6. SUMMARY AND CONCLUSION

Fruit quality is determined by a wide range of desirable characteristics such as nutritional value, flavor, and shelf life. There is increasing appreciation that quality means more than just taste, texture, and appearance. Nutritional properties of fruit and perceived health benefits are becoming factors in consumer preference. Several studies have sought to attribute to the potential beneficial effects of fruits and vegetables to specific metabolites or groups of metabolites. One such which has received a significant amount of interest is the antioxidants such as carotenoids (beta-carotene) and lycopene which are fat-soluble antioxidants.

The composition of melon fruit is well known, but to understand and explore its health promoting properties which in turn provides the information about the nutritional value of melons which thereby reduce the risk of chronic diseases is very much essential. Moreover, the structural changes occurring during the melon fruit ripening is important to co-relate them with the biochemical composition of different cultivars of fruit. Hence the present study focused on the elucidation of histo-architectural features associated with the biochemical changes during maturation and ripening of melons and also evaluation of the nutritional quality of melon fruit based on the biochemical analysis of antioxidants and quality attributes. Individual metabolites analyzed in present study helped to understand the significance of the health promoting components in melons.

6.1. Summary

In the presently studied cultivars of muskmelon and watermelon, sugars got accumulated, mainly of non-reducing and total sugars, during their ripening, whereas the reducing sugars got accumulated in the early stages of fruit development. Among the presently analyzed cultivars of melons, icebox watermelon fruits had significant amount of sugars when compared with that of other cultivars. The sugar metabolizing enzyme activities in conjunction with sucrose accumulation were also analyzed and sucrose phosphate synthase and sucrose synthase activities were found to exhibit positive relation with sugar accumulation process in melons. Phenols and polyphenols which possessed health promoting properties accumulated significantly in the ripe muskmelon as well as
icebox watermelon cultivars. In other local cultivars of watermelon, ripening did not significantly influence the phenolic levels.

In the present study, the chlorophyll degradation concomitant with the carotenoid accumulation was noticed towards ripening process in melons. The most promising antioxidant and quality attribute in melons, lycopene, accumulated in a higher level in the ripened stage indicating the improved nutritional quality of fruit, especially icebox watermelon cultivars. The antioxidant enzymes studied indicated the role of peroxidase, polyphenol oxidase and catalase in the early stages of melon fruit development. However, superoxide dismutase analyzed in the present study, displayed its higher level of activity during ripening in all the cultivars of melons. The wall softening enzymes were also analyzed among which β-galactosidase was positively related with the textural softening in melons as it had increased activities towards ripening. The other cell wall degrading enzymes such as polygalacturonase and cellulase had a very limited role in wall softening process in muskmelon as well as watermelon fruits.

The histo-architectural studies in melons revealed a single layered epicarp followed by a multilayered mesocarp in melons. As the fruit proceeds towards maturation, the cell layers increased related to increased fruit size. The cell walls got loosened as the fruit passed from young to the ripened stage correlating with the cell wall degrading enzymes analyzed. Secondary thickenings were observed which maintained the structural integrity of cell and protected the pericarpic tissue of melon fruit. Plastids, mainly chloroplasts and chromoplasts were observed in the young and ripened fruit respectively which further confirmed the biochemical results for the accumulation of carotenoids in the ripe fruit of melons.

6.2. Conclusion

Hence considering the results obtained from the present study, it may be concluded that all melon cultivars including the non-netted muskmelon and icebox watermelon proved to be highly nutritional, being rich sources of sugars. Besides, the fruits also contained high phenolic content, which is known for its antioxidant as well as health promoting property. Likewise, the abundance of minerals in melons helps in evaluating their importance as they play vital role in improving the
wellness of humans/consumers. The cell wall degrading enzymes act as an indicator to denote the degree of softening that takes place in the fruits and in turn helps in determining maturity indices of fruits and better postharvest life. In addition, the role of ethylene and respiration rate studied in the present investigation may be helpful in determining the harvest index of fruits. Based on the maturity indices, the quality of fruit can be determined.

