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# VARIATIONS IN THE LANDED QUALITY OF TRAWLER-CAUGHT SHRIMP DURING A PERIOD OF 13 MONTHS

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Seasonal variations in edible and inedible portion, condition index, moisture, protein, lipid, fatty acids and ash during a period of 13 months were determined. Shrimp harvested in April, May, June and October were found to contain more edible portion (flesh) if compared with shrimp harvested in other months. Condition index revealed the same information. Shrimp of acceptable sensory quality were obtained throughout the study period. Shrimp harvested in January, April and June were found to contain relatively high water content giving an indirect evidence of breeding season of this species. No apparent seasonal variation in pH, ash, lipid and bacterial counts of shrimp was noticeable.

***Key words:*** Landed quality, Seasonal variation, Trawler-caught shrimp.

## Introduction

Not much information is available on the biochemical aspects of tropical fishery products, including shrimp. In recent years work on microbiological [1-3] and biochemical aspects [4-6] of spoilage of tropical shrimp has been carried out in the PCSIR Laboratories Complex, Karachi.

It is well known that the condition of fresh shrimp at landing and prior to processing is the most important factor influencing the quality of processed shrimp. In Pakistan, trawlers remain at sea from 7 to 15 days depending upon the size. Obviously, there will be some difference between the quality of shrimp stored for different periods.

From the production viewpoint, information such as variation in edible and in-edible portion of whole shrimp, percentage of moisture, total bacterial load and chemical composition of raw material is essential. This knowledge is useful not only for processors but also for biologists and nutritionists. This information, thus, can be utilized to determine food value and also to plan the most appropriate processing method. There is a total lack of information on the variation of landed quality at different months of the year for the shrimp *Penaeus merguiensis,* locally known as Jaira, processed for export purposes. Keeping this in mind, 13 months study was undertaken to collect some basic data of shrimp of commercial importance in Pakistan.

## Materials and Methods

Large size *Peneaid* shrimp, locally known as Jaira, used in this study were obtained from local fish harbour, covered with ice immediately after purchase and transported to the Laboratories. Before the commencement of experiment, at each month, the shrimp samples were sorted, examined for different species, only *peaneaus merguiensis* were selected and the rest discarded. Shrimp used were of most common size for this particular species ranging from 70 to 80 g in weight and 14 to 16 cm in length. Shrimp were collected at monthly intervals during middle of the months from December 1984 through december 1985. Special care was taken to obtain a representative sample from the landing of the day.

At each sampling period, the shrimp were deheaded, exoskeleton removed from the meat, and weighed separately for determination of edible and inedible portion. Condition index was calculated by dry weight method of Gabbot and Bayne [7].

*Sensory Evaluation:* The sensory evaluation was carried out by a panel of eight trained judges. Shrimp tails after removing the exoskeletion were placed in boiling water for 5-7 mins. and tasted for flavour and texture and judged for appearance. A scale was worked out between 9 (extremely good) and 1 (very poor). The score of each parameter was calculated in terms of score points awarded by the judges to each sample. The sensory data were analysed by the analysis of variance.

*Aerobic Plate Counts:* Areobic plate counts were determined by spreading 0.1ml of appropriate dilutions, prepared in peptone water 0.1% peptone (w/v) (Difco) and 0.9% NaCl (w/v) on plates of nutrient agar (Merck) with an additional 1%, Nacl (w/v). The plates were incubated at 35° for 48 hrs. Protein (N x 6.25), moisture and ash were determined according to AOAC procedures [8]. Lipid were extracted by the Bligh and Dyer [9] method. Free fatty acids were determined by titrating potentiometerically to pH 10 with 0.03 N alcoholic sodium hydroxide, calculated as oleic acid and experessed as percentage of extracted lipid. Using Cambridge pH meter, pH was measured by homogenizing 10 g of muscle in 20 ml distilled water.

