Review of Literature
Diversification of new products in fish processing sector is very important for better utilization of the underutilized marine resources. Development of fish products from low priced fish was studied by Gopakumar and Nair (1980). They reported a variety of useful protein rich products such as fish protein concentrate, edible fish powder, fish hydrolysate, fish soup powder, fish fingers, fish flakes and pet food for domestic animals can be prepared from economically low priced fish. Exier (1987) discussed about the composition of foods: Finfish and shellfish products – Raw, processed and prepared.

Samuel (1988) worked on processing and product development of bivalves and gastropods. He also reported that it is possible to process marketable products from various types of bivalves by freezing, canning, smoking and canning, pickling, drying etc which may find a good domestic market with effective popularization measures.

Kandoran (1989) described the importance of transfer of technology in diversification of fish products. Gopakumar (1989) reported minced fish based products. He explained the various food products developed from fish and the shelf life of each product. Appukuttan \textit{et al.} (1989) have discussed about molluscan resources.

Jayachandran \textit{et al.} (1988) studied the utilization of edible oyster \textit{Crassostrea madrasensis} through the preparation of certain value added products. They reported different types of products such as oyster soup, nectar, curry, and oyster pickle will have export potential, as these items are popular in western
countries. In addition to that, oysters canned in brine, oil etc. have been prepared and it is hoped that there will be a good market for these products among people especially in urban areas. The products can either be canned or frozen and preserved for reasonable storage period. Gopakumar (1988) has discussed about the quality control of molluscan products.

Balachandran et al. (1988) have studied about the post harvest technology of mussel processing and product development. They also observed that the fresh mussel stored in ice remained organoleptically acceptable up to eight days. However, when intended for canning, the iced storage should not be more than two days. It has been shown that fresh frozen mussel meat remained acceptable for 40 weeks when stored at -23°C whereas frozen meat prepared out of material iced stored for 8 days was acceptable only up to 15 weeks at -23°C. Process have also been worked out for mussel meat pickle, dried, smoked and marinated mussel meat, mussel chutney powder and lime for mussel shell.

Ramesh and Ayyakkannu (1994) worked on the softening of the Chicoreus ramosus foot muscle. The foot muscles of C. ramosus were cooked under different pressures and treated with locally available herbal materials and synthetic chemicals. They observed that none of the herbal materials were effective in softening the foot muscle. Effective softening was obtained with citric acid and dibasic sodium phosphate for 12 hours at low temperature.

Patterson et al. (1994) developed various recipes for the gastropod Chicoreus ramosus in order to create an awareness of the protein – rich Chicoreus meat in India and the biochemical composition of each recipe was also determined.
Gopakumar (1996) has discussed about the post harvest handling, processing and quality control of molluscan products. He described a recommended code of practice concerning handling of catch, icing, post – harvesting procedures, and storage, including depuration and hygiene measures for molluscan products.

Swamy et al. (1988) reported the Indian bivalves and gastropods: strategies for production and market development. The potential of the cultured shellfish resources in providing cheap animal protein and additional employment, in improving the socio – economic status of the users, in exploiting the fisheries optimally and, increasing the foreign exchange earnings are discussed in the backdrop of the fish marketing systems in India. Hjelmel and Gildberg (1985) discussed the processing of fish and squid by controlled proteolysis.

James and Iyer (1998) reported the quality of frozen squid and cuttlefish of the export trade. The results showed that the Volatile Base Nitrogen, Trimethylamine Nitrogen and indole were below the permitted levels. They were free from Salmonella, Listeria monocytogenes and Vibrio cholerae. 8.3% of cuttlefish sample contained V. cholerae NON 01 type and 10% squid samples had Vibrio parahaemolyticus. Except 10% cuttlefish, all samples had copper below the permitted levels.

Hassan and Mathew (1999) discussed about a protein-rich base material for value added products from low cost fishes. Chellappan (1999) has reported the nutritive and mineral value of canned oyster meat in oil and brine. He also reported that the meat in oil had more nutritive value and mineral content and good taste than the meat packed in brine medium.

Dey et al. (2000) discussed about Japanese market for value added sea foods. Gram and Huss (2000) worked on fresh and processed fish and shellfish and
reported that during storage, the micro flora changes owing to different abilities of the microorganisms to tolerate the preservation conditions. Lalitha and Surendran (2003) have reported the presence of *Clostridium botulinum* in finfish and shellfish.

