4. DISCUSSION

As mentioned earlier Shark is almost available in all parts of the world. According to Kreuzer and Ahmed (1978) some 60 to 70 years ago shark was familiar to the inhabitants of the Pacific Islands, along the coasts of Africa, Latin America and Europe. In Japan salted, dried and smoked shark meat was the traditional food. What characterized the consumption pattern of this period was that relatively small quantities, which were utilized near the place of landing as heavily salted and smoked products. On these days sharks were not really commercially exploited. The commercial exploitation of shark began in the middle of forties. In this period smoked shark meat was introduced in Germany and frozen shark meat was introduced in U.K. In the early seventies market for shark meat was increased in Australia. Now-a-days most of shark meat is utilizing for the production of kamaboco and hampen in Japan.

In our country shark is mainly handled for its fins. The carcass after cutting off the fins has not been utilized properly - it is observed that in many parts of India, fishermen throw off the remaining body of the shark after cutting of the fins to the sea itself. Another important observation is that in many parts of India, shark is sold at very low prices after removal of the fins. This point to the lack of awareness that the meat, hide, liver and even offal of shark can be effectively used to develop products which will have
a good consumer acceptance. Also the knowledge of preserving the products was lacking. The cured or sundried shark handled by the traditional fish curer gives a very low quality product because of the following reasons (a) the raw material used is not preserved and is inferior in quality (b) the method of processing is not hygienic and (c) the preservation of the product is not satisfactory.

During this study period diversified fishery products were made utilizing the entire portion of the shark.

Kreuzer and Ahmed (1978) explained a method for pulling away the skin of small species Squalus acanthias. This method was tried for the dressed shark made from S. palasorra and found that it is a failure because the meat is damaged when the skin is pulled out. So the method adopted in this study is found to be more effective for our species. It is also found that the size less than 60 cm is more palatable and maximum meat is retained in this product.

Shark fillet is a fully processed form and the consumer can prepare dishes without much effort. The fillet need only minimum space for storing and the transportation is more easy. Another advantage for the fillet is that the physical appearance of the product is entirely different from the whole shark. This will also favour easy marketing of the product. Hence it is suggested to process the coastal shark of larger than 60 cm into fillets. Kreuzer and Ahmed (1978) suggested a brine washing (5%) for the fillets before freezing. But in this study the fillets was given only ice water washing of 4 hours in the ratio 1:3 (fillet:water) and consumer's
appeal was pleasing for this product.

According to Kreuzer and Ahamed (1978) though Japan is the biggest shark catcher in the world, import sharks in the chilled and frozen condition. It is converted into minced meat and utilized for making of kamaboko, hampen, yoki-chukuwa etc. In the present study period coastal shark *S. palasorra* of size less than 70 cm used for minced meat production. The dressed and sufficiently scored sharks must be given ice water washing before mincing. This will help to improve the colour and reduce the urea content of the product.

Fish cakes and fish balls were developed for the first time in India from the minced meat of shark after mixing it with other fish meat like pink perch in the ratio 1:2 and 2:3 respectively during this study period.

The pickles made out of the shark meat is already proved its superiority among the consumers. Production of the above items can be suggested to the Women Welfare Societies as a cottage industry.

Mathew and Balachandran (1990) explained a method for producing smoked shark fillets. According to them the brined fillets after surface drying for about one or two hours in sun is smoked by burning saw dust. Smoking is carried out at a temperature of about 50°C for 2 to 3 hours. The method developed in the present study is quite different from the above method. Fillets of the coastal sharks (*S. palasorra*) are found to be suitable for smoking. Salting is given in a saturated brine for 15 minutes. Draining and smoking is carried
out inside the smoking chamber and the product is not at all dried in sunlight. If the product is dried in sun, there is every chance of contamination which will lower the quality of the product.

The procedure for the canning of shark meat is not mentioned so far by anybody in India. Smoked fillets and fish balls are canned and the analytical reports favours the products.