## Results and Discussion

Table 1 presents seasonal variation in edible and in-edible portion and condition index of whole shrimp sample collected at different months. It may be seen that fresh flesh

weight of whole shrimp varied between 515 g/kg (July) and more than 572g/kg (June and Oct.). However, the variations were marginal showing two peaks viz. during June and Oct. More data is required to confirm these findings. Shrimp for export are frozen as headless shellon and individually quick frozen (IQF) product. The availability and prices of shrimp vary considerably during different periods of the year. For a processor, it is very important to know the time of the year when one can buy a better product, in terms of high yield of meat and low wastage, for processing. Shrimp are auctioned on the total weight basis. The limited data however suggests that shrimp processed in June and Oct. should give a better return to the processor in terms of processed meat and, therefore, price per unit weight. The condition index, in fact, is the measure of meat quality. This measurement has been applied for the first time in case of crustacean shellfish for the same purpose. It may be noted that highly significant correlation coefficient (r = 0.94) was obtained between flesh weight measured directly and the condition index measured

TABLE 1. SEASONAL VARIATIONS IN EDIBLE AND IN-EDIBLE PORTIONS AND CONDITION INDEX OF SHRIMP *PENEAUS MERGUIENSIS* COLLECTED AT DIFFERENT MONTHS

| Sample No. | Months | Weight of Head g | Weight of Shell g | Weight of Flesh g | Dry Weight (%) | Condition index of (14–16cm) |
|---|---|---|---|---|---|---|
| 1 | Dec. 84 | 363.63 | 90.90 | 545.45 | 27.80 | 564 |
| 2 | Jan. 85 | 3 4.60 | 93.00 | 544.80 | 22.14 | 568 |
| 3 | Feb. 85 | 364.00 | 94.76 | 542.14 | 22.90 | 559 |
| 4 | March 85 | 357.40 | 92.74 | 549.78 | 24.00 | 568 |
| 5. | April 85 | 355.70 | 93.80 | 550.50 | 21.44 | 569 |
| 6 | May 85 | 348.83 | 93.00 | 558.13 | 26.93 | 577 |
| 7 | June 85 | 333.33 | 94.37 | 572.29 | 21.62 | 592 |
| 8 | July 85 | 400.00 | 85.00 | 515.00 | 23.50 | 532 |
| 9 | Aug. 85 | 375.00 | 90.85 | 534.15 | 25.69 | 552 |
| 10 | Sept. 85 | 375.00 | 91.00 | 534.00 | 23.38 | 552 |
| 11 | Oct. 85 | 333.33 | 94.46 | 572.21 | 25.40 | 591 |
| 12 | Nov. 85 | 375.00 | 96.72 | 528.28 | 27.13 | 547 |
| 13 | Dec. 85 | 361.33 | 92.58 | 546.09 | 22.93 | 565 |

(Expressed as g/1000g of we weight)

by the total dry tissue method [10], indicating that the same information for shrimp may be obtained either way. Results of sensory evaluation of different samples are presented in Fig. 1. Each point represents average of mean sensory response (MSR) score of raw (olfactory) and cooked (gustatory) shrimp samples. The mean organoleptic score ranged between 7 to 8.9 for gustatory response. These two sets of data revealed a direct correlation between the olfactory and gustatory response.

If a MSR score of 6.5 for olfactory and 7.5 for gustatory is condsidered as minimum for acceptance, not a single sample may be considered poor or unacceptable. No significant difference was obtained among the samples collected at different months of the year. Seasonal variation in moisture, protein, total lipids, free fatty acids, ash, and pH are presented in Table 2. The moisture level of different samples of shrimp fluctuated between 72.2 % in Dec. (1984) and 78.56%, in April. The water content in most of the shrimp samples have been reported to vary between 70 and 80% depending upon the physiological conditions [10,11]. A relationship between water content and spaning in different shellfish varieties has been reported as the moisture or water content increases after spawning [11]. Very little information