The occurrence of increased levels of sugars in the ripe fruit of non netted muskmelon fruit of present study indicated it to be high sucrose accumulating genotype. Due to significant accumulation of sugars, phenolics and carotenoids, the melon fruit is a promising source of sweetness and natural antioxidant compounds. The accumulation of sugars and antioxidants underline the nutritional value of muskmelon fruit and thus the fruit quality improvement can be imparted based on these biochemical studies during development and ripening. Moreover, it gives an insight into the further characterization of antioxidants to increase the productivity of melons with improved quality traits which are highly appreciated by consumers and producers.

Furthermore, from the results of the present study it may be concluded that in terms of the health-promoting attributes, icebox cultivars of watermelon possess the better nutritional quality as compared to other watermelon cultivars. Hence the fruit of icebox watermelon can be considered as a supplement to make human diets more balanced as consumer quality acceptance is generally related to specific perceived quality attributes. The important fruit quality determining parameter, carbohydrates, based on the data obtained from the current study indicated that sweetening of melon fruit seemed to be as a result of sucrose, which is the predominant sugar. The study of bioactive compounds and antioxidant activity is of great relevance both to the human health and commercial purposes as it provides valuable information about their synthesis thereby evaluating the best harvest period to reach highest antioxidant potential. Ultimately the accumulation of carbohydrates and bioactive compounds in the ripe muskmelon fruit suggests its use to the food scientists to maximize the nutritional value, thereby confirming melon fruit extracts as a nutritionally balanced source of dietary antioxidants for food and nutraceutical products. These results also may provide the essential
information to reveal the biosynthetic pathways of the bioactive compounds in melons.

The results of the present study could be used as baseline information which may be helpful for the farmers to determine the optimum stage of harvesting and for consumers to choose the cultivar with best nutritional quality. As consumers become increasingly aware of the nutritional quality of fruits and get interested in a healthier lifestyle, the positive nutritional information on the currently analyzed cultivars of muskmelon and watermelon will help consumers to make informed decisions on consuming this nutritious food. Furthermore, the other factors such as cell wall neutral sugars or nonenzymatic factors that contribute to texture softening should be taken into account in further research in order to identify melon fruit metabolomics.

The results of the current study strengthen the hypothesis previously established on other cultivars of melons that sucrose phosphate synthase is responsible for the increased accumulation of sugars. The observations of this study add to previous ones to underline the complexity of mode of SPS activity regulation already observed. Further, based on the results for the sugar metabolizing enzymes, it can be concluded that these enzyme activity determination provides an important foundation for future investigations of carbohydrate metabolism which determines to a large extent crop quality and yield in the melon species. The information from the present study may facilitate the selection of molecular genetic targets to improve carbohydrate accumulation in muskmelon and watermelon. The increased activities of softening enzymes especially, β-Gal enzyme during ripening is an indication of better postharvest storage life.

Thus the changes in the relative activities of enzymes analyzed under the present study should help in improvement of the shelf life and quality of melon fruit. Further, a comprehensive study combining ultrastructural and biochemical aspects of watermelon fruit would provide an insight into the relationships between its structural and metabolic aspects of enzyme activities. The process of development and ripening in melon fruit is extremely complicated and is not influenced by just one enzyme, but activities of many enzymes synergistically.
Hence, it is desirable that significant breakthroughs in the activities of these enzymes and their mechanism of action during melon fruit development and ripening should to be considered in future investigations.

Moreover, in future, further studies are needed to analyze new genetic resources and identify the new genes implicated in the development, ripening and quality of melon fruit. The elucidation of molecular basis of fruit quality and ripening by gaining insight into the regulatory factors, which control the various development changes which contribute to the melon fruit quality is necessary. This outcome may be useful to the breeders by employing the tools of genetic biotechnology for the enhancement of both agricultural productivity and food quality including high yield, good nutrient quality, desirable sensory characteristics, and long storage and transportation life. It will represent more attractive challenge.