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# STUDIES ON THE PROCESSING AND STORAGE CHARACTERSTICS OF SEMI-DRIED PRODUCTS FROM SHARK*

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ABSTRACT

Skin-on split opened products and skinless boneless fillets were prepared from shark by modified processing methods. Their quality and storage behaviour under different Relative Humidities (RH) and vacuum packaging, irradiation, etc. were studied. Maximum salt absorption by the muscles during salting was observed during the first eight hours which decreased gradually as time passed. Likewise dehydration too showed a similar trend during salting. An optimum salting period of 16 to 18 hours in saturated brine is considered to be the best to obtain a product with 16 to 18% salt and 52 to 56% moisture content. The improved processing method reduces the processing time and improves quality of the product. The yield of split opened variety and skinless boneless fillet were 73% and 35% respectively. Polythene packed products that were evacuated and irradiated gave a longer shelflife. Storage at higher RHs accelerated surface discolouration and spoilage. The product stored at 65% RH was found to retain the product composition and quality for about one month.

## INTRODUCTION

SHARK is one of the major groups of fishes contributing substantially to our marine fish landings. The estimated shark landings is 1984 was 3,629 tonnes (Anon., 1986). But this resource is not being properly exploited or utilised by the fishery industry in India. Major Share of the landings goes for salt curing in the traditional method which resulted in a poor quality, heavily salted product with high urea content. For these reasons, shark products are considered as inferior products and consumed mainly by the poor. Shark in fresh form is not very much appreciated by consumers due to the high level of urea content.

High moisture cured products are attaining more importance in India and abroad due to its fresh fish like appearance. The studies conducted on dry fish trade in Southeast Asian countries by Marine Products Export Development Authority, Cochin shows that the consumer preference has been shifted from fully dried fish products to high moisture cured fish products (Anon., 1986 a). The studies conducted by the authors on the preparation and marketing on semidried fish products from India shows that they lack standardization of processing methods (Ramachandran and Solanki, 1988).

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## Material and Methods

*Scoliodon sorrakowah* (between 0.6 to 0.7 kg/Fish) and *Carcharhinus* spp. (between 4.0 to 6.0 kg/Fish) were used for the preparation of semidried skin-on split opened shark and semidried skinless boneless fillets respectively. The methods of processing of skin-on split opened product and the fillet are given in follow chart 1 and 2 respectively.

*Follow Chart* 1

Raw Shark→Washing →Longitudinal cutting and spliting of shark →Gutting →Leaching of urea in cold water →Salting in filtered saturated brine → surface washing to remove surface salt and draining → Surface drying → Packing → Storing.

*Follow Chart* 2

Raw Shark → Washing → Beheading and filleting → Leaching of Urea in Cold water → Trimming and washing → Salting in saturated brine →Rinsing to remove surface salt and draining → Surface drying → Packing → Storing.

*Treatment :* (1) Sodium propionate : 0.1% of sodium propionate (w/v) was dissolved in saturated brine and this brine was used for salting the fish. (2) Potassium Sorbate : The treatment was given after the completion of salting process just before drying by dipping the dressed material (fish/fish fillets) in the chemical (0.5% w/v for 5 minutes).

Salted samples were further grouped into two batches, one batch was kept for surface drying for about 1.5 hours (This is just to remove the water from the surface of the fish products). The other batch was dried for 4-6 hours to bring down the moisture of the product to a lower level between 54 to 58%. One set from the various batches were kept in open condition without packing to simulate the commercial practice. Other sets were packed in polyethelene bags in two groups. One group was vacuum packed and other non-vacuum packed. The groups were further divided into three (1) One hour irradiated, (2) Two hours irradiated and (3) without irradiation. The source of irradiation was from a UV lamp.

The moisture, salt, fat and ash were estimated by the methods described by AOAC (1975). Nitrogen was estimated by Microkjeldahl method. Urea was estimated by Micro-discussion technique of Conway (1947). The salt pickup and dehydration of shark muscles while salting was periodically estimated to optimise the salting process. The fish to saturated brine ratio used was 1 : 2 (w/v). The brine was changed after 24 hours of salting. The physical quality of the products after preparation and during storage was estimated by a five member test panel. Periodic weight loss of the products during storage was also observed. The semidried products were rehydrated with water (fish : water = 1 : 10) and the moisture and salt contents were estimated periodically during the rehydration process.