Shanthini (2003) has reported some value added products from underutilized marine gastropod *Pleuroloca trapezium* (Gastropoda: Fasciolaridae). Bacteriological quality of farmed fresh water fish and shellfish meant for export has been studied by Bandekar *et al.* (2004). The results suggested the need for implementation of good hygienic practices including HACCP and GMP for the improvement of microbial quality of aquacultured fishery products to meet international quality standards.

Hebard *et al.* (1982) discussed about the occurrence and significance of Trimethylamine Oxide and its derivatives in fish and shellfish. They also reported that TMA – N is often used as an index to assess the keeping quality and shelf life of seafood products.

A study on the bacterial quality of brown mussel, *Perna viridis* and its purification was carried out by Selvan and Pillai (1988). They also observed that the mussels were subjected for purification by employing different purification methods and chlorination was found to be better. The faecal coliforms were found to be very low and they were in permissible limits. The pathogenic bacteria *Salmonella*, *Streptococci* and *Staphylococci* were absent.

Removal of pathogenic bacteria and grittiness from clam (*Vilorrita cyprinoides*) and mussel (*Perna viridis*) meant for processing by a biological method was carried out by Surendran and Balachandran (1988). It follows from these experiments that for achieving best results in removing the grittiness and eliminating pathogenic bacteria from the clam and mussel meat meant for further
processing or consumption, they should be depurated for 24h in clean water from their respective habitat followed by chlorination of the system to 5ppm level and maintaining like that for 2 more h.

Singh et al. (1996) reported a note on prevalence of Vibrios in marine fin and shellfishes. Rajapandian et al. (1988) discussed about the post-harvest techniques and sanitation for oysters. A study on the bacteria of edible oyster Crassostrea madrasensis and its purification was reported by Pillai and Selvan (1988).

James (1988) has discussed about the development of molluscan fisheries in India. The percentage edibility and the index condition of the oyster Crassostrea gryphoides (Schlotheim) was studied by Durve (1964). The molluscan fisheries resource of India has been studied by Jones (1968). Molluscs of commercial importance are all essentially marine and broadly come under two major categories, viz., (i) edible and (ii) ornamental. Squids, mussels, oysters, clam, etc., which are used for human consumption come under the edible molluscan fisheries.

Seasonal changes in meat weight and biochemical composition of the black clam Villorita cyprinoides (Grey) was carried out by Ansari et al. (1981). Nayar and Rao (1985) have reported molluscan fisheries of India. Sreenivasan and Siraimeetan (1988) reported the chank fishery of Portnovo Coast. This study suggested to carry out a survey of beds off portonovo and also to introduce regular diving with modern diving equipments for regular chank fishery. Chank caught by the research vessel cadalmin IV from trawling grounds in Gulf of Mannar was recorded by Siraimeetan et al. (1988).

Edward and Ayyakkannu (1992) have reported the economic importance of the gastropod Fasciolaria trapezium, an important seafood resource occurring along
the southeast coast of India. Information on the fishery status of *Chicoreus ramosus* in Indian waters was given by Ayyakkannu (1992).

Edward *et al.* (1994) reported the landing data and meat trade with *Chicoreus ramosus* and *Pleuroloca trapezium* in the Gulf of Mannar and Palk Bay, Southeastern coast of India. They reported that the *C. ramosus* and *P. trapezium* fishery is mainly associated with lobster fishery. The export value of the meat of these two gastropods has attracted the attention of the fisher folk and it has emerged as an additional source of income for them.

Effect of temperature, heating time and chemicals on shucking edible oyster *Crassostrea madrasensis* (Preston) was carried out by Balasundari *et al.* (1995). This investigation revealed that there was a significant difference in meat yield between the chemical treatments.

The Condition index and percentage edibility of *Crassostrea madrasensis* (Preston) inhabiting the Cochin harbour was studied by Nair and Nair (1987). Hartati *et al.* (1997) have reported the condition index of oysters *Crassostrea madrasensis* of Mlonggo Beach, Jepara, Indonesia.

Venkataraman and Chari (1951) have studied the seasonal quantitative changes in water, fat, protein, glycogen, ash, phosphorus, calcium, iron and copper contents of oysters of Ennur. The basic organic constituents of the squid meat (*Ommastrephes sloanii pacificus*) and utility of the meat as human food from the point of view of digestibility and nutrition have been extensively studied by Tanikawa and Suno (1952). Chari (1966) has reported that there is a good demand for the chank flesh as it is rich in protein and minerals.
Takahashi (1960) reported the utilization of cuttle fish *Ommastrephes sloaniipacificus* and seasonal variation in the gravimetric constitution and chemical composition of the various parts of the body. Durve and Bal (1961) have studied the chemical composition of oyster *Crassostrea gryphoides*. Takahashi (1965) have reported that the squid meat may be a perfect source of protein.

