e.g., heads spines etc (which are rejected by many people) suggests that the full nutritional potential of small fish can be utilized only through consumption of the fish body as a whole. Further, the present study could justify the common belief of the people of
Northeast India regarding the importance of several fish species in regular diet of pregnant women and nursing mothers, since these fishes are found to contain high amount of zinc, manganese, cobalt etc.

The present study regarding the absence of any addition to dietary essential elements from consumption of meat suggests that the existing preference of red meat by the local population should be minimized in view of a number of its harmful effects on human health (De Stefani et.al., 1999; Lopaz-Carrilo et.al., 1999; Tavani et.al., 2000; Kestin et.al., 1999).

The detection of low amount of some essential elements such as cobalt in milk as compared to fish suggests that lacto-vegetarians in this region are at risk in terms of intake of some essential elements. A substantial content of selenium in milk on the other hand suggests that daily consumption of milk is essential for adequate selenium intake even for nonvegetarians. This is important in view of a number of beneficial role of the element in human health (Lyons et.al., 2005; Brenneisen et.al., 2005; Hartkeinen 2005).

The detection of some heavy metals as for example, lead, nickel and cadmium in some common edibles from Northeast India appears to be a cause of concern because of their known adverse affects on human health (Silbergalt 2003; Das & Dasgupta 2002; Li et.al., 2003; Jin, et.al., 2003; Bizarro et.al., 2003). Although, the level of the aforementioned heavy metals was found to be low, it should not be taken lightly as far as the human health is concerned. This is because of some recent evidences on the effect of heavy metals on disturbances in essential elemental homeostasis even at low heavy metal level. Further, the possible accumulation of heavy metals in human body through food is likely to complicate the general human physiology in long term exposure.

The possible sources of heavy metals in human edibles from the present study area appear to be mostly anthropogenic. Hence, precautionary measures such as,
relocating the cultivating lands by the farmers from the vicinities of highways, old painted structures, garbage dumps etc. should be encouraged. Further, erecting vegetation fences such as hedges between the streets and the farmlands may also protect cultivars from air-borne particulate heavy metals. To minimize the toxic effects of heavy metal contaminants in food, intake of adequate amount of vitamin C, E, α-tocopherol etc. may be used as detoxifying agents (Arjun et al., 2001; Patra et al., 2001).

The presence of relatively high concentration of several essential elements in some edibles of limited popularity such as Indian pennywort (Centella asiatica), mint (Mentha arvensis) leaves, salad (Lactuca sativa) leaves, neem (Azadirachta indica) leaves, arum (Colocasia esculenta), sweet gourd (Cucurbita maxima) leaves, squash (Sachium edule) tender leaves, banana (Musa paradisiaca) stems and inflorescences suggests that these may compensate for low intake of many essential elements through consumption of common edibles. Further, most of these edibles contain high amount of selenium and thus these should invariably be consumed by people challenged with non-insulin dependent diabetes mellitus, because practically there is very low source of dietary selenium to them due to their restrictions on different carbohydrate rich edibles such as sweet gourd (Cucurbita maxima), radish (Raphanus sativus), turnip (Brassica rapa), sweet potato (Ipomoea batatus) etc. which contain considerably high amount of selenium, as revealed from the present study.

Relatively high content of chromium in some of the aforementioned edibles of limited popularity such as aloe (Aloe barbadensis) and chebulic (Terminalia chebula) suggests that these should be consumed by people with non-insulin dependent diabetes mellitus in view of the known role of chromium in insulin resistance (Anderson 1998).

The detection of very high concentration of several essential elements such as zinc, manganese and selenium in some Khasi traditional vegetables and fruits suggests
that these can supplement many important elements that are not available in adequate quantities in common human dietary sources in the present study area. Besides the essential elements, the microstructural features of the Khasi traditional food plants revealing well defined primary and secondary folds suggests the efficiency in trapping of solar energy and consequently high photosynthetic activity. This is likely to result in adequacy of several essential nutrient contents. Further studies are therefore suggested on qualitative and quantitative assessment of different nutrients such as proteins, carbohydrates, fats, vitamins and fibers of the Khasi traditional vegetables and fruits.

While assessing the quality of food in the present study area, the detection of a number of pathogenic and non-pathogenic fungi in some common human edibles brought out some important facts regarding the inadequacy in maintainance and storage of the same. The presence of *Aspergillus* hypae and spores in some vegetables and other edibles, *Rhizopus* hypae and spores in some fruits, *Fuserium* in different spices appears to be a cause of concern for human health in the present study area. A number of human diseases like aspergillosis, emphyema thorasics, peritonitis etc. are known to be associated with contamination of food and other environmental objects by these aforementioned moulds.

Bacterial contamination particularly by *Escherichia coli* in fish has been found to be common in the present study area because of long time taken between capture and landing. In this context, it is to be noted that *Escherichia coli* is a significant cause of diarrhea in developing countries (Bhattacharya 2003; Parsot 2005; Wirth et.al., 2006).

As far as bacterial contamination of fish is concerned, development of biopreservatives appears to be extremely important. Further, appropriate steps in packaging during transportation and quality control management seem to be important.
It can be concluded that, microbial contamination can be a cause of great concern for the people of Northeast India in future if necessary steps are not taken to stop it and immediate awareness among the people is not generated.

The present study on the status of essential elements in some common edibles, Khasi traditional foods and other edibles of limited popularity suggests that, inclusion of Khasi traditional foods and edibles of limited popularity in the daily diet of the people in this region will certainly improve the dietary intake of essential elements. The detection of several heavy metals in some edibles and fungal contamination of some of them suggests the need for proper food quality management. Ultrastructural features of several edibles suggest that Electron Microscopy should form an integral part of food quality analysis.