CHAPTER VI

SUMMARY AND CONCLUSION

India stands second largest producer of fruits and vegetables in the world. Common fruit species in the state of Arunachal Pradesh includes banana, pineapple, citrus, plum, kiwi etc. For the year 2012-13, fruits and vegetable together cover an area of 16.18 million hectares with a production of 243.47 million tonnes. In Arunachal Pradesh, production was 349.80 thousand tonnes from an area 93.20 thousand hectares during the year 2012-13 (Indian Horticulture Database, 2013). Consumption of vegetables in the country is 175g per capita per day, which is lower than the recommended dietary allowance (RDA) of 280 g per capita per day. Although vegetable production has appreciably increased in the last two decades, it is yet not sufficient to meet the growing needs of the population for achieving nutritional security.

Vegetables, besides providing nutritional security, are also major source of income especially for small and marginal farmers of the country. Newly developed short duration cultivars of vegetables crops like cabbage, tomato, potato, pea, okra etc. fit in the rice based cropping system of this state and thereby the cropping intensity can be increased many fold to fulfill the growing demand and can improve the economic condition of the growers as compared to cereal crops in the state. Keeping above importance and need in view, a systematic study was carried out with the aim of documentation of vegetable and fruit crops, and physico-chemical characteristic analysing productivity and nutritional quality of selected crops in Papum Pare district of Arunachal Pradesh.

Based on the agro-climatic variability in account present study was conducted in Papum Pare district of Arunachal Pradesh situated between 26°55’ to 28°40’ N latitude and 92°40’ E to 94°21’ E longitude covering total geographical area of about 3,462 km² (Anonymous, 2011). Information on indigenous cultivars of selected fruits and vegetables were collected from the farms established by local farmers and improved cultivars from Govt. farms/centers. Three such sites were
selected from local and improved cultivars each. Documentation of fruits and vegetables was done through questionnaire/field survey in selected areas. Sites were selected keeping agro-climatic conditions in view. Random sampling was done in select villages (average 4 to 5 villages) from each agro-climatic condition. Age group of 18-70 years was chosen for gathering the information on fruits and vegetables. Secondary information from the published sources was also taken into consideration. Traditional cultivation methods were recorded through personal interview with the selected farmers and by visiting their cultivation fields in the present studies. Physical parameters such as size, fresh weight, yield, moisture, dry weight and specific gravity of fruits and vegetables were studied following standard method described by Ranganna (1986) and A.O.A.C (1984). Bio-chemical parameters like protein, fat, crude fiber, carbohydrate, vitamin C, riboflavin, thiamine, calcium, phosphorus, iron, sodium were estimated following the standard method as described by Sadasivam and Manickam (2008), A.O.A.C (1984) and Phillips (1997).

Findings of the study revealed that, a total of 36 fruit and 48 vegetable species were recorded from the selected sites. They were represented by 26 genera from 21 families and 38 genera from 19 families, respectively. Brassica was among the most dominant genera represented by 7 species followed by Phaseolus (3 species), Allium and Solanum (2 species each). Large numbers of plants were represented by the single species contributing to 71 percent of the total species diversity. Based on the species richness of the family of fruit plants, Rutaceae was the most dominant family (7 species) followed by Rosaceae (6 species) Moraceae (4 species) and Myrtaceae (2 species). Large numbers of families were represented by single species contributing 47 percent of the total species richness. However, Brassicaceae and Cucurbitaceae were among the most dominant families (8 species each) on the basis of species diversity followed by Fabaceae (7 species) and Solanaceae (4 species). Three species each were recorded from the family Amaranthaceae and Apiaceae while family Araceae and Amarilidaceae were represented by 2 species each. Altogether, 11 families were represented by single species.
Utilization pattern of the vegetable species for parts used revealed that large numbers (34.5 percent) of species were used for fruit/seed followed by leafy parts (15.6 percent species), root/rhizome/bulbs (14.5 percent). These groups together contributed to about 65 percent of the total species. It has been recorded by various workers that in wild vegetable leafy parts are used maximum. Vegetable species were grouped into 10 categories (vegetables, salad, soup, juice, pickles etc.) based on its uses 77 percent species were used for some purposes other than the vegetables. Parts of the plant used are fruits, leaves, roots, inflorescences, etc. or in combination of these parts for various purposes. Among the different plant parts, fruit (38 percent) were most frequently used part followed by whole plants (34.74 percent), leaves/bud (15.79 percent). Out of the 34 species recorded 30.46 percent species were used as fresh and juice and 13.22 percent was used for medicinal purpose. 27 percent fruits species were used as firewood/fodder. It has been found that fruits and vegetables were also utilised for other purposes such as medicine, firewood and fodder.