Mukundan (1968) discussed about the molluscs in Indian tradition and economy. He reported that molluscs have approximately 8 – 10% of proteins (by weight), 4 – 5% of carbohydrates, 2 – 3% of minerals and 1 – 2% of fat.

Giese (1969) introduced a new approach to the biochemical composition of the mollusc body. Blackmore (1969) have reported the seasonal variation in biochemical composition of *Patella vulgate*. Williams (1970) have studied the seasonal variation in the biochemical composition of the edible winkle *Littorina littorea* (L). Ackman and Eaton (1971) have reported mackerel lipids and fatty acids.

The biochemical composition of the oyster *Crassostrea gryphoides* from Marathwad has been reported by Nagabhushanam and Mantale (1972). Topping (1973) reported heavy metals in shellfish from Scottish waters. Suryanarayanan *et al.* (1973) worked on the biochemical composition of edible molluscs of Kerala. He also reported the nutritional value of some gastropods and cephalopods.

Wafer (1974) reported the biochemical composition of the lamellibranches, *Meretrix casta* (Chemnitz) and *Sanguinolaria diphos* (Gmelin). Ackman (1974) reported marine lipids and fatty acids in human nutrition. Young (1977) reported the roles of food and direct uptakes from water in the accumulation of Zinc and iron in the tissues of the dog whelk, *Nucella lapillus* (L). The distribution of some trace
metals such as lead, zinc, copper and manganese in marine gastropods, *Thais lapillus* and *Littorina littorea*, around the coast of Wales have been reported by Ireland and Wootton (1977).

Bryan *et al.* (1977) reported heavy metals in the gastropod mollusc *Haliotis tuberculata* (L). Shiber and Shatila (1978) reported trace metals such as lead, cadmium, copper, nickel and iron in limpets, mussels and snails from the coast of Ras Beirut, Lebanon.

Zynudheen *et al.* (2003) have recorded the incidence of cadmium in processed products of cephalopods from Gujarat, India. The results showed that the different products about 20% of whole cuttlefish samples and tentacles showed cadmium levels above the permissible limits of 2ppm, which implies the necessity of proper cleaning procedures during the processing stage.

Lakshmanan (2003) described the heavy metal residues in molluscan shellfish. He reported the levels of Cd, Hg, Pb, As, Cu, Zn, Mn, etc., in cephalopods from different geographic locations and indicated higher levels of Cd (>2ppm) and lower level of Hg (0.1ppm) and clams, mussels and oysters from Cochin area had comparatively higher levels of some of the metals (e.g. Zn).

The concentration of some of the heavy metals in oyster, *Crassostrea madrasensis* (Preston) from the Cochin region have been reported by Sankaranarayanan *et al.* (1978). Nagabhushanam and Bidarkar (1978) studied the seasonal changes in the biochemical constituents of the oyster *Crassostrea culcullata*. Radhakrishnan and Natarajan (1979) worked on the nutritive value of the crab *Podophthalmus vigil* (Fabricius). The seasonal changes on the lipid of the mollusc *Chlamys tehuelcha* have been reported by Pollero *et al.* (1979).
Oxidation of fatty acids of edible molluscs during the storage was studied by Pastoriza et al. (1980). Moreno et al. (1980) reported lipids and fatty acids of the mussel (Mytilus platensis d’ Orbigny) from South Atlantic waters. Accumulation of arsenic from water and food by Littorina littorea and Nucella lapillus was reported by Klumpp (1980).

Lakshmanan and Nambisan (1983) have reported the seasonal variations in trace metal content in bivalve molluscs, Villorita cyprinoides var cochinensi (Hanley), Meretrix casta and Perna viridis (Linnaeus).

Rao and Bandyopadhyay (1983) have reported the lipid composition of salted and Sun – dried Indian Mackerel (Rastrelliger kanagurta). They reported that there was considerable reduction in glyceride content and iodine value with increase in free fatty acid content and peroxide value of muscle lipids. The fatty acid composition of fish lipid as determined by gas liquid chromatography indicated that salting and sun – drying of mackerel caused considerable loss in higher poly unsaturated fatty acids attributable to lipid oxidation.

