5. SUMMARY AND CONCLUSIONS

The present study entitled “Nutritional quality, functional properties and value addition of underutilized fruits of Himachal Pradesh” was undertaken as research endeavor to explore the post harvest potential of underutilized fruits for the development of various value added products and also to test quality characteristics of underutilized fruits viz. fig, Kaiphal, wild apricot beedana, wild pomegranate, kainth, wild peach and crab apple.

By looking at its noteworthy remedial affluence an attempt has been made to develop various value added products viz. RTS beverage, squash, suyup, jam, spread, preserve, candy, toffee, leather, anardana goli, ladoo, chutney and instant chutney powder from underutilized fruits with or without blending of other fruits. The prepared products were assessed for their storage stability with respect to nutritional parameters, microbiological and consumer’s acceptability at different storage intervals. The economics of the prepared products were also calculated. The survey was also conducted in different locations of Himachal Pradesh (as illustrated in Chapter III) to obtain information on underutilized fruits with regard to medicinal and household uses. By keeping in view the significance of underutilized fruits, the present study was planned with the following objectives;

Objectives

1. To study the physico-chemical and nutritional parameters of selected wild/underutilized fruits growing in different agro climatic zones of Himachal Pradesh.

2. To study the functional/product development properties and evaluation of different value added products.

3. To assess the consumer’s acceptability and marketing profile of the prepared products.

4. To document the use of selected wild/underutilized fruits for medicinal as well as for household purposes in the areas where grown/available.
Technical Plan of Work

Research work of the present study was performed in the Department of Food Science and Nutrition, College of Home Science, CSK Himachal Pradesh Krishi Vishvavidyalaya Palampur. Quality evaluation and functional properties of underutilized fruits were estimated by using standard/approved methods. Pulp extraction techniques were also standardized for the maximum recovery of pulp/juice of underutilized fruits. The prepared value added products were assessed for their nutritional profile, consumer's acceptability and microbiological status at fresh, 3, 6 and 9 months of storage interval. Marketing profile of the prepared value added products were also calculated. The data on documentation of underutilized fruits with respect to household and medicinal uses was collected from the availability areas of fruits as illustrated in Fig 3.1 through interview schedule method.

Major findings of the Study

Results obtained from the present study are summarized below:

1. The results pertaining to specific characteristics of underutilized fruits revealed that all the fruits with respect to fruit, flesh colour, shape, appearance, taste and flesh firmness varied from fruit to fruit. The fruits viz. fig and kainth were gritty when evaluated for sensory parameters while the fruits viz. beedana and wild pomegranate were slightly astringent in taste.

2. The results with respect to physical characteristics of selected underutilized fruits revealed that the maximum values for length, breadth, weight were noticed for beedana fruit 8.02 cm, 6.40 cm and 225.30 g while lowest values were observed for Kaiphal fruit 1.05 cm, 1.10 cm and 2.16 g, respectively. The maximum value for specific gravity was observed for wild pomegranate (1.20 g/ml) and minimum for fig fruit (0.83g/ml).

3. Results with respect to proximate composition showed that the moisture content in selected underutilized fruits ranged from 68.05 to 84.28 per
cent. The values for fat, fibre and ash content were in the range of 0.26 to 1.43, 0.96 to 5.58 and 0.41 to 1.68 per cent, respectively. The highest and lowest values for protein and total carbohydrates were recorded for kainth and beedana (3.26 and 0.40 %) and wild peach and wild apricot (26.74 and 12.39 %), respectively.

4. The results pertaining to dietary fibre constituents revealed that the maximum values for NDF, ADF and hemicellulose were recorded for wild pomegranate (19.53 %), wild peach (12.86 %) and wild pomegranate (8.53 %). However, the lowest values were recorded for wild apricot (10.93 %), fig (6.26 %) and kainth (3.66 %), respectively. The data regarding available and unavailable carbohydrate content exhibit higher percentage for wild peach and wild pomegranate (9.29 and 19.53 %) and lowest for wild apricot (2.30 and 10.69 %). However, the values for total and available energy for all the fruits were in the range of 61.18 to 122.72 and 17.45 to 51.21 Kcal/100g, respectively.

