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# Evaluation of Quality of Shark Livers Using Bio-Chemical Properties and Organoleptic Score Sheet

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## Abstract

KEYWORDS: ORGANOLEPTIC SCORE; VOLATILE NITROGEN; PEROXIDE VALUE; SHARK LIVERS.

Shark livers are considered as an important raw material providing a quality fish oil. It has been reported to aid white – blood-cell production and act as an active ingredient in hemorrhoid treatments. It is also reported that liver oil as a good supplement of vitamin A and poly- unsaturated fatty acids which are important to the development of brain cells in human. Freshness of livers is very important to extract better quality oil. In Sri Lanka, the annual shark production amounts to 8000t, however the quality of livers collected from landing sites has not being measured yet. Present study was conducted to evaluate the quality of silky (*Charcarninus falciformis*) shark livers available in Negombo and Beruwala landing sites in the West Coast of Sri Lanka and also to study the relationship between organoleptic and bio-chemical correlation on freshness of shark livers.

Liver samples which were collected from landing sites in the West coast of Sri Lanka, were evaluated for external and internal colour, texture and odour. Total volatile nitrogen (TVN), pH value, free fatty acid (FFA%) and peroxide (PV) values of livers were also determined to assess quality. According to the organoleptic scoring system 4.3 % of liver samples were categorized as best in quality while 30.4%, 56.5% and 8.7% rated as good, medium and poor in quality respectively at the Negombo and Beruwala landing sites. Bio- chemical analysis showed that the better quality livers had the highest score for sensory evaluation and low values for TVN, FFA and peroxide value while low quality livers gave low score for sensory evaluation and high TVN, FFA, peroxide values.

Correlation coefficient of organoleptic scores against total volatile nitrogen value, pH value, free fatty acid % and peroxide value of shark livers were determined by statistical analysis. Organoleptic score of shark livers was found to be highly

correlated (r =0.9174) with total volatile nitrogen, peroxide value (r=0.8672) and pH value (r= 0.7738).

# Introduction

The total shark production of Sri Lanka is approximately 12% of the total fish production (Anon, 1997). Among the total shark production silky shark (*C. falciformis*) is the dominant species (75%) followed by oceanic white tip (*C. longimanus*) (5%) (Amarasooriya, 1997). Relative weight of the liver of silky sharks varies between 3-8% (Jayasinghe and Jayaweera, 1995). The weight and oil content of shark livers vary with species, age, sex and season (Jayasinghe *et al*, 1998). Large quantities of livers of sharks are wasted except livers from deep-sea sharks. A small quantity of oil extracted from shark livers is presently being used to prepare animal feeds such as fish feed and poultry feed. It is beneficial to prepare food grade oil from waste shark livers, which could be utilized as a nutritional supplement, especially for children with vitamin A deficiencies.

Shenoy and Dey (1984) reported that sharks deteriorate very soon after catching and shark products become valueless unless preparation is started as early as possible. The Indian standards for shark liver oil for veterinary use stipulate that the material shall be obtained from fresh or preserved shark livers (Govindan, 1985).

Colour changes and development of rancidity after a few days of oil extraction has been reported in Sri Lanka (personal communications with oil producers). Shenoy and Dey (1984) reported that care must be taken to select only fresh livers and inclusion of even one of spoiled liver can ruin an entire batch of oil. Therefore, it is very important to evaluate the quality of shark livers available at the landing sites. The present study was carried out to evaluate the liver quality and assess bio- chemical relationship with organoleptic score on freshness of silky shark (*C. falciformis)* livers.

# Materials and Methods

## Raw material

Liver samples of *C. falciformis* were collected fortnight intervals from fish landing sites at Negombo and Beruwala in the West coast in Sri Lanka.

### Evaluation of liver quality using organoleptic score sheet

Livers of silky sharks were subjected to sensory evaluation according to the score sheet given in Table 1. The internal and external color, texture and odor of the liver samples were determined at the landing sites. Then the livers were immediately iced and brought to the laboratory at National Aquatic Resources Research and Development Agency (NARA), Colombo for bio-chemical investigations.

