VI. SUMMARY

Cephalopods are one of the important marine fishery resources of India. Due to the increasing demand in the International market for octopus in recent days, effective utilization of underutilized octopus resources in different forms, their storage and extension of shelf life for human consumption, popularization in local market are receiving more importance and there is a need to develop different types of acceptable products.

Keeping in view of the objectives and above points, the following studies were conducted:

1. Chemical composition of octopus (*Octopus membranaceus*).
2. Iced storage of octopus
   a) Whole and dressed form in contact with ice.
   b) Dressed form out of contact with ice.
3. Frozen storage life of dressed octopus
4. Frozen storage of coated octopus
5. Frozen storage of smoked octopus
6. Studies on the effect of pretreatments on quality parameters and shelf lives of
   a) Control (dressed octopus)  b) STPP treated  c) SC treated  d) H2O2 treated

The results obtained from different studies are summerised in this section.

Analysis of biochemical composition of raw octopus, amino acid composition, presence of heavy metals indicated that octopus was good, nutritious and safe for consumption. Suitable processing method was developed (3.2.2). The dressed meat yield was found to vary from 65.6 - 77.9%.

In ice storage study of octopus, slight increase in moisture content was noticed in WOI and DOI samples, whereas in DPI sample slight decrease was noticed. Crude protein decreased in all the samples. There was not much change in pH, fat and ash content in all the samples. Increase in Hx, TVB-N, TMA-N, PV and FFA was noticed in all the samples but the rate of change was more in DPI and DOI samples. Initial total plate count of octopus was 4.2x10^4 which increased to 9.93x10^5, 6.50x10^5 and 8.76x10^5 cfu/g and psychrophiles with initial count of 3.45x10^3 cfu/g which increased to 3.79x10^4, 1.90x10^4 and 2.20x10^4 in WOI, DOI and DPI samples respectively. There was decrease in nitrogenous compounds such as SSN, WSN and NPN in all the samples throughout the storage period.

It was found that the whole octopus ice stored was acceptable up to 15 days and fair up to 18 days, whereas DOI and DPI were acceptable up to 12 days and fair up to
15 days, but the DPI had little inferior quality than the DOI. WOI showed lower values of quality indices such as PV, FFA, TVB-N, TMA-N, TPC and psychrophiles count, indicating better quality than the DOI and DPI. Indirect icing (DPI) gave shorter shelf life and did not show any advantages over direct icing (WOI and DOI) of octopus. While, icing of octopus in whole form (WOI) showed advantage in terms of better quality and shelf-life over icing in dressed forms (DOI and DPI). Except TVB-N all the quality parameters showed good correlation with sensory characteristics of all the samples.

For the development of value added products i.e., battered and breaded octopus, batter from maida found better than rice, among different spice mixtures tried, chilli powder (2%), ginger (1%), garlic (1%) and salt (2%) was selected. Addition of 650 ml of water for every 500 g maida gave better viscosity. The final battering and breading pickup was found to be 46.47%.

In the process of development of smoked octopus, mixture of mango, acacia and teak wood saw dusts in equal proportion was selected, brining at 10% salt concentration for 4 min., smoking at 90 °C for 135 min. were found optimum. The final smoking yield was found to be 63.85%. The prepared products were frozen at -35 °C, stored at -20 °C and changes in quality were assessed once in a month.

During frozen storage of prepared products, gradual decrease in moisture and protein were found, the decrease was more in battered and breaded product than control and smoked product. SSN, NPN, AAN showed decrease in all the samples. Battered and breaded sample showed less loss of SSN and smoked sample showed less loss of NPN and AAN compared to other samples.

There was less fluctuation in fat, pH in all the prepared products. Gradual increase in PV, FFA, VBN, were noticed in all the samples throughout the frozen storage period. The rate of increase in PV was found to be less in smoked octopus. The rate of FFA increase was more in smoked octopus and followed by battered & breaded octopus and control. The rate of increase of VBN was more at the beginning of the storage up to 7 months, later there was decrease in the rate. Smoked octopus showed more rapid increase than other samples. Steam volatile and non volatile phenolic compounds decreased in smoked octopus throughout the storage.