Sterol and fatty acid content in three groups of surf clams (Spisula solidissim); wild clams (60 and 120mm size) and cultured clams (60mm size) was reported by Krzynowek et al. (1983). Khayat and Schwall (1983) have discussed about the lipid oxidation in seafood.

Subramanian and Venugopalan (1985) determined the heavy metals, iron and manganese in fish and shellfish of Vellar estuary. The results suggested that the fishes which feed on detritus always contain a notably higher concentration of Mn and Fe and this revealed that the feeding behavior of animals has some effect on the concentration of the metals in these animals.
Heavy metal concentration in some common edible fish sold in the city of Bombay was reported by Khot et al. (1985). The study revealed that arsenic concentration was high in all species and all other heavy metals were found within the tolerable limits. Lakshmanan and Stephen (1994) have discussed trace metals in cephalopod molluscs – A unique phenomenon in metal accumulation. Kumar et al. (1986) did works on the biochemical studies on a little known marine gastropod *Hemifusus pugilinus* Born (Volemidae).

Lakshmanan and Nambisan (1985) have studied the uptake and loss of mercury in three bivalve molluscs *Perna viridis* (Linnaeus), *Villorita cyprinoides* var. *cochinensis* and *Meretrix casta* (Chemnitz). They reported that the highest concentration factor was obtained for the mussel, *Perna viridis* and it decreased with increasing concentration of mercury and the rate of uptake is rather slow in *Meretrix casta*.

Krzynowek (1985) discussed about sterols and fatty acids in seafood. He also reported crab as good source of EPA. Proximate composition, mineral content and fatty acids of catfish (*Lctalurus punctatus*, Rafinsque) for different seasons and cooking methods was carried out by Mustafa and Medeiros (1985).

Krzynowek and Murphy (1987) have studied the proximate composition, energy, fatty acid, sodium and cholesterol content of finfish, shellfish and their products. Tagore et al. (1988) have reported the distribution of heavy metals in the edible marine gastropods of Porto Novo Coast.

Lakshmanan (1988) reported heavy metals in commercially processed molluscan products in relation to quality. This study revealed that the concentrations of Hg, Cu, Zn, Cd, Pb and Sn were well below the recommended maximum concentrations in clams and mussel products. However, copper and zinc were higher
in oyster products. Depuration studies have been suggested to remove heavy metals from molluscs.

Jasmine et al. (1988) reported mercury level in the edible oyster *Crassostrea madrasensis*. This study results showed that the level of mercury was less than the accepted standard limit of 0.5ppm in the edible meat. Biochemical changes in the oyster *Crassostrea madrasensis* (Preston) was reported by Easterson and Kandasami (1988).

Studies on seasonal variations in the biochemical composition of *Meretrix casta* (Chemnitz) occurring in Vellar estuary was carried out by Balasubramanyan and Natarajan (1988). This study results showed that high percentage of protein was found in the mantle than any other organ. Further, it was found that gonad and digestive gland had respectively high percentage of carbohydrate and fat than other organs. Total lipids and nutritionally important fatty acids of some Nova Scotia fish and shellfish food products were studied by Ackman and McLeod (1988).

Ackman (1989) has reported the nutritional composition of fats in seafoods. Nott and Nicolaidou (1989) discussed about metals in gastropods. They reported that in marine gastropod, high concentrations of heavy metals occur in the digestive gland where these metals are accumulated within intracellular mineralized granules as phosphates and within lysosomal residual bodies in association with sulphur in a form that render them unavailable to the general metabolic processes of the animal and also to a carnivore that eats the tissue.

Nicolaidou and Nott (1990) reported Mediterranean pollution from a ferro-nickel smelter: differential uptake of metals of some gastropods. They also reported the cytology of heavy metal accumulation, metal metabolism and bioreduction.
Proximate composition, minerals, fatty acids and sterols of some shellfish was analysed by King et al. (1990). Ackman (1990) discussed about the seafood lipids and fatty acids. Stability of lipids and omega - 3 fatty acids during frozen storage of Atlantic salmon was studied by Polvi et al. (1991).


Studies on the trace metal content of fish and shellfish including bivalves was reported by Radhakrishnan (1994). Size dependent metal concentrations in two marine gastropod species was studied by Catsiki et al. (1994). Patterson et al. (1997) have reported the distribution of Zn, Mn, Fe, and Cu in edible marine gastropods along the southeast coast of India. They observed that the animals from heavily polluted sites showed high levels of metal. High concentrations of all metals were recorded during the rainy monsoon whereas concentrations were low during the dry summer. Effects of cooking on the fatty acid profiles of selected sea foods were studied by Dudek and Elkins (1997).

