Chapter-6

Summary and Conclusion

The present investigation entitled “Evaluation of selected vegetables of Sikkim Himalayas for some Nutraceutical properties” was carried out at Department of Horticulture, School of Life Sciences, Sikkim University, Gangtok, Sikkim with the objectives of evaluation of nutraceutical properties of some vegetables of Sikkim Himalayas which are indigenous and underutilized.

The study was carried out on five selected vegetables viz. Solanum aethiopicum, Solanum macrocarpon, Capsicum annuum var. cerasiformae, Tupistra aurantiaca and Nasturtium officinale. All the samples were collected from the villages during their peak season of availability. A survey was conducted for these vegetable to assess the knowledge of the ethnic people on the medicinal properties. Standard methods were followed for all type of analysis. The salient findings of this study are summarized below:

- *Solanum aethiopicum, Solanum macrocarpon, Capsicum annuum var. cerasiformae, Nasturtium officinale* and *Tupistra aurantiaca* are the crops, though not very commercially cultivated, consumed by the local inhabitant of the Sikkim Himalayas. All the above mentioned crops under the study were claimed to have medicinal properties as revealed from the survey. A total of 137 number of respondent participated in the survey and dominantly, vegetable belonging to cucurbitaceae, fabaceae, solanaceae and araceae were found to be used by communities of the surveyed area. Thirty Six vegetables were found to have the medicinal properties. The respondents perceived that these vegetables are the ideal food or are used for management and curing of wide range of the
diseases like hypertension, diabetics, jaundice, chickenpox, slow-healing wounds, etc.

- **Tupistra aurantiaca, Solanum anguivi, Solanum macrocarpon, Cyphomandra betacea, Fagopyrum esculentum** and **Musa spp.** were reported to be used for treatment of diabetes. For lowering of blood pressure **Apium graveolens var. dulce, Solanum anguivi** and **Spinacea oleracea** were used.

- **Tupistra aurantiaca** was found to have high proximate and mineral content than other vegetables under study. **Solanum aethiopicum, Solanum macrocarpon, Capsicum annuum var. cerasiformae** and **Nasturtium officinale** when compared to secondary data of closely related commercial species like **Solanum melongena** and **Capsicum annuum** were found to be at par for proximate and mineral content.

- Potassium and magnesium was found highest in **Solanum aethiopicum** which makes it suitable for consumption for people suffering from hypertension, high blood pressure and asthma etc. Calcium and Zinc was reported to be highest in **Solanum macrocarpon** and can be recommended for people suffering from osteoporosis, arthritis, night blindness and less immunity. Phosphorus, Iron, manganese, copper and molybdenum were found highest in **Tupistra aurantiaca** which makes it suitable for consumption for people suffering from aging problem, anaemia, muscle weakness and osteoporosis etc.

- Adequate phytochemicals and phenolics were recorded in all the vegetables under study. The higher values of total phenol, flavonoids and carotene were recorded for **Capsicum annuum var. cerasiformae**, flavonols for **Nasturtium officinale** and ascorbic acid in **Solanum macrocarpon**. Gallic acid was found
highest in *Capsicum annuum* var. *cerasiformae*, rutin, catechol and ferulic acid in *Nasturtium officinale* and quercetin in *Solanum macrocarpon*.

- Antioxidant activity were determined by six assays namely DPPH activity, FRAP value, ferrous ion chelating activity, phosphomolybdenum activity, hydrogen peroxide and hydroxyl ion scavenging activity. High DPPH and hydroxyl radical scavenging activity was found highest in *Capsicum annuum* var. *cerasiformae*, whereas FRAP value, ferrous ion chelating activity, phosphomolybdenum activity found highest in *Solanum aethiopicum* and hydrogen peroxide scavenging activity in *Nasturtium officinale*.

- Fat soluble vitamins were found in all vegetables except Vitamin D in case of *Solanum aethiopicum* and Vitamin K in case of *Capsicum annuum* var *cerasiformae* were not detected. Vitamin A and D content was found more in *Solanum aethiopicum* whereas Vitamin D in *Capsicum annuum* var *cerasiformae* and Vitamin E in *Solanum macrocarpon*.

- *Tupistra aurantiaca* and *Capsicum annuum* var. *cerasiformae* being rich in phytochemicals, phenolics, vitamins and antioxidant content can be considered as potent nutraceutical plants.

- *Solanum aethiopicum*, *Solanum macrocarpon*, *Capsicum annuum* var. *cerasiformae* and *Nasturtium officinale* having optimum proximate and mineral content at par with the commercial vegetables like Brinjal and tomato, are to be promoted for commercial cultivation to bring the food diversity in the population of Sikkim in particular and India as a whole. These crops being suited to the climatic condition can be more successfully grown at low input level and organic farming system.
Future line of work

1. Thorough study for finding the particular molecular responsible for medicinal properties of these plants can be undertaken.

2. The parameters with high importance as potential nutraceuticals that are not included in this study like different class of dietary polyphenols with individuals metabolites can be future thrust of study for these plants. The polyphenols putative mechanism of action responsible for protective action of these vegetables can be another facet of the study.

3. Identifying metabolites and catabolites abundantly present in these plants and testing them in cell based models at different concentration for further validating these plants as nutraceuticals.

4. None of the studied vegetables has improved varieties. Hence, breeding for high nutraceutical characters will bring new dimension to the expansion of cultivation area of the crop.

5. The cultivation practices for all the studied vegetables can be standardized, particularly under the organic farming system.