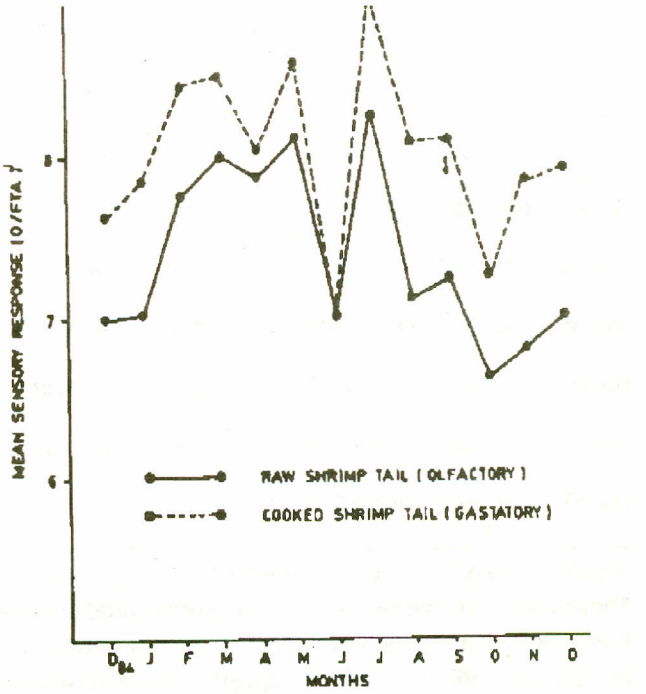


Fig. 1. Seasonal variation In the landed quality of shrimp (Odour/ Flavour Texture and Appearance)

is available on the breeding of *Penaeus merguiensis*. The breeding season of this species has been reported from Dec. through April with peak in Jan.-Feb. [12]. The breeding seasons of *P. penicillatus and P. semisulcatus* have been reported to be Oct. through May and Jan. through May, respectively. This study indicated a generally high moisture in Jan. April and June. This data, however, provide some indirect evidence that the breeding season of this speciye may be between Jan. and June. Indeed, more data is required to support this contention.

The protein content of shrimp muscle varied between 15.01 and 21.1%. The lowest value was obtained in June while the highest in July. In general, a relatively high protein was obtained during May, July, Sep. and Dec. (1985).

Total inorganic content or ash value of shrimp muscle varied between 1.35 and 1.8%. The highest ash content was

TABLE 2. SEASONAL VARIATIONS IN THE COMPOSITION OF SHRIMP (*PENAEUS MERGUIENSIS*) (AS PERCENT OF WET WEIGHT)