## Results and Discussion

Salting in filtered saturated brine is preferred as it removes dust particles and gives the product a better appeal. Moreover, the salt pickup by this method is quicker than by dry salting. The salt pickup and dehydration pattern during salting are presented in Fig. 1.

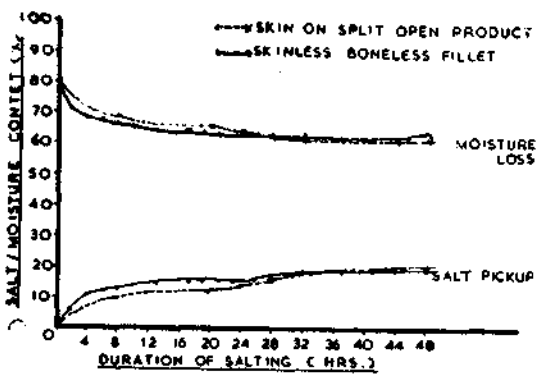


Fig. 1. Dehydration and salt pick-up during the salting process.

By about 12 hours of salting itself the salt content of the skin-on split opened shark and skinless boneless fillet reached a level of 13 and 15% respectively. The corresponding moisture contents of the products at this stage were about 67 and 65% respectively. The salting beyond this stage yields only very little additional salt pickup and an optimum salting time of 16 to 18 hours on commercial level is suggested to be on the safer side to yield a final product with 16 to 18% salt and 52 to 56% moisture content. In commercial practice prolonged salting is carried out (Ramachandran and Solanki, 1988).

The pattern of change of the urea level in shark muscle during salting is presented in Fig. 2. The final urea content of the product depends on the initial urea content. Bleading of the dressed fish in cold water for one hour is found to reduce the urea content to about 50% and subsequent salting in saturated brine further reduces the urea (Fig. 2). Initial icing of the shark fillets in crushed ice is suggested to reduce the urea content on a commercial scale by Solanki and Venkataraman (1978).

The yield of the product depends on its final moisture content and maintaining the moisture content of the product during storage and marketing is one of the important factors which decides the economy of the business (Table 1). A loss of about 45% in saleable yield was noticed in unpacked products, but it was only 10.5% (8.48-13.25%) in packed products (Fig. 3). The proximate composition

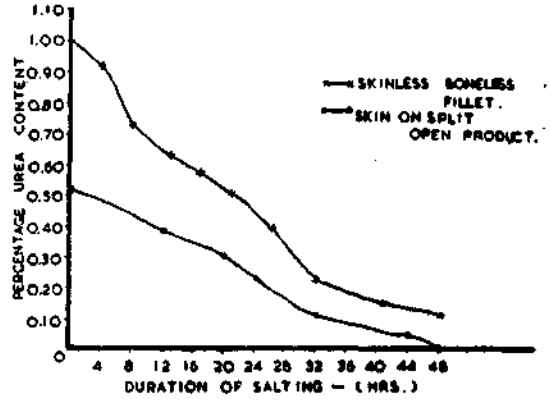


Fig. 2. Urea loss during salting in saturated brine.

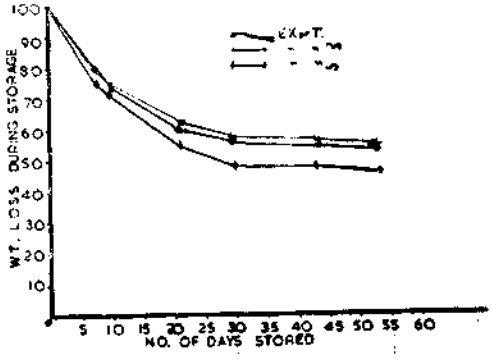


Fig. 3. Weight loss in semidried skin on split opened shark product kept in open condition.

TABLE 1. *Yield of semi-dried shark products (percentage)*

| Product | | Yield of dressed material from raw shark | Yield of final product from raw shark | Yield of final product from dressed material |
|---|---|---|---|---|
| Skin on split open shark | Average | 92.09 | 72.93 | 79.03 |
| | Range | 91.95-92.22 | 72.65-73.21 | 78.68—79.38 |
| Skinless and boneless fillet | Average | 49.38 | 35.23 | 71.29 |
| | Range | 48.54-50.21 | 32.79-37.67 | 67.55-75.02 |

of semidried products at 55% moisture content is estimated and is presented in Table 2.