### Bio chemical analysis

The moisture content and pH value of shark livers were determined by using the methods of Anon (1980). Lipid contents of livers were determined according to Bligh and Dyer (1959). Micro- diffusion technique of Conway (1962) was used to determine total volatile nitrogen content. The peroxide value and free fatty acid content of liver oil were determined according to Anon (1992 a) and Anon (1992 b) respectively.

### Statistical Analysis

Statistical analysis was done by the methods described by Zar (1984).

## Results

### Evaluation of liver quality at the landing site

According to the organoleptic scoring system used in this study (Table 1), livers which had the score of 25-21 were categorized as the best in quality, 20-16, good in quality, 15-11 medium in quality and below 10 poor in quality. More than 30 liver samples of silky shark were examined organoleptically using the above scoring system, at the landing sites of Negombo and Beruwala. The results of the study are given in Figure 1.

4.34% of liver samples were categorized as best in quality while 30.4% as good in quality, 56.5% of the livers fallen in to medium quality and 8.7% below the average (Figure 1).

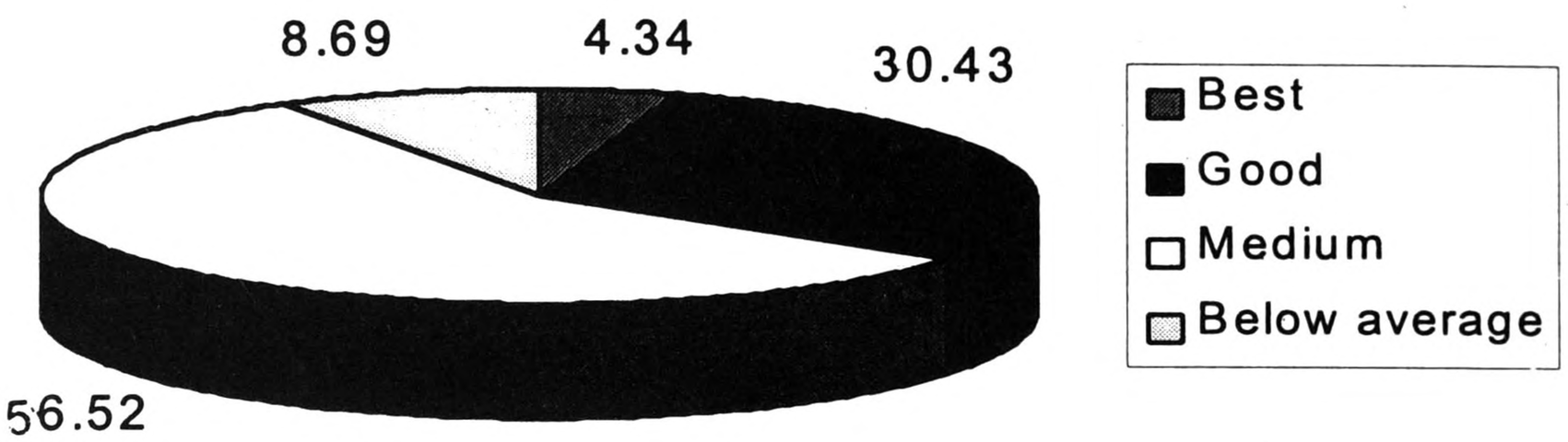


**Fig.1: Liver quality of silky sharks at Negombo and Beruwala landing sites**

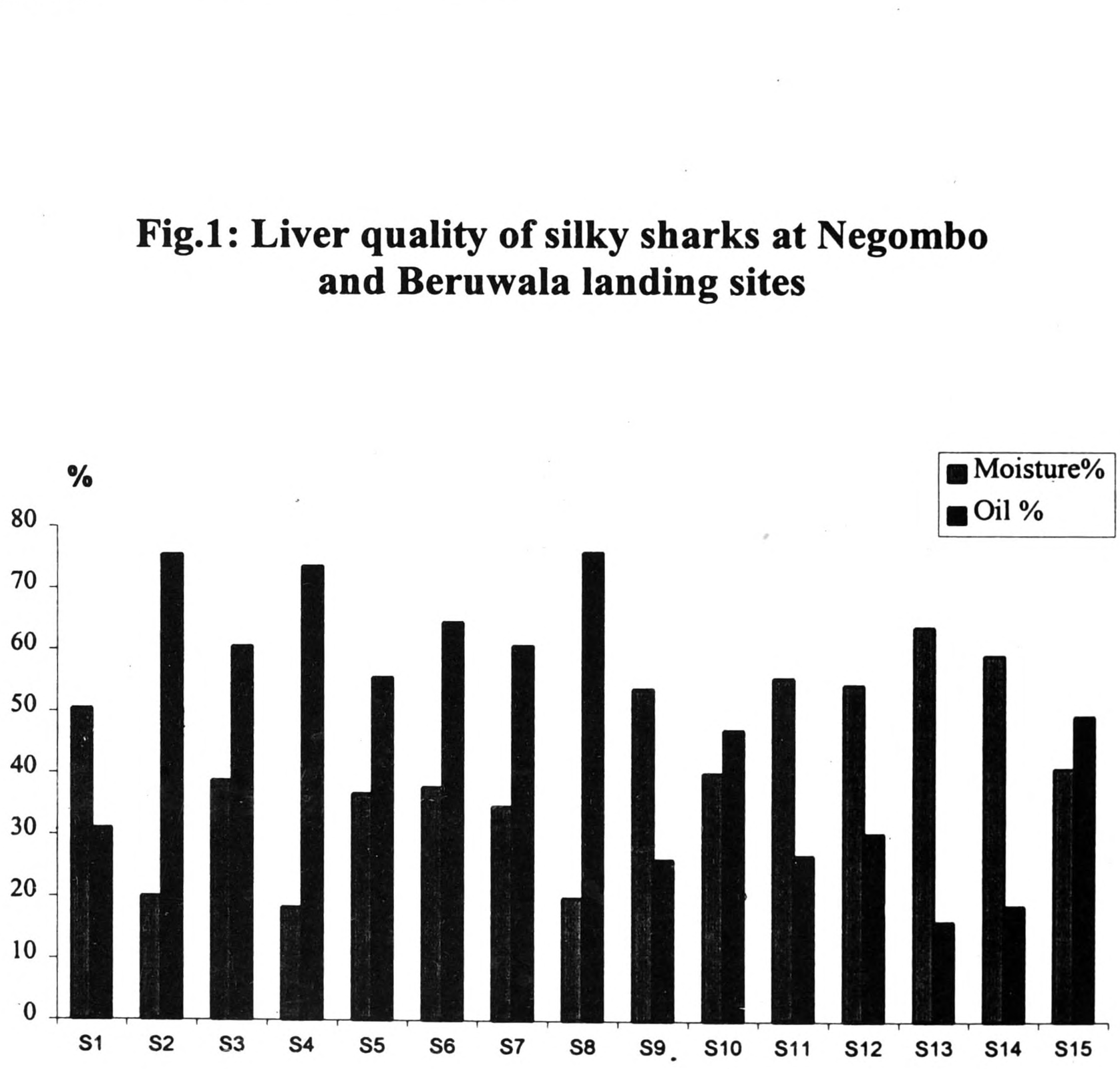


**Fig.2: Relationship of moisture and oil content of silky shark liver**

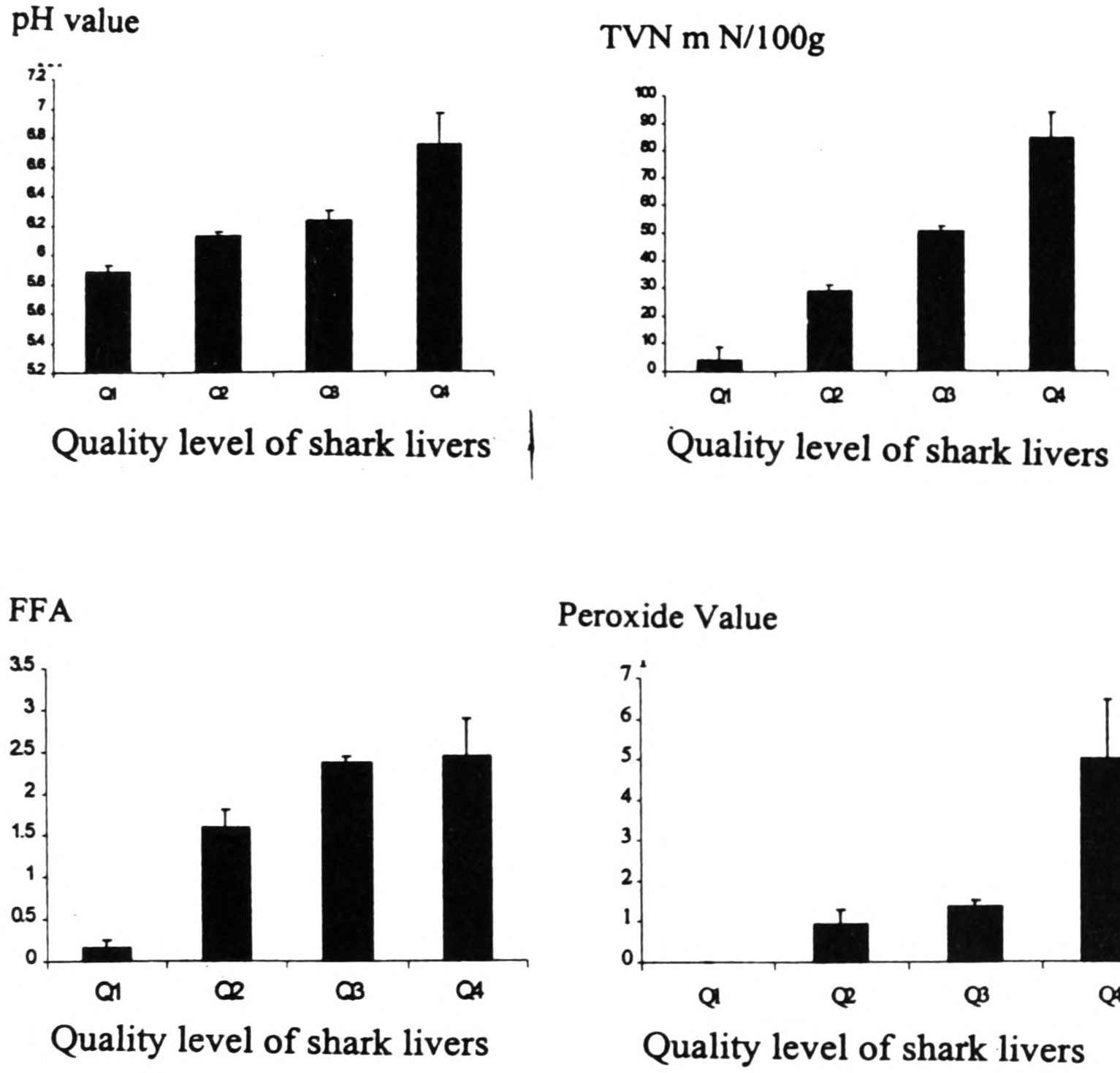


**Fig.3: Variation of liver quality (freshness) of shark liver with pH, total volatile nitrogen, free fatty acid and peroxides (Q1:best, Q2:good, Q3:medium, Q4: poor- below average) (Values are given with mean + _S.D)**

As seen in Figure 2 the oil content was found to be more in livers where the moisture content was low and viz.

**Evaluation of quality changes of liver and liver oil**

Results of the organoleptic evaluation and bio - chemical studies are given in Figure 3. Liver samples categorized as the "best" showed lower TVN (3.9 ±

4.8 mg N / 100g), FFA(0.16 ± 0.7%), and pH(5.8 ± 0.4) values. Liver samples categorized as "good" quality showed the moderate amount of TVN (28.5 ± 2.4 mg N/100g), FFA (1.6 ± 0.2%), pH (6.1 ± 0.02) and PV (0.95 ± 0.32meq/kg). Highest TVN(84.36 ± 9.5 mg N/100g), FFA(2.4 ± 0.43%), pH(6.74±0.21) and PV(5.01± 1.42 meq/kg) were recorded in "poor" quality