Rajan (1998) reported the bioaccumulation of manganese in Meretrix casta (Chemnitz). The result of this study showed that the manganese was higher in sediment than in water and the tissues as also in females than in males. Higher levels of manganese were recorded in sediment, water and tissues during monsoon than summer. Statistical analyses suggest that levels in the tissues are directly proportional to the concentration in the external medium.
Variations in the biochemical composition of the squid *Illex argentinus* from the South Atlantic Ocean was studied by Moreno de *et al.* (1998). This study results showed that all tissues contained high concentrations of polyunsaturated fatty acids followed by saturated fatty acids and monosaturated fatty acids. This digestive gland of the squid is rich in polyenoic fatty acids, 20:5n – 3 and 22:6n – 3.

Ackman (2000) discussed about the fatty acids in fish and shellfish. He also reported that oysters, mussels, clams etc. contain lipid ranging from 1 – 3% and in crustaceans the fat content ranges from 0.5 – 1.5%. Effects of season and processing on oil content and fatty acids of Baltic herring (*Clupea harengus membras*) were carried out by Aro *et al.* (2000).

Nutritional quality of shrimp extract powder was carried out by Thankamma *et al.* (1985). The results showed that the Protein Efficiency Ratio of the shrimp extract powder (2.03) was lower than that of reference protein casein (2.83). and a mixture of shrimp extract powder and casein (1:1) had a PER comparable to that of casein (2.67).

Nair *et al.* (1985) have studied the nutritional evaluation of products from Squilla. They also noticed lower PER than the reference protein casein. The weights of liver and kidney of rats fed both diets were normal and no untoward symptoms were noticed. Nutritional studies on the evaluation of the safety of squilla protein were carried out by Nair *et al.* (1991).

George and Mathew (1996) did experimental study on the biochemical and nutritional evaluation of yellow clams. This study explained that the meat from *Katelysia* or *Tapes* sp. was better in sensory qualities than that from *Meretrix* sp. Protein Efficiency Ratio of clam muscle was higher than the standard casein diet.
Biochemical and nutritional evaluation of crab meat was carried out by Selvin et al. (1998). They observed that the meat had high content of α amino nitrogen, ribose, phosphorus and sodium whereas lipids, glycogen, fructose, potassium and calcium were low. Protein Efficiency Ratios except that of P. sanguinolentus were better than that of casein.

Effect of dietary fish on antioxidant parameters of normal and cholesterol stressed rats was carried out by Nandini et al. (1999). This study suggested that the high polyunsaturated fatty acid content of S. longiceps, the fish abundantly available in the west coast of India, does not have any deleterious effect by way of free radical generation. The observed lipid peroxidation is not critical as is evident from the results of glutathione level and other scavenging enzymes. Anilakumar et al. (2002) did experimental works on the effects of dried fish on antioxidant levels in rat liver.

Two cases of bacterial discoloration of squids have been reported by Srinivasan (1962). Smith et al. (1980) worked on the storage of herring (Clupea harengus) in ice, refrigerated sea water at ambient temperature. They also studied about the chemical and sensory assessment.

Botta et al. (1982) have studied the chemical and sensory assessment of round nose grenadier (Macrourus rupestris) subjected to long term frozen storage. Sastry and Srikar (1985) reported the protein and related changes in cuttlefish (Sepia aculeata) during iced storage. They also reported that the electrophoretic studies indicated alteration of sarcoplasmic and myofibrillar proteins during iced storage.

Physical, chemical and sensory analysis of sardine (Sardina pilchardus) stored in ice was studied by Nunes et al. (1992). Observation on the shelf – life
period of fresh and ice stored edible portion of *Chicoreus ramosus* and *Fasciolaria trapezium* was carried out by Ramesh and Ayyakkannu (1992).

Vishwanath and Lilabati (1995) have studied the biochemical and microbiological quality of ice stored catfish *Wallago attu* of the Imphal market. They also observed that there was a high content of TVB-N and FFA at 12.00±1.73mg 100g⁻¹ and 5.50 ± 0.29% oleic acid, respectively. *Salmonella* and *E. coli* were not detected. However, presence of *Staphylococcus aureus*, faecal streptococci, coliforms and a high content of bacteria (10⁸ g⁻¹) and fungi (10⁶ g⁻¹) indicated that the fishes were probably from polluted waters and or proper sanitary care was not taken after capture.