TABLE 2. *Proximate composition of semi-dried shark products*

| Content | Skin on split opened shark | Skinless and Boneless fillet |
|---|---|---|
| Moisture .. | 55.00 | 55.00 |
| Protein (TN x 6.25) .. | 23.82 | 20.95 |
| Fat .. | 3.00 | 0.14 |
| Ash .. | 15.26 | 21.37 |

*Shelf-life Studies*

The changes in physical characteristics of semidried products kept in unpacked condition is summarised in Table 3. The main change noticed in exposed samples was rapid dehydration resulting in textural changes and distortion. This results in reduction of saleable yield and loss of semidried nature.

The 0.1% propionate treated product was found to score maximum for colour and remained in acceptable conditions upto 40 days. The product prepared with filtered saturated brine (untreated) also gave good result, but was acceptable only upto about 30 days. The product prepared in the traditional method was acceptable only upto 7 days. Even the initial score of this product was low. This was mainly due to the precipitation of salt ; blood remains in the muscle and urea/ammoniacal smell.

The changes in the physical characteristics of semidried products packed in polythene bags

TABLE 3. *Physical characteristics of semidried shark products stored in open condition*

| Products/Treatments | No. of days stored | Appearance | Colour | Odour | Texture | Total score *Acceptability |
|---|---|---|---|---|---|---|
| 48 h. salted in sat. brine, propionate treated and surface dried for 4 hours .. | 0 | 3.8 | 4.2 | 3.2 | 3.8 | 15.0 (A) |
| | 7 | 3.8 | 3.8 | 3.6 | 3.2 | 14.4 (A) |
| | 15 | 3.4 | 3.8 | 3.6 | 2.4 | 13.2 (A) |
| | 21 | 3.4 | 3.4 | 3.4 | 1.8 | 12.0 (A) |
| | 30 | 3.4 | 3.0 | 3.4 | 1.4 | 11.0 (A) |
| | 40 | 3.0 | 2.8 | 3.2 | 1.2 | 10.2 (A) |
| 48 h. salted in sat. brine and untreated .. | 0 | 3.8 | 3.8 | 3.2 | 4.2 | 15.0 (A) |
| | 7 | 3.4 | 3.4 | 3.4 | 3.2 | 13.0 (A) |
| | 15 | 3.2 | 3.2 | 3.4 | 2.0 | 11.8 (A) |
| | 21 | 3.4 | 3.2 | 3.2 | 1.6 | 11.4 (A) |
| | 30 | 3.0 | 2.8 | 2.8 | 1.4 | 10.0 (A) |
| | 40 | 2.8 | 2.6 | 2.6 | 1.2 | 9.2 (NA) |
| Product prepared in traditional method .. | 0 | 3.0 | 3.0 | 2.2 | 3.0 | 12.2 (A) |
| | 7 | 2.6 | 2.6 | 2.2 | 2.6 | 10.0 (A) |
| | 15 | 2.4 | 2.8 | 2.4 | 1.8 | 9.4 (NA) |
| | 21 | 2.4 | 2.6 | 2.4 | 1.6 | 9.0 (NA) |
| | 30 | 2.4 | 2.8 | 2.4 | 1.4 | 9.0 (NA) |

*Acceptability : A = Acceptable ; NA = Not Acceptable.

Score : Appearance : Excellent 5, Good 3, Satisfactory 2, Bad 1, Very bad 0.

Colour : Characteristics 5, slight loss of characteristic colour 3, Dull yellowish 2, Slight red discolouration 1, Red discolouration 0.

Odour : No Urea/Ammonia smell 5, slight Urea / Ammonia smell 3, Ammoniacal smell 2, Deep ammoniacal smell and slight off odour 1.

Texture : Soft, firm and fresh fish-like 5, Slightly hard 3, hard 2, very hard 1.

and subjected to different treatments are presented in Table 4. The main advantage of packaging of semidried product is the retention of the textural features of the product. Irradiation of the products for two hours was found to increase the shelf-life of the product by about 10 days. The product brined for 18 hours, treated with 0.5% Pot. sorbate, vacuum packed and irradiated for 2 hours remained acceptable upto 60 days. Similarly treated product, but brined for 48 hours had only a reduced shelf-life. The red discolouration was the main problem associated with all the batches of products and its occurrence and intensity was found to depend on the salt content of the product. (Products with salt contents above 20% salt was found to have accelerated growth of red discolouration.) Several other authors have also reported similar trend of halophilic growth in salted products (Brown, 1946; Kushner, 1968; Larsen, 1962, 1967).