**Table 1: Organoliptic scorecard used for evaluation of shark livers at the landing site**

ORGANOLEPTIC SCORE CARD FOR SHARK LIVERS

STATION:.....
DATE:.....

| Individual rating | Excellent (5) | (4.5) | Good (4) | (3) | Fair (3) | (2.5) | Poor (2) | (1.5) | Bad (1) |
|---|---|---|---|---|---|---|---|---|---|
| | Very Good | | Fairly Good | | Below Average | | Very Poor | | |
| Texture | Very firm, elastic and cannot be easily pressed | | Firm elastic and leaves no thumb impression when pressed | | Slightly firm and leaves thumb impression when pressed | | Soft and broken when pressed | | Soft and flabby |
| External color | Very pink color | | Reddish pink or pink | | Reddish | | Grayish pink or brown | | Dark gray or dark brown |
| Internal color | Pinkish | | Pinkish red or pinkish yellow when cut | | Reddish when cut | | Grayish yellow or brown when cut | | Dark gray or dark brown when cut |
| Odour | Fresh seaweed smell | | Neutral | | Slightly ammoniacal | | Ammoniacal or sour | | Putrid |
| Quality | Best in Quality | | Good in quality | | Medium in quality | | Poor in quality | | Inferior in quality |
| Total score | 25 24 23 22 21 | | 20 19 18 17 16 | | 15 14 13 12 11 | | 10 9 8 7 6 | | 5 4 3 2 1 |

**Table 2 : Correlation coefficient of Organoleptic score against total volatile nitrogen value, pH value, free fatty acid % and peroxide value of shark livers and liver oil**

| Parameter | Correlation coefficient (r) | Critical values of the correlation coefficient |
|---|---|---|
| Organoleptic score– total volatile nitrogen | -0.9174 | 0.001 |
| Organoleptic score – free fatty acid | -0.4450 | 0.01 |
| Organoleptic score – peroxide value | -0.8672 | 0.001 |
| Acceptability level – pH | -0.7738 | 0.005 |
| Total volatile nitrogen – free fatty acid | 0.9051 | 0.001 |
| Total volatile nitrogen – peroxide value | 0.7161 | 0.01 |
| Total volatile nitrogen - pH | 0.8838 | 0.001 |

Statistical analysis for determination of correlation coefficient of acceptability level (organoleptic score) of raw shark livers against total volatile nitrogen value, pH value, free fatty acid percentage and peroxide value of shark livers are presented in table 2.

The organoleptic score and TVN value of livers showed a negative correlation; r = -0.9174 while FFA - organoleptic score, peroxide value - organoleptic score and pH value - organoleptic score showed; r= -0.445; -0.8672 and -0.7738 respectively. Correlation coefficients of total volatile nitrogen content against percentage of free fatty acid, peroxide and pH values of shark livers were also measured. A positive correlation was seen between all groups such as TVN - FFA; r = 0.9051, TVN - peroxide; r = 0.7161 and TVN - pH; r = 0.8838.

## Discussion

In Sri Lanka most off shore fishing gears are operated for more than one week. Sharks are caught to obtain fins as a priority product and fishermen are not worried about the quality of the flesh. During long trip duration the quality of liver get deteriorate due to bad handling practices. The results of the present study suggest that more than 50% of livers at landing sites are not

in very good quality due to unsatisfactory handling practices at boats and landing sites.

The organoleptic score sheet prepared in the present study, for assessing freshness of livers has been improved compared to the score sheet presented by Chandrasekhar and Manisseri (un dated). The authors selected firm and pinkish livers as the best in quality. According to their score sheet firm and grayish externally and reddish when cut are medium in quality. Flabby white externally and white internally livers are inferior in quality. However score sheet used in this study suggested that very firm texture, very pink external and internal colour and fresh seaweed smell livers which scored 21 to 25 are the best in quality. Livers with firm elastic texture, reddish pink or pink external colour, pinkish red or pinkish yellow internal colour and neutral smell or total score of 16to 20 are considered as good in quality. Further more slightly firm texture, external and internal colour reddish, slightly ammonical smell livers having total score in between 11 to 15 are medium in quality. Livers with a score lower than 11 are poor or inferior in quality.