All improved cultivars have more length than its local ones. Maximum fruit length was recorded in case of papaya improved (19.69 cm) and minimum in aonla local (2.29 cm). Variation in improved and local fruits crop ranges between 16-71 percent and was maximum (71.61 percent) in Aonla than the other fruits crops. Among the vegetables, pod length of improved okra was 12.40 cm long and was greater than its local ones. Similar to length, diameter was also better for all improved cultivars (fruits and vegetables) than the local ones. Variation in improved and local fruits crops ranged between 30 and 65 percent and maximum (65.31 percent) was recorded in Aonla.

Fresh weight of improved papaya expressed 1685 g being heavier than its local cultivar. Aonla gave 97.81 percent improvement in fresh weight over its local cultivar. Among the improved cultivars i.e. tomato, pineapple, okra and potato recorded 93.11, 28.07, 17.35 and 16.23 percent improvement over their locally grown cultivars, respectively. All improved cultivars of fruits and vegetables expressed higher yield values on its local cultivars and shows great variation which is obviously due to their size, weight and genetic variability. Among the fruits,
pineapple cultivars revealed maximum yield (401; 350 q/ha) followed by papaya (266; 185 q/ha), aonla (157; 90 quintal per hectare) and pummelo (115; 105 q/ha) in improved and local cultivars, respectively. In vegetables, potato resulted maximum (270; 200 q/ha) yield followed by tomato (each 190; 95 q/ha) and okra (125; 50 q/ha).

Specific gravity did not show much variation while slightly more specific gravity was recorded in a few local cultivars than the improved fruit crops and almost similar pattern was observed among the vegetable crops too. In vegetables, tomato showed maximum moisture content 94-95 percent followed by other species. Among the fruits species, moisture content varies from 81 percent to 90 percent. Higher moisture in papaya and tomato could be mainly due to succulent nature. There was not much variation in moisture content among the local and improved cultivars. Among the fruits, aonla accumulated maximum (18.5 percent; local) dry matter followed by pineapple (14.8 percent; local cultivar). Papaya (9.65 percent) revealed lesser dry matter. In vegetables, potato recorded maximum 25.36 percent dry matter than the rest of vegetables studied. Almost all the local crops showed more dry matter accumulation than the improved cultivars except tomato.

Improved cultivars of selected crops show higher protein content except pineapple. An examination of improved and local cultivars of fruits and vegetables revealed that okra registered maximum (1.89 percent) protein followed by its indigenous cultivar (1.86 percent). Potato tubers had showed second superior protein content by improved and local cultivars (1.59 percent and 1.52 percent). Pineapple recorded lesser protein in both cultivars (0.40 and 0.39 percent) as compared to remaining fruits and vegetables.

Fat content estimated in different fruits and vegetables exhibited trace concentration. Vegetables, revealed relatively higher fat content than the fruits and all improved cultivars showed superior to the local ones. Aonla among the fruits showed maximum fat content (0.12 percent) followed by papaya (0.10 percent) and pineapple (0.09 percent). A comparison of cultivars resulted that improved cultivars have better fat content except a few crops like aonla and papaya than the local
cultivars. Much variation in fibre content was recorded among the fruits and vegetables. Mostly indigenous cultivars recorded higher edible fibre content in among the fruits and vegetables except pineapple and tomato. Aonla both cultivars expressed maximum fibre content and potato resulted the minimum content. Indigenous as well as improved potato and pineapple seems to be inferior with respect to fibre content in vegetables and fruits. Potato accumulated maximum (22.65 percent) carbohydrate content followed by its local cultivar (22.63 percent) and minimum recorded in tomato (3.58 percent) being at par with its indigenous cultivar (3.57 percent). Among the fruits, improved cultivars aonla recorded maximum (13.70 percent) carbohydrate content followed by pineapple (10.71 percent) and was lowest in papaya (7.30 percent).