The TPC showed decrease in all the samples and were well within the tolerable limits. Presence of pathogens like *Salmonella* spp. confirmed their absence throughout the storage. Even though, *Vibrio cholerae* and *Vibrio parahaemolyticus* were showed their presence in the raw material, after freezing and before storage, they were absent in the subsequent frozen storage.

Sensory evaluation mean scores were found to be decreasing as a function of storage period, smoked octopus product was well accepted and scored highest overall
acceptance scores throughout the storage, followed by battered and breaded octopus product and control. 164 ml of vegetable oil / kg was absorbed during frying of battered and breaded octopus. Deep frying for 3-5 min. was found to be sufficient. Sensory evaluation mean scores showed good correlation and significant difference between changes in different biochemical and microbiological parameters during frozen storage. From the study; it was found that both the products were good and wholesome throughout the storage period of 12 months with little loss of characteristic taste and flavour.

In the study of effect of different pretreatments on the frozen storage stability of octopus muscle, dressed octopus meat was pretreated with chemicals in different batches viz., STPP, SC, H₂O₂ and control. After treatment they were packed in polyethylene bags, frozen at -35 °C, stored at -20 °C.

During 12 months of frozen storage, gradual decrease in moisture, protein were noticed, the decrease was more in control samples than treated ones. Among treated samples STPP showed less loss of moisture and SC showed minimum loss of protein. A fluctuation was noticed in total lipids and pH of all the samples. The SSN, NPN and AAN were recorded decrease as the storage progresses, the decrease was found to be less in treated samples than control. The minimum losses of nitrogenous compounds such as SSN, AAN and NPN were noticed in SC, STPP and H₂O₂ samples respectively.

PV, FFA and VBN found to be increasing during frozen storage. The rate of increase was more in control sample than treated samples. However, there was no sign of rancidity or off odour detected. The VBN content did not cross the limit of acceptability in any of the samples.

As the storage progress drip loss was found to be increasing and cook loss was found to be decreasing in all the samples during storage. Among treated samples SC showed better stability with minimum drip loss and cook loss retaining more proteins as indicated in SDS-PAGE analysis pattern of total protein followed by STPP and H₂O₂ treatment. In control, more degradation of protein bands was observed as compared to the fresh octopus.

The TPC was found to be decreasing, the counts were low and well within the limit of acceptability. Pathogens like Salmonella spp. Vibrio cholerae and Vibrio parahaemolyticus were absent throughout the storage. This ensures better safety throughout the storage period.

Sensory evaluation mean scores were found to be decreased as a function of storage period, SC sample was well accepted followed by H₂O₂. Control and STPP scored lower organoleptic score due to loss of firm texture due to the effect of treatment. SC and H₂O₂ samples had better texture than STPP and control. Sensory evaluation
mean scores showed good correlation and significance between different biochemical and microbiological parameters except pH and TPC in all the samples. It was found that all the products were good and wholesome throughout the 12 months of frozen storage period. Among the different treatments tried, SC treatment was found to be better followed by STPP and H₂O₂ treatments. However, it is important to note that drip loss may be minimized to certain extent using SC treatment but it is difficult to avoid completely.

From the study, it was found that octopus meat can be effectively utilized, its shelf-life can be extended up to 18 days in iced condition in whole form and its meat can be used for the development of value added products like battered & breaded product and smoked product. These products can be stored at -20 °C for 12 months. Using dip in 5% NaCl for 5 min. and then with mixtures of solutions of 3% sodium citrate and 0.1% ascorbic acid for 5 min. pretreatment before freezing, shelf-life of meat can be extended up to 12 months with minimal loss in quality.