TABLE 4. *Physical characteristics of semidried shark products packed in various forms*

| Products/Treatments | No. of days stored | Appearance | Colour | Odour | Texture | Total score *Acceptability |
|---|---|---|---|---|---|---|
| 48 h. brined, propionate .. | 0 | 4.2 | 4.2 | 3.8 | 3.8 | 16.0 (A) |
| | 7 | 4.2 | 4.2 | 3.4 | 3.4 | 15.2 (A) |
| | 15 | 3.8 | 3.8 | 3.4 | 3.4 | 14.2 (A) |
| | 21 | 3.4 | 3.4 | 3.4 | 3.8 | 14.0 (A) |
| | 30 | 2.8 | 2.6 | 2.6 | 3.4 | 11.4 (A) |
| | 40 | 2.4 | 2.6 | 2.4 | 3.4 | 10.8 (A) |
| | 50 | 2.0 | 2.4 | 2.4 | 3.0 | 9.8 (A) |
| 48 h. brined, propionate treated surface not dried and packed in polyethylene bags .. | 0 | 3.0 | 4.2 | 3.8 | 3.4 | 14.4 (A) |
| | 7 | 2.8 | 3.8 | 3.8 | 3.8 | 14.2 (A) |
| | 15 | 2.8 | 3.0 | 2.8 | 2.8 | 11.6 (A) |
| | 21 | 2.0 | 3.0 | 2.8 | 2.8 | 11.2 (A) |
| | 30 | 2.4 | 2.6 | 2.6 | 2.8 | 10.4 (A) |
| 48 h. brined, untreated, surface dried and packed in polyethelyne bags .. | 0 | 3.4 | 3.4 | 3.4 | 3.8 | 14.0 (A) |
| | 7 | 3.4 | 3.4 | 3.4 | 3.8 | 14.0 (A) |
| | 15 | 3.0 | 3.0 | 3.0 | 3.4 | 13.4 (A) |
| | 21 | 3.0 | 2.8 | 2.8 | 3.4 | 12.0 (A) |
| | 30 | 2.4 | 2.2 | 2.6 | 3.0 | 10.2 (A) |
| | 40 | 1.6 | 1.6 | 2.4 | 3.0 | 8.6 (NA) |
| 14 h. brined, untreated and packed in polyethene bags | 0 | 3.8 | 3.8 | 3.0 | 3.8 | 14.4 (A) |
| | 7 | 3.4 | 3.4 | 3.0 | 3.8 | 13.6 (A) |
| | 15 | 3.0 | 3.0 | 3.0 | 3.4 | 12.4 (A) |
| | 21 | 3.0 | 3.0 | 3.0 | 3.4 | 12.4 (A) |
| | 30 | 3.0 | 2.8 | 2.8 | 3.4 | 12.0 (A) |
| | 40 | 3.0 | 2.8 | 2.8 | 3.4 | 12.0 (A) |
| | 50 | 2.4 | 2.2 | 2.4 | 3.0 | 10.0 (A) |