Patterson *et al.* (1996) did experimental works on microbiological changes during freezing of *Chicoreus ramosus* meat. The results showed that the Total Heterotrophic Bacteria reduced slowly in meat samples, both cooked and raw, but even after 50 days of freezing, bacteria were detected in samples. *Vibrio parahaemolyticus* was detected only in the raw samples and after 20 days of freezing they were found to be totally eliminated.

Rajeswari and Hameed (1998) worked on the frozen storage characteristics of *Oratosquilla nepa*. They observed that the organoleptic quality was acceptable up to 5 months. Frozen squilla stored for 5 months can be used for further processing into value added products. Information on the objective analysis of seafood quality was discussed by Gill (1990).

Prafulla *et al.* (2000) conducted studies on the effect of different methods of icing on the quality of squid and cuttlefish during storage. The study indicated that indirect icing preserves most of the nutrients in squid and cuttlefish, but with shorter shelf life, while chilling in a mixture of salt and ice gave a product of better quality.
Quality changes in whale shark (*Rhiniodon typus* Smith) meat during storage in ice was carried out by Kumar *et al.* (2000). They reported that there was a decrease in the proportion of soluble fractions of protein during storage. It was also observed that the meat could be stored in ice up to 12 days in acceptable condition.

Effect of packaging on the spoilage of King Scallop (*Pectin maximus*) during chilled storage was carried out by Ruiz-Capillas and Horner (2001). Freezing and cold storage of seer fish, white pomfret and croaker was carried out by Hiremath and Sen (1988). Jiang *et al.* (1979) worked on freezing preservation of fresh-shucked oysters.

Paarup *et al.* (2002) observed the changes in sensory, chemical and bacteriological during storage of iced squid (*Todaropsis eblanae*) stored at 4°C. Studies on frozen storage characteristics of treated and untreated meat from male and female mussel (*Perna viridis*) was carried out by Sawant and Patange (2002). The study showed that among the treated samples, male blanched mussel product could be frozen stored in very good condition for more than 105 days and from organoleptic point of view it had the best shelf life. However, the quality of untreated meat was acceptable for 30 days only.

Joseph and Sherief (2003a) did experimental works on the effect of treatments on the iced storage shelf life of cuttlefish (*Sepia aculeata*) fillets. The results showed that the salt + citric acid treatment was found to be superior in retaining the texture, physical appearance and overall quality of the frozen fillets.

Effect of iced storage duration and treatments on the frozen storage characteristics of cuttle fish fillets was carried out by Joseph and Sherief (2003b). They reported that the salt + citric acid treatment was found to improve the appearance and overall quality of the fillets. The salt + citric acid treated sample was
organoleptically in good condition for four days and fair up to six days of storage in ice.

Peryam and Pilgrim (1957) introduced the hedonic scale method of measuring food preferences. The processing method for the flesh of the pearl oyster *Pinctada vulgaris* Schum have been studied by Gunasekara (1961). Ruiter (1971) had discussed the trimethylamine and the quality of fish. The biochemical and microbial studies on shrimp especially about the Volatile Nitrogen and aminoacid analysis have studied by Cobb *et al.* (1973).

The bacterial quality of tuna loins (*Euthynnus affinis*) stored in ice was investigated by Jeyasekaran *et al.* (2004). He observed that the samples were found to be sensorially acceptable upto 15 and 11d, when stored in ice immediately and after a delay of 6h, respectively.

Studies on Colombo curing of Mackerel (*Rastrelliger kanagurta*) were carried out by Muraleedharan and Balachandran (1975). It has been proved that the gingili oil is used to protect the pickle from mold growth without affecting the taste and flavour. Pickles curing of fish using the preservatives such as tartaric acid and garlic have been studied by Devadasan *et al.* (1975).

Vijayan *et al.* (1982) have studied the processing of clam meat into pickle. He also reported that the mould growth in pickled product could be arrested by the use of skinned mustard and gingili oil.

Chandrasekhar (1979) reported a method of processing and preservation of prawn pickle. He also reported that these pickled products are considered a delicacy and are safe without any harmful bacteria being present, maintaining their quality for more than 6 months at ambient temperature. Chandrasekhar *et al.* (1978) did
experimental work on the utilization of trash fish for human consumption such as development of fish pickle from *Nemipterus japonicus*.