5. The values with respect to chemical characteristics of selected underutilized fruits determined that TSS and pH content varied from 9.00 to 19.00 °B and 3.16 to 3.94, respectively. The highest and lowest value for acidity was recorded for wild pomegranate and kaiphal (6.61 and 0.21 %). The values for total, reducing and non-reducing sugars for all the fruits were ranged from 5.21 to 16.36, 2.08 to 10.46 and 2.51 to 5.90 per cent, respectively.

6. The functional constituents viz. vitamin C, pectin, β-carotene, vitamin A and anthocyanin were determined in selected underutilized fruits. From the results obtained, it has been observed that wild apricot had highest amount of vitamin C (18.13 mg/100g), β-carotene (2214.13 mg/100g) and vitamin A (I.U). The highest and lowest value for anthocyanin content was recorded for wild pomegranate and fig (21.38 and 5.10 %). While crab apple had highest pectin content (5.57 %).
7. The data on mineral contents revealed that fig had highest content of calcium and potassium (88.86 and 326.66 mg/100g). However, the maximum values for phosphorus and iron were observed for *kaiphal* fruit 93.18 and 3.39 mg/100g, respectively. The fruit wild pomegranate had highest content of magnesium 29.00 mg/100g.

8. Data pertaining to standardization of different juice extraction techniques viz. hot lye peeling, cold lye peeling, blanching, steam blanching, hot pulping, cold pulping, basket press and screw type juicer for selected underutilized fruits reveal that the maximum time and temperature for easy removal of peel was noted for the treatment of blanching for beedana fruit (92° C for 10 minutes) and lowest was recorded for the treatment of hot lye peeling for wild peach (2.0 % NaOH at 85±5° C for 2 minutes).

9. Results with respect to effect of extraction techniques on the per cent juice, peel and seed showed that highest pulp recovery was observed in hot lye peeling, followed by cold lye peeling, steam blanching, blanching, hot pulping and cold pulping technique as the values for per cent pulp/juice recovery varied from fruit to fruit. The per cent juice recovery for wild pomegranate fruit was more in screw type juicer than basket press.

10. The various value added products were prepared from selected underutilized fruits with and without blending of cultivated fruits in different proportions (100:00), (75:25), (50:50), (25:75) and (00:100) and changes with respect to nutritional parameters, consumers acceptability and microbiological status were assessed during fresh, 3, 6 and 9 months of storage interval. The results with respect to organoleptic evaluation revealed that sensory scores decreased with the increase of storage period, but the products were in acceptable range even up to 9 month of storage interval. From microbiological view point, almost all the products were free from microbial load even up to 6 months of storage period except RTS beverage.
11. Results pertaining to the economics of prepared products from underutilized fruits revealed that the cost of all the products was found to be economically viable. But as the blending proportions increased the cost of the product increases accordingly.

12. Results regarding documentation of underutilized fruits with respect to medicinal as well as household uses of selected underutilized fruits revealed that cab apple and kainth are used as a rootstock.

13. The information on household uses of selected underutilized fruits revealed that the fruit wild pomegranate is commonly used in the form of anardana while the fruits viz. wild apricot and crab apple are used in dehydrated form and in wine preparation. However, the kaiphal and fig fruit are used in raw form only.

14. Majority of the respondents were not aware about the medicinal value of kainth and crab apple. The fruit /part of the plant viz. whole fruit, leaves, root, bark and seed are used to cure various diseases/ ailments like constipation, diarrhea etc. The fruits also aid digestion and improve appetite.

From the results obtained, it has been observed that the underutilized fruits viz. fig, kaiphal, wild apricot, beedana, wild pomegranate, kainth, wild peach and crab apple are rich sources of vitamins, minerals and other nutrient and can be processed into different value added products. Among the different treatments used for extraction of pulp/juice from underutilized fruits, the ‘hot lye peeling’ was the best treatment in terms of maximum juice recovery but in terms of taste, ‘steam blanching’ was recognized as the best treatment. These fruits have tremendous medicinal value and have potential in curing various diseases/disorders. An attempt has been made to develop various value added products. The specialty food products were also prepared for the study viz, anardana golian (rich in fibre), fig and amaranth based ladoo (rich in iron) and kainth and wild aonla based instant chutney powder (good source of vitamin C). The value added products prepared from selected underutilized / unexploited fruits have industrial applications and can be promoted for commercialization of technologies for promoting entrepreneur.