Among the fruit crops improved cultivars showed better calcium content than local except papaya, however, majority of local vegetable crops recorded more calcium content than improved cultivars. The local cultivar of okra registered (66 mg/100 g) calcium being at par with its Parbhani Kranti (65 mg). Improved cultivars of pummelo registered 64 mg/100 g calcium followed by aonla (50 mg) and pineapple (19 mg). It is evident from the data that potato both improved as well local having lowest calcium content. Among all fruits and vegetables, local cultivars revealed more phosphorus content than the improved cultivars. Vegetables on average were observed relatively richer in this mineral. Okra registered maximum (57.5 mg) phosphorus followed by potato (39.5 mg) and tomato (19.5mg/100 g). Aonla fruit recorded 20.5mg/100g phosphorus proved superior over pummelo (18.5 mg), papaya (12.5 mg) and pineapple (10.5 mg/100 g).

Okra (both cultivars) exhibited maximum iron content followed by potato and minimum in pummelo. As regard fruits, indigenous cultivars of aonla and pineapple showed higher values of iron content. Among the vegetables, okra and potato improvement were reverse showing the superiority of improved cultivars over its local ones. Tomato showed lowest iron content 0.41mg/100g and aonla fruits slightly rich in iron content followed by pineapple and papaya. Sodium content varied from 0.99 mg (pummelo) to 6.90 mg/100 g (okra) in all the fruits and vegetables. All vegetables are superior in sodium content than the fruit crops. All
improved cultivars revealed slightly higher sodium content than the local cultivars except pineapple and tomato.

Aonla (both cultivars) resulted 6-10 times higher Vitamin C content than the other fruit crops. Local papaya and pineapple expressed higher contents than its improved cultivars. Among the vegetables, all indigenous cultivars expressed higher vitamin C. Thiamine content ranged from 0.02 to 0.20 mg/100g in the selected fruits and vegetables. Among the indigenous cultivar of pineapple showed maximum thiamine followed by tomato, potato and okra. It was noted that indigenous cultivars are relatively richer in thiamine content. Riboflavin content was higher in local cultivars than the improved cultivars except tomato. Higher content was recorded in pummelo and papaya for fruit species while okra resulted more for vegetable crops. Aonla and potato were lowest in riboflavin content as compared to other fruits and vegetables.

CONCLUSION:

A total of 36 fruits and 48 vegetables species were recorded from the study area. Brassica was most dominant genus and majority of genera were represented by single species. There were not much variation among local and improved cultivars in moisture and dry weight content. Utilization pattern (vegetables) for parts used revealed that large numbers (34.5 percent) of species are used as fruit/seed followed by leafy components, root/rhizome/bulbs, etc. For fruit species, 30.46 percent species are used as fresh and juice and 13.22 percent as medicinal values. 27 percent fruits species are used as firewood/fodder. It has been found that fruits and vegetables are also utilised for other purposes such as medicine, firewood and fodder are the main.

All vegetables recorded relatively higher fat content than the fruits and improved cultivars have better fat content except Aonla and Papaya. Carbohydrate content was greater in aonla, followed by pineapple and pummelo cultivars. However, not significant variations in carbohydrate content are recorded between the cultivars. Vitamin C content was also found greater in both cultivars of aonla. Among the vegetables, all indigenous cultivars expressed higher vitamin C.
Thiamine and riboflavin contents were generally higher in local cultivars than the improved cultivars. Improved cultivars of fruits and vegetables showed higher yield, mainly due to their size and weight. Statistical analysis (student t-test) of the data resulted that significant variation are observed in size and fresh weight among the local and improved cultivars. Significant variation is also recorded in diameter of local and improved cultivars except okra. Significant variation observed in Yield except pineapple and pummelo. Non-significant variation are observed in specific gravity, moisture, dry matter, fat, fibre, carbohydrate, Vitamin C, thiamine, riboflavin, calcium, iron content among the cultivars. Non-significant variation was observed in protein except papaya cultivars. Non-significant variation was also observed in phosphorus except pineapple cultivars.

Based on the present research findings, it is concluded that, improved cultivars showed impact on various physical, bio-chemical and yield parameters, however, statistically most of variations are non-significant (except few parameters). Non-significant variation could be due to non-adaptation of the improved cultivars in the area, non-favourable site characteristics (soil and climate), poor management etc. Improved cultivars may be promoted for area specific in which local cultivars may play a key role in improvement (cultivars) programme. It is being suggested for further intensive study through consistent crop improvement process to acclimatize the crops to different edapho-climatic regime to standardize sustainable production mechanism. This is particularly important for state like Arunachal Pradesh, which is geologically young, ecologically fragile and facing challenges of sustainable production of fruits and vegetables among different agro-ecological settings. Findings of the present research are helpful in selecting the economical crops for better yield in given crops for socio-economic growth and poverty alleviation of Arunachal Pradesh in particular and northeast India in general.