Preparation of fish pickles from low cost fish was studied by Vijayan *et al.* (1989). They also observed that the tuna pickle has remained in acceptable condition throughout the period of storage. The cat fish pickle developed a dark colour at the top layer and rancid flavour from the 6\textsuperscript{th} month onwards. The higher fat content might have contributed to the poor shelf life of cat fish pickle.

Studies on pickled products from green mussel were carried out by Muraleedharan *et al.* (1982). They prepared three types of pickles from mussel meat namely, dried and pickled, fried and pickled and light smoked and pickled and found best shelf life in smoked and pickled product.

Gopal *et al.* (1985) did experiments on the development of flexible packaging for mussel pickled in oil. They observed that the samples packed in both polyester – polythene laminate pouches and glass bottles were equally acceptable at the end of the storage period of 6 months.

Gupta and Basu (1985) have reported the pickle from blood clam (*Anadara granosa*) meat. They observed that the decrease of pH may also be the reflection of the increase of titrable acid due to the multiplication of certain acid bacteria at the low pH, which produced acid.

Yellappa and Chandrasekhar (1979) have developed the clam pickle using organic acids. It is evident from the study that pickle products of good quality can be made by utilizing the major species of clams with edible organic acids like acetic, lactic and tartaric and preserved in acceptable condition for a reasonable period at ambient temperature.
Processing chank meat (*Xancus pyrum*) into pickles was studied by Dhanapaul *et al.* (1994). They also reported that the decrease in pH in pickles may be due to the uptake of acid by the meat. Patterson *et al.* (1995) introduced a method for processing meat of *Chicoreus ramosus* into pickle. They also reported that the shelf life of the pickle was more than 5 months in airtight glass bottles.

Microbiological characteristics of prawn pickle stored at ambient temperature (30±2°C) were studied by Abraham *et al.* (1996). They observed that the lactic acid bacteria, coliforms, *Staphylococcus aureus*, *Salmonellae*, *Vibrios* and *Clostridium perfringens* were not encountered. The product did not show any visible signs of spoilage for a period of 270 days.

Patterson and Ayyakkannu (1997b) studied pickled product from a gastropod, *Babylonia Spirata*. This results showed that the pickle remained in good condition for a period of 150 days and did not show any specific signs of spoilage.

Venugopalan and James (1969) worked on the utilization of trash fish such as preparation of fish soup mix. This study revealed that the product contained about 25% protein and had a storage life of 4 months at ambient temperature (28 - 31°C). Debervere and Voets (1974) worked on microbiological changes in pre packed plaice in relation to the oxygen permeability of the film.

Debervere and Voets (1971) did experimental work on microbiological changes in prepacked cod fillets in relation to the oxygen permeability of the film. Feasibility report on production of fish soup powder was studied by Shenoy *et al.* (1983). They have been formulated the standard recipe for fish soup powder. Chai *et al.* (1984) worked on the extension of shelf-life of oysters by pasteurization in flexible pouches.
Gopal et al. (1988) have reported the development of flexible packaging for fish soup powder. They observed that soup powder stored in HMHD, LDPE and PP were organoleptically acceptable only for 2½ months, in PEST – LDPE and MXXT – LDPE pouches for 4 months and in LDPE – HDPE co-extruded film for 5 months.

Thankamma et al. (1998) conducted studies on storage of fish paste heat-processed in retort pouch. This study revealed that the product was acceptable up to 36 weeks. Afterwards it became unacceptable due to changes in texture and spreadability. No peroxide formation was noticed up to 36 weeks of storage.

Effects of gamma radiation on sensory qualities, microbiological and chemical properties of salted and fermented squid was carried out by Byun et al. (2000). Effect of vacuum packaging on the shelf life of fried mussel, *Perna viridis* (Linnaeus) in flexible packaging material was studied by Bindhu et al. (2002) and reported that the samples packed under vacuum had a storage life of 9 months and those packed in air were acceptable for a period of 6 months.

Manju et al. (2004) have studied the heat penetration characteristics and shelf life studies of seer fish moilee packed in retort pouch. They reported that the product remained sterile throughout the storage period. Shelf life studies showed that samples stored at ambient temperature (27±10°C) were acceptable and had good sensory attributes up to 18 months whereas samples stored at 37°C were acceptable only up to 10 months. Sen and Rao (1966) developed the deodorization process for fish protein concentrate from Bombay duck (*Harpodon nehereus*).