Most of the shark meat is converted into dried or cured form in our country. Kreuzer and Ahmed (1978) explained two methods namely kench and pickle curing. The product will be dried with a moisture content of about 35%. They also estimated that sun drying of fillets of 2 cm thickness will take 3-4 days. Mathew and Balachandran (1990) also explained the same methods for drying the shark. According to them the fish to salt is usually in the ratio 3:1.

Ramachandran (1989) described the typical method adopted for the production of semi-dried shark in Veravel area and also estimated the cost of production and marketing. Ramachandran and Solanki (1988) have suggested an improved method for the processing of semi-dried shark. They suggested filtered saturated brine for salting instead of using dry salt directly for curing. This will eliminate all dust and other foreign particles from the salt.

But the present study proved that washing of fish before salting and after salting give good appearance and eliminate the ammonia smell from the product. The washing of salted
fish before drying remove all unwanted material from the meat and also reduce the high percentage of salt content. The low percentage of salt will help easy drying and thus lowering the moisture content. The low moisture content (less than 25%) increase the shelf life of the product to about six months, so the processors are getting enough time for marketing their products in good condition. Normally it is already known that the demand for dried fish is reduced in the peak season of fresh fish landing. The present study the shark is dried until the moisture content reaches less than 25% and thus increasing the storage life. Though the yield percentage is a little bit lowered the advantage is that the product can be stored for larger period and can market the product at lean season when the prices of the dried fish is at its maximum.

Salting the meat using saturated brine solution and keeping it in the same solution is not recommended for our tropical condition because the water from the fish diffuses out which will reduce the brine concentration and increasing the chances of spoilage and also lowering the quality of the product. It is also suggested that the meat of larger oceanic sharks are processed into dried form because the meat is not palatable compared with coastal shark meat due to high percentage of urea content.

Shark liver oil containing high percentage of squalene has a good market. According to Kreuzer and Ahmed (1978) shark liver oil of high squalene content is used in cosmetic industry in Japan. The squalene is an emollient believed to rejuvenate the human skin and is found as unsaponifiable matter
in the liver of certain deep sea sharks.

Buranudeen and Rajadurai (1986) described the extraction of squalene from the liver. The liver have to be processed as soon as possible, preferably within 15 minutes after its death. As soon as the liver are taken out, they should immediately be chopped, placed over a wire mesh basket and heated below about 82°C in 2% caustic soda solution for 30-45 minutes. This process is called as alkali digestion method.

Shark liver oil of high squalene content was separated from C. granulosus species by simply exposing the liver to sunlight or air. The oil separated by the alkali digestion method as stated above was found more viscous and dark coloured. But the oil separated by exposing to sunlight was light coloured with a pleasant odour.

Thankappan and Gopakumar (1991) estimated the squalene content of the liver oil of four species using latroscan method. According to them the detection of squalene is found to be higher using latroscan compared to column Chromatography using alumina.

The processing of shark fins and fin-rays differs considerably from place to place. Mathew and Balachandran (1990) suggested a method for producing semi-prepared fins and fin rays. The fins are first soaked in 10% acetic acid over night. The shagreen present on the skin is scrapped off and the adhering scrap residues are washed away with water and further soaked in acetic acid (10%) in a separate tank until they become soft. In the case of
The present study suggests two methods for the separation of shark fin rays namely cold and hot process. The cold process is similar to the above process which need only a few PVC buckets and commercial acetic acid. Hot process need heating facilities and more over a good acid resistant metallic container for heating to around 70°C. No yield variation is noticed in both process. The production of shark fin rays can be done by the fishermen as a cottage industry in a hygienic way, because the process is simple and getting a good price. The product is mainly exported and hence the quality must be of supreme nature.

Kreuzer and Ahmed (1978) explained the processing of shark skin in detail. The most important contribution of the large sharks in the market place, apart from the fins, is its uniquely strong skin. The recent techniques in processing can transform shark skins into superior quality leather making articles of distinctive beauty with unusual comfort and serviceability.