Results of the present experiment confirmed the finding of Soudan (1978) and Huss (1988) that the organoleptic examination plays an important role in assessing the quality of any food product, specially fish and fishery products. It is the scale for standardizing measurement, whether it be physical, chemical or bacteriological; a given perception has a given value of measurement (Soudan, 1978). The previous author showed that it is sometimes slow when numerous characteristics have to be observed, but it is still quicker than many chemical or bacteriological methods.

In the present study, results of the sensory evaluation could be explained by biochemical parameters such as TVN, pH, peroxide and free fatty acid values of liver and liver oil samples. The pH of the muscle tissues of live fish is close to neutral. Due to the postmortem anaerobic formation of lactic acid, pH decreases within the first day of death. The present results agreed with Huss (1988) that pH is more or less constant or slightly increased due to the formation of basic compounds. In very fresh sample the total volatile nitrogen content was not in detectable level while poor quality sample(Q4) recorded high values. These results agree with the observations of Huss (1988) that the measurement of the total amount of volatile basic compounds is the best chemical method for assessing fish quality. The method has wider applications since it can be used for fish containing little or no trimethyl amino oxide (TMAO). Also it is more useful for quality assessment of fish species where volatile bases other than trimethy amine (TMA) are formed during spoilage (Huss 1988). The occurrence of a high level of urea in the muscle and blood is a characteristic of the elasmobranchs (James and Olley,

1971). Urea is the precursor of the ammonia formed in shark after death. The deterioration of the urea into ammonia, the reduction of trimethyl amine oxide, and results of autolytic and microbial action are responsible for the pungent shark odour (Tsachiza *et al* 1951; Suyama, 1960 quoted by Keruzer, 1974).

Free fatty acid variation pattern observed in the present experiment confirmed the findings of Dattatreya (1944). Shenoy and Dey (1984) observed that the spoiled liver contains a high level of FFA while fresh livers contain low FFA values. Furthermore, Indian standards for shark liver oil states that the acid value of liver oil must be less than 3% (Indian standards quaoted by Govindan, 1985). However, fish in poor quality yielded a malodorus oil with high content of FFA and sulphur (Kristensen, 1993).

Peroxide value of the best quality sample (Q1) was also very low and not observed in detectable level. In poor quality samples(Q4), the peroxide value was 2.4 mg peroxide / 100g fish. However, the peroxide value of the samples was not sufficient for the actual evaluation of oil quality of shark livers.

Therefore, the results of total volatile nitrogen content and organoleptic score have been found to be useful indicators for the evaluation of oil quality of shark livers. The degree of freshness of fish livers has to be considered before selecting them for production of high grade oil. These could be handled in such a way that as much of the original vitamin content is retained once the processing is completed. Hull (1992) recorded the importance of the quality of livers in extraction of high quality liver oil. He reported that if fresh livers were used to extract oil it would result in a produce a good quality oil. But if stale livers were used it would result a high fatty acid level. Kristensen (1993) reported that the condition of the fish livers at the time of processing affects the oil physically, chemically and nutritionally.

Microbiological spoilage, rancidity, enzymatic degeneration and fermentation can cause livers to spoil (Hull, 1992). Fish liver can be processed fresh and refrigeration can slightly extend the shelf life but livers are very susceptible to bacteriological and lipolytic degradation (Hull,1992). Chandrasekhar and Manisseri (no date) recommended the use of ice for better storage of livers at 0°C and 5°C.

Shenoy and Dey (1984) reported that ice or refrigeration equipment on board will provide an immediate temporary means of preservation and if this is available, the livers may be removed from the fish as soon as it has been caught and then iced. On this basis the livers will keep from spoiling for 3 to 4 days. The present study indicates that high percentage of livers available for oil extraction at the landing sites are of low quality. Therefore, icing livers on board

immediately after catching certainly would result bringing more high quality livers to the land that would give a better oil.

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