| Products/Treatments | No. of days stored | Appearance | Colour | Odout | Texture | Total score Acceptability |
|---|---|---|---|---|---|---|
| 18 h. brined, pot. sorbate treated and vaccum packed | 0 | 3.8 | 3.8 | 3.0 | 3.8 | 14.4 (A) |
| | 7 | 3.8 | 3.8 | 3.0 | 3.4 | 14.0 (A) |
| | 15 | 3.8 | 3.8 | 3.0 | 3.4 | 14.0 (A) |
| | 21 | 3.8 | 3.4 | 3.0 | 3.4 | 13.6 (A) |
| | 30 | 3.4 | 3.0 | 2.8 | 3.4 | 12.6 (A) |
| | 40 | 3.4 | 3.0 | 2.8 | 3.4 | 12.6 (A) |
| | 50 | 2.8 | 2.8 | 2.8 | 3.0 | 11.4 (A) |
| 18 h. brined, pot. sorbate treated, vaccum packed and irradiated for 2 h. .. | 0 | 3.8 | 3.8 | 3.4 | 3.8 | 14.8 (A) |
| | 7 | 3.8 | 3.8 | 3.4 | 3.4 | 14.4 (A) |
| | 15 | 3.8 | 3.8 | 3.0 | 3.4 | 14.0 (A) |
| | 21 | 3.8 | 3.8 | 3.0 | 3.4 | 14.0 (A) |
| | 30 | 3.4 | 3.4 | 3.0 | 3.4 | 13.2 (A) |
| | 40 | 3.4 | 3.4 | 3.0 | 3.4 | 13.2 (A) |
| | 50 | 2.8 | 2.8 | 2.8 | 3.4 | 11.8 (A) |
| | 60 | 2.6 | 2.6 | 2.4 | 3.4 | 11.0 (A) |
| 48 h. brined, surface, dried and untreated .. | 0 | 3.8 | 3.8 | 3.8 | 3.4 | 14.8 (A) |
| | 7 | 3.8 | 3.4 | 3.8 | 3.4 | 14.4 (A) |
| | 15 | 2.8 | 2.8 | 2.6 | 3.4 | 11.6 (A) |
| | 21 | 2.4 | 2.2 | 2.0 | 3.0 | 9.6 (NA) |
| | 30 | 1.6 | 1.2 | 1.0 | 3.0 | 6.8 (NA) |
| 48 h. brined, surface dried and vacuum packed .. | 0 | 3.8 | 3.8 | 3.4 | 3.4 | 14.4 (A) |
| | 7 | 3.4 | 3.0 | 3.0 | 3.4 | 12.8 (A) |
| | 15 | 3.0 | 3.0 | 3.0 | 3.0 | 12.0 (A) |
| | 21 | 2.2 | 1.8 | 2.6 | 3.0 | 9.6 (NA) |
| 48 h. brined, surface dried irradiated for one hour and packed in polyethene bags | 0 | 3.8 | 3.8 | 3.8 | 3.4 | 14.8 (A) |
| | 7 | 3.4 | 3.4 | 3.4 | 3.4 | 13.2 (A) |
| | 15 | 3.0 | 3.0 | 3.0 | 3.0 | 12.0 (A) |
| | 21 | 2.6 | 2.6 | 2.6 | 3.0 | 10.8 (A) |
| | 30 | 2.2 | 1.6 | 2.0 | 3.0 | 8.8 (NA) |
| 48 h. brined, surface dried, irradiated for 2 hours and packed in polyethene bags | 0 | 3.8 | 3.8 | 3.4 | 3.4 | 14.4 (A) |
| | 7 | 3.4 | 3.4 | 3.0 | 3.4 | 13.2 (A) |
| | 15 | 3.0 | 3.0 | 2.8 | 3.0 | 11.8 (A) |
| | 21 | 2.8 | 2.8 | 2.6 | 3.0 | 11.2 (A) |
| | 30 | 2.6 | 2.6 | 2.4 | 3.0 | 10.6 (A) |
| | 40 | 2.2 | 2.0 | 2.2 | 3.0 | 9.9 (NA) |

*Acceptability : A=Acceptable ; NA=Not Acceptable.
Score : See Table 3.

The rehydration and desalting characteristics of skinless boneless shark fillets upto a period of six hours are presented in Fig. 4. The product after rehydration for 5 hours was found to have a similar moisture content and appearance as that of fresh fish fillets. During the period of rehydration the salt from an initial level of 22.5% has brought down to 2.8%.

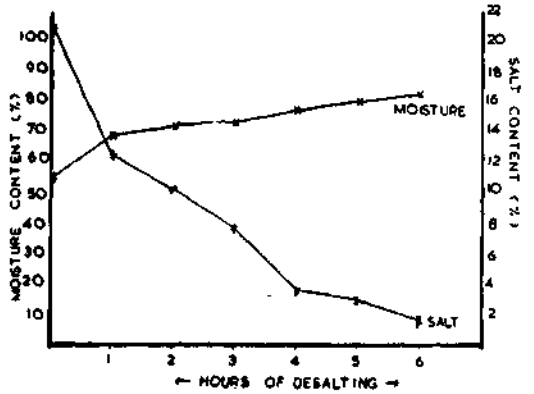


Fig. 4. Moisture and salt content during rehydration.

The semidried products were behaving differently during storage under different (constant) RH conditions. Storage at higher RHs was found to accelerate the surface discolouration and spoilage within few days. The product stored at lower RH conditions were found to be dried and distorted. The product stored at 65% RH was found to retain the product composition and quality for about a month.

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