Instant soup powder from king abalone (*Chicoreus ramosus*) was studied by Patterson and Ayyakkannu (1997a). They reported that the product was
microbiologically sound and the characteristics of flavour were maintained throughout the storage period.

Studies on ready to fry dried products from low cost fish were carried out by Khasim and Prasad (1998). The shelf life studies indicated that the products from sciaenids and upenoids were acceptable for five months and those from silver belly upto six months.

Stabilized products from thermal processed fish were reported by Nair and Menon (1985). The products have been subjected to storage studies with respect to microbial status and product quality and were found to be stable for over one year.

Non-traditional exotic product form Jawala prawns was developed by Damle et al. (1989). This study revealed that the storage material was in excellent condition up to six months. After this period, the product slowly started developing discoloration and beyond nine months the development of discoloration was rapid and became brittle.

Setty et al. (1977) developed the partially hydrolyzed and deodorized fish flour. They reported that the products had shelf life of more than a year at room temperature. The flour prepared from Nemipterus sp had a PER 2.32 compared to 2.68 of raw fish meat and 2.5 of standard casein.

Majumdar et al. (2005) have studied biochemical and microbiological characteristics of salt fermented Hilsa (Tenualosa ilisha) and observed a significant variation in the amino acid profile of the product as compared to that of raw fish.

Studies on technological properties and biochemical studies of Bonga Ethmalosa fimbriata was carried out by Akande and Faturoti (2005). He also
reported that the chemical composition did not vary significantly except in lipid content where a significant (P< 0.05) inverse relationship between moisture and lipid content was observed. Studies on sausage from blood clam meat were reported by Basu (1989).

Patterson (2000) has studied the utilization of gastropod meat for the preparation of flakes. This study revealed that the flakes prepared using C. ramosus meat have more appealing organoleptic characters than the flakes with Pleuroloca trapezium. Flakes containing a combination of corn and C. ramosus are the best and all products have better storage life.

Raju et al. (1997) conducted studies on the development of ready-to-fry crab products. This study contains the development of two important ready to fry products from crab meat viz., crab sticks and crab cutlets. The suitable recipes for these products are standardized and their chemical analysis recorded. Zynudheen et al. (1998) discussed the utilization of Jawala (Acetes spp.). The studies showed that all products were acceptable.

Physiochemical properties of Malaysian fish balls were studied by Huda et al. (2001). The study revealed that there was a wide variation in the amount and types of ingredients used in producing the different kinds of fish balls. Different brands of fish balls exhibited different cooking effect, which ranged between -11.06% and +8.21%. All samples showed AA grade in folding test, which indicated that the texture of fish balls was acceptable to consumer.

Studies on storage characteristics of dried chank meat (Xancus pyrum) chips were reported by Kumar et al. (2003). They observed that there is a significance difference between the market and laboratory samples in overall acceptability (p<0.05).
Shanthini and Patterson (2001) have studied the smoke curing of *Pleuroloca trapezium* meat (Gastropoda: Fasciolariidae). This study revealed that the best quality of the smoked meat of *P. trapezium* was obtained after 5 minutes of blanching in 5% brine and 45 minutes of smoking.

Patterson (2001) has studied the canning of smoked brown mussel *Perna indica* and observed that the microbial load is drastically decreased when small mussels are smoked for 30 min and larger ones for 45 minutes. The final product is sterile and has the best consumer preference qualities.

Mariappan *et al.* (2004) worked on survival of *salmonella*, *Staphylococcus aureus* and *Vibrio parahaemolyticus* in hot smoked fish (*Nemipterus* Sp) fillets under low temperature storage. They also reported that the hot smoking process reduced the initial bacterial flora by over 97%, *Vibrio parahaemolyticus* was completely eliminated while *salmonella* and *Staphylococcus aureus* were reduced by 99.8 and 89.6 % respectively.

Ramesh and Ayyakkannu (1995) carried out studies on smoking and sun drying of *Chicoreus ramosus* muscles and observed that the shelf life of sun dried meat was about 210 and 180 days for foot and columella muscles, and about 270 and 240 days for smoked foot and columella muscles, respectively.

Development of smoked products from marine gastropods was studied by Renitta and Patterson (2004). They also reported the smoked meats of *Chicoreus virgineus* and *Babylonia spirata* had a good protein content of 8.6% and 6.2% and less fat content of 3.3% and 3.3% respectively. This study revealed that biochemically, microbiologically and organoleptically it is good and safe for human consumption till the end of the storage period.