| | Moisture | | | Protein | | | Total lipids/free fatty acids | | | Ash | | | pH | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Month | Mean | S.D.± | Range | Mean | S.D.± | Range | Mean | S.D.± | Range | Mean | S.D.± | Range | Mean | S.D.± | Range |
| Dec. 84 | 72.20 | 1.67 | 70.30–73.42 | 17.50 | 0.50 | 17.00–18.00 | 1.16 | 0.02 | 1.14–1.18 | 1.72 | 0.025 | 1.70–1.75 | 6.90 | 0.05 | 6.85–6.95 |
| | | | | | | | — | — | | | | | | | |
| Jan. 85 | 77.86 | 0.19 | 77.65–78.00 | 15.57 | 0.02 | 15.55–15.59 | 1.18 | 0.02 | 1.16–1.20 | 1.57 | 0.020 | 1.55–1.58 | 6.75 | 0.03 | 6.72–6.78 |
| | | | | | | | — | — | | | | | | | |
| Feb. 85 | 77.10 | 0.15 | 76.95–77.26 | 17.00 | 0.50 | 16.50–17.50 | 1.12 | 0.02 | 1.10–1.14 | 1.74 | 0.010 | 1.73–1.75 | 6.55 | 0.01 | 6.59–6.56 |
| | | | | | | | 0.04 | 0.00 | 0.04–0.05 | | | | | | |
| March85 | 76.00 | 0.05 | 75.95–76.05 | 16.24 | 0.21 | 16.00–16.38 | 1.18 | 0.01 | 1.17–1.19 | 1.65 | 0.010 | 1.64–1.66 | 6.45 | 0.03 | 6.42–6.48 |
| | | | | | | | 0.11 | 0.003 | 0.11–0.12 | | | | | | |
| April 85 | 78.56 | 0.21 | 78.40–78.80 | 17.69 | 0.05 | 17.63–17.74 | 1.23 | 0.02 | 1.21–1.25 | 1.78 | 0.026 | 1.75–1.80 | 6.48 | 0.01 | 6.47–6.49 |
| | | | | | | | 0.14 | 0.004 | 0.14–0.15 | | | | | | |
| May 85 | 73.07 | 0.18 | 72.95–73.28 | 18.60 | 0.10 | 18.50–18.70 | 1.22 | 0.02 | 1.20–1.24 | 1.61 | 0.036 | 1.58–1.65 | 6.75 | 0.04 | 6.71–6.79 |
| | | | | | | | 0.14 | 0.002 | 0.14–0.15 | | | | | | |
| June 85 | 78.38 | 0.35 | 78.00–78.68 | 15.01 | 0.01 | 15.00–15.02 | 1.09 | 0.01 | 1.08–1.10 | 1.75 | 0.020 | 1.73–1.77 | 6.65 | 0.02 | 6.63–6.67 |
| | | | | | | | 0.06 | 0.003 | 0.06–0.07 | | | | | | |
| July 85 | 76.50 | 0.24 | 76.25–76.73 | 21.10 | 0.10 | 21.00–21.20 | 1.12 | 0.02 | 1.10–1.14 | 1.53 | 0.010 | 1.52–1.54 | 6.60 | 0.05 | 6.55–6.65 |
| | | | | | | | 0.08 | 0.010 | 0.07–0.09 | | | | | | |
| Aug. 85 | 74.31 | 0.28 | 74.00–74.54 | 17.08 | 0.02 | 17.06–17.10 | 1.10 | 0.02 | 1.08–1.12 | 1.70 | 0.003 | 1.67–1.73 | 6.30 | 0.05 | 6.25–6.35 |
| | | | | | | | 0.08 | 0.003 | 0.08–0.09 | | | | | | |
| Sept. 85 | 76.62 | 0.17 | 76.45–76.79 | 19.50 | 0.20 | 19.30–19.70 | 1.35 | 0.03 | 1.32–1.38 | 1.34 | 0.020 | 1.32–1.36 | 6.49 | 0.02 | 6.47–6.51 |
| | | | | | | | 0.24 | 0.004 | 0.24–0.25 | | | | | | |
| Oct. 85 | 74.60 | 0.10 | 74.50–74.70 | 16.82 | 0.02 | 16.80–16.84 | 1.16 | 0.02 | 1.14–1.18 | 1.63 | 0.020 | 1.61–1.65 | 6.38 | 0.01 | 6.37–6.39 |
| | | | | | | | 0.03 | 0.010 | 0.02–0.04 | | | | | | |
| Nov. 85 | 72.87 | 0.09 | 72.79–72.97 | 16.21 | 0.01 | 16.20–16.22 | 1.24 | 0.04 | 1.20–1.28 | 1.32 | 0.030 | 1.30–1.35 | 6.68 | 0.03 | 6.65–6.71 |
| | | | | | | | 0.07 | 0.003 | 0.07–0.08 | | | | | | |
| Dec. 85 | 77.02 | 0.07 | 76.95–77.10 | 19.24 | 0.02 | 19.22–19.26 | 1.20 | 0.02 | 1.18–1.22 | 1.48 | 0.020 | 1.46–1.50 | 6.72 | 0.01 | 6.71–6.73 |
| | | | | | | | 0.03 | 0.004 | 0.02–0.04 | | | | | | |

obtained during April while the lowest during Sept. and Nov. The ash content of the muscle of various fishery products have been reported to vary between 1 to 2.5% on wet weight basis by different workers [13,14]. No apparent seasonal variation was noticeable.

It may be noted that the lipid content varied between 1.09 and 1.35% during the study period. No clearcut tendency is noticeable in seasonal variation. It has been reported that *P.merguiensis* contains an average of 1% total lipids on fresh weight basis. The results obtained are generally in agreement with the data of fat contents of the shrimp [13,14].

Free fatty acids (FFA) in the lipid revealed a trend similar to total lipids. The lowest value was obtained in Oct. and the highest in Sept.