Since the shark hides are considered as the key revenue product in the shark fishery, it is appropriate to discuss the factors responsible for getting the good quality hides. The shark must be skinned as soon as possible and the skin should be thoroughly cleaned of flesh. The cleaned skins are to be salted immediately. Mathew and Balanchandran (1990) recommends that the mixture of pure salt using for salting of shark hide contains 0.5% Zinc.
In this study the hides were separated from *C. limbatus* by split opening the dorsal side and separating the flesh and bone carefully using knives, because the pulling off skin was a failure. The tanned hides are superior in strength and colour even after five years. Hence it is suggested that the skin of the oceanic sharks of larger size which is now discarding in our country can be utilized for making good quality leather. Another factor noted in the study was that the hides separated from the frozen shark is inferior in quality compared to the hides of fresh shark (without icing and freezing).

Kreuzer and Ahmed (1978) suggested the conversion of shark offal into fish meal. But the present study shows that the fish silage production need only very low investment and the process is very simple. Another attractive factor is that even the fisherman can produce the silage from the daily waste using few PVC buckets. The silage produced can be utilized for feeding their poultry or cattles as such or by mixing with rice bran, tapioca etc.

Gordievskaya (1971) estimated the chemical composition of meat of five species of shark namely Horn shark, White tipped shark, Hammer headed shark, Silky shark and Tiger shark. According to him protein content differs in different species. In the present study chemical composition of the meat of three selected species of shark was estimated and the result showed that the chemical composition varies according to species. Highest moisture content was noticed in the *S. palasorrah* while protein was highest in *C. limbatus* and fat content was more in the *C. granulosus*. 
The investigation of Gordievskaya (1971) and Mathew and Balachandran (1990) on the urea content of shark species have shown that it varies from 1600 mg% to 2300 mg%. Moreover it is noticed that 1200 mg% is the threshold value below which urea is not detected in shark meat; 1400 mg% of urea is not noticeable if the meat is prepared with ingredients which give a distinct flavour.

For reducing urea content they suggested soaking of shark meat in 5% brine solution or a mild solution (1.5%) of acids like citric, acetic or lactic acids etc.

It was found from the present study that the different species of shark have different percentages of urea content and this content is species characteristic; S. palasorra varied 1600 to 1800 mg%, C. limbatus varied 1800 to 2100 mg% and C. granulosus varied 1200 to 1300 mg%. In the study period the shark meat was given ice water washing of about 4 hours in the ratio 1:3 (fish:water) after making thin slices of maximum 3 cm thickness. The result showed that the urea content was reduced about 1500 mg% and by preparing shark meat with hot spices like red chillies, pepper, garlic etc. reduced the pungent odour (due to urea content) of the meat into undetectable level.

Based on the commercial feasibility study conducted in the present context supports the view that the shark fishery will be a profitable one even if the existing industry diversify their processing activities from shrimp to fishes.

Unless all parts of shark are used in the most remunerative way, utilization may not lead to commercial success. The present study concentrates on methods of preparing hygienic
and acceptable products from shark and attaining fullest utilization of shark. In order to overcome the traditional consumer prejudice against shark meat, it will be ideal to conceal the physical nature of shark by developing products like fillets, minced meat and other value added products like fish cake, fish balls, battered and breaded fillets, fish pickles etc. which can easily introduced to the market. The product range allows selection of products to be adopted in large scale as well as small scale and cottage industries. The products can be prepared even in a house based system. Therefore, the product-line system can be adopted by the fish processing industry to develop a scale production or to develop as an alternative production system to utilize spare capacities in the existing plants. This can be adopted by the traditional fish processor and also by fisher women as a family business or as Women's Co-operatives. Such a production system can bring economic benefits to the fisherman community and also to the traditional as well as industrial fish processor.

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