All samples had a pH lower than 7.0. The highest pH was obtained in Dec. 1984 (6.9) and the lowest in Aug. 1985 (6.3). A relationship is apparent between the pH and the sensory response. During the course of study, both pH and sensory response indicated a reasonably good quality product through the year (Fig. 1). Again no apparent seasonal variation in the pH of shrimp was noticeable. Relatively high pH was obtained during Dec., Jan. and May and low during Aug. and Oct. Figure 2 shows the variation in the bacterial counts in samples collected during the period of study. The bacterial counts ranged from $1.14 \times 10^5$ CFU/g to $2 \times 10^6$ CFU/g. The highest counts were obtained in Oct. and the lowest in Dec. 1985. However, the corresponding counts in Dec. 1984 were $1.5 \times 10^6$ CFU/g. No clearcut seasonal variation was noticeable. The counts decreased almost gradually from Dec. 1984 through May 1985, showed a gradual upward trend, thereafter, upto August dropped again in Sept. and reached the highest level in Oct., followed by downward trend. No statutory standard for total counts of shrimp are operative anywhere in the world. However, counts higher than $1 \times 10^6$ CFU/g. flesh have been considered to indicate a product of poor quality [15]. It may be seen that the count crossed this limit at 4 out of 13 sampling months. In general, the counts obtained in this study were similar to counts reported for harbour fresh shrimp in our previous studies [1, 2].

From the results that have been recorded in this report there seems no significant difference between the quality of shrimp at the time of landing throughout the year, whether this pattern is repeated year after year can only be established by further studies. For those who are interested in the commercial aspects of shrimp quality, the results of these tests

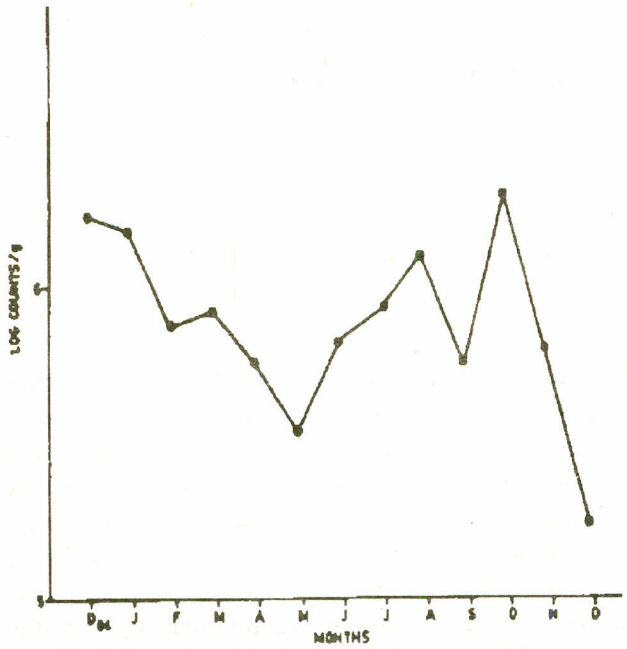

Fig. 2. Seasonal variation in the total plate counts of shrimp

can be interpreted to give very close approximation to the quality of shrimp landed each month. Some of the parameters undergo variations due to season or other factors. The reason of these variations are not yet understood, some of them at least may be linked with spawning cycle. Inspite of the search made, no study on the seasonal variation in protein, lipid, moisture, and ash content with its relationship with spawning cycle in tropical shrimp could be obtained. Therefore, it is not possible to compare the data. In this context, we are concerned with the complex factors such as appearance and odour of raw shrimp and colour and flavour of cooked shrimp, factors which affect the sensory judgement of the buyer or consumer, and which may be termed as eating quality.

It must also be emphasized that this has been a study of the rate of deterioration of shrimp in the vessels during different periods of the year. It does not deal with the initial quality of shrimp at the time they are taken from the water.

Although little data is available, it is generally beleived that spoilage rate of iced shrimp in trawlers is influenced by many different factors. These factors may be grouped into those associated with the living shrimp and its environment before it has been caught, and those that act primarily on the spoilage organisms after the shrimp has been captured.

Different type of spoilage may occur in shrimp of different species and of the same species, depending upon the factors such as the variation in the chemical constituents of the muscle of different species, the conditions of handling during storage at the vessel and the kind of enzymes and bacteria involved. A knowledge why different type of spoilage occur under various handling conditions and what type of chemical compounds are formed would be of great value in preservation studies and in the development of objective tests for determining the freshness of shrimp, is the subject of our furture research.

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