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Storage Characteristics of Cultured *Penaeus indicus* in Ice and at Ambient Temperature

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Live *P. indicus* collected from a prawn farm was used for storage studies at ambient temperature and in ice. The changes in sensory, chemical and bacteriological characteristics were followed during storage. Shelf life of *P. indicus* at 30°C was only 12 h. When stored in ice it remained in organoleptically acceptable condition for 15 days. Balck discolouration was noticed in 6 h at ambient temperature and by the 4th day in ice. The TVBN values were 40 mg/100 g initially, which decreased during early stages of storage and then increased. Changes in quality of farm-produced prawn during ice storage were similar to the quality changes in wild prawns.

Key words: ***P. indicus*, ice storage, storage at 30°C, shelf life.**

The world shrimp production from capture fisheries is around 1.9 million tonnes per annum for the last several years (Anon, 1995a). Demand for shrimp is increasing at a rapid rate. It is very difficult to increase the existing wild catch through increased fishing activities because this may lead to the depletion of this vary valuable resource. Hence the producers have turned to farming of prawns in confined waters and the results are quite encouraging. The farmed shrimp production increased from 97,000 tonnes in 1980 to 6,86,000 tonnes in 1990 (Anon, 1995a). At present farms account for about 25% of the world shrimp supplies (Anon, 1995a). In 1994 India produced 70,000 tonnes of farmed shrimp (Anon, 1995b).

Quality of prawn deteriorates rapidly unless adequate methods of preservation are adopted. Proper icing keeps the product in acceptable condition for reasonable periods. Changes in quality of different species of prawns during storage in ice have been investigated extensively (Fieger & Friloux, 1954; Bailey *et al.* 1956; Velankar & Govindan, 1959; Susamma *et al.*, 1962; Govindan, 1962). Fieger & Friloux (1954) and Baily *et al.* (1962) found that iced prawn remained in prime condition for 4-7 days and was edible up to two weeks. Haard (1992a) reported that changes in quality, especially appearance of black spots vary with species.

In the case of cultured prawns the environmental conditions are totally different from those of the wild variety and the effect of environment on the quality of the processed products is not well understood. In this context it is important to document the quality changes in cultured prawns during processing and preservation and compare their behaviour with prawns caught from the wild. This paper presents the changes in quality of farmed *Penaeus indicus* during storage at ambient temperature and in ice.

Materials and Methods

Live *P. indicus*, collected from a prawn farm was iced (ice to prawn ratio, 1:1) and kept for further studies. Another set of prawns from the same lot was kept at ambient temperature (30±2°C).

Samples from the lot stored at ambient temperature were drawn at one/two hour intervals and analysed for changes in sensory characteristics of raw whole prawn, raw meat and cooked meat (Amerine *et al.* 1965). Samples were drawn from iced material and analysed for total bacterial count (TBC), salmonella, *Vibrio cholera*, staphylococci, *E. coli* and coliforms as per the FDA Bacteriological Analytical Manual (FDA, 1978). Total nitrogen (TN), moisture and non protein nitrogen (NPN) were determined by the method of AOAC (1984), α-amino nitrogen (α-AN) was estimated by the method of Pope & Stevens (1939), total volatile base nitrogen (TVBN), by the method of Conway (1947) and salt soluble nitrogen (SSN), by the method of Dyer *et al.* (1950). The sensory characteristics of the raw and

Table 1. Changes in sensory characteristics of *Penaeus indicus* during storage at ambient temperature (30±2°C)

Storage time hours	Whole prawns	Cooked meat
0	Bright, shining, blue shade, fresh characteristic odour, firm texture	Very light pink colour, sweet, firm and slightly tough texture
1	Bright, shining, blue shade, in rigor, fresh odour	Light pink colour, sweet flavour, firm, slightly tough
2	Most pieces in rigor, bluish shade slightly reduced	Light pink colour, sweet flavour, firm
3	Rigor over in most cases, whiteness of shell increased, slight sea weedy odour	Light pink colour, sweet, firm
4	Rigor resolved in all pieces, slight detachment of shells at the head in few pieces, sea weedy odour	Light pink colour, sweet, firm
6	Slight blackening at the head portion in few pieces, slight detachment of shells at the head portion, pronounced sea weedy odour	Pale pink colour, sweet, firm
8	Blackening at the head portion, blackening of the body shells in few pieces, moderate hanging of head, slight detachment of body shells, sea weedy odour	Pink, slight sweet flavour, firmness reduced
10	Blackening spread, hanging head, detachment of body shells	Pink colour, no off odour, slightly soft
12	Head detached from body in most cases, body shells soft and detached, blackening spread, slight decayed odour, muscle decayed, weedy odour, shells soft	Pink colour, dull meat, slight spoiled odour, no off taste to meat, moderately soft
14	Decayed odour	

cooked material were also studied. The yield as headless (HL), peeled and undeveined (PUD) and weight loss on cooking were also determined.

Results and Discussion

Table 1 gives the changes in sensory properties of *P. indicus* during storage at ambient temperature (30±2°C). Fresh prawn had the characteristic fresh odour which turned to fresh sea weedy odour after storage for 3 h at ambient temperature. The blue green shade noticed in fresh *P. indicus* was gradually reduced and after 3-4 h of storage it became white. Slight hanging of head portion was noticeable after 4 h and slight blackening at the head portion by 6 h of storage. Therefore, it is necessary that the product should be processed within 4 h of catch if it is to be packed as whole. The shells became slightly loose after 8 h and hence was unsuitable for packing as headless. After 12 h, the head of whole prawns became detached, blackening started spreading, the body meat near the head portion became dull brown and the meat developed slight decayed odour. But the cooked meat had no decayed odour except slight off odour and the meat was only moderately soft. Hence it is possible to keep *P. indicus* in acceptable condition for a maximum period of 12 h when stored at 30±2°C.

Changes in TN and other nitrogenous components in *P. indicus* when stored in ice are given in Table 2. Levels TN, NPN, α-AN and SSN in *P. indicus* gradually decreased on storage. The samples iced for 2 days had high TVBN content of 39.2 mg/100g meat which decreased on further storage and then increased after 9 days.

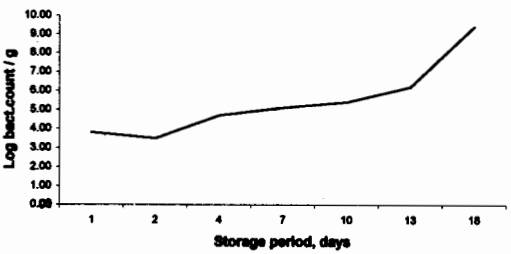

Fig. 1. Changes in total bacterial count of *P. indicus* during storage in ice.

Fig. 1 shows the changes in total bacterial count of prawns during storage in ice. It remained without much change for 4 days and then gradually increased. By the 15th day the total count became 10^7/g. Pathogenic bacteria such as coliforms, *E. coli*, staphylococci, salmonella and *Vibrio cholera* were absent in all the samples.

Table 2. Changes in total nitrogen and nitrogenous components in *P. indicus* during storage in ice

Storage period days	TN (% of meat)	NPN (% of TN)	α-amino nitrogen (% of TN)	SSN (% of TN)	TVBN (mg/100 g meat)
2	3.58	30.28	5.86	82.12	39.2
4	3.57	29.45	6.80	76.27	28.0
7	3.38	28.99	7.35	74.55	24.0
9	3.29	25.53	5.96	75.10	28.0
13	3.10	27.10	5.58	72.25	25.0
15	3.25	25.85	7.54	74.85	36.4
18	2.90	28.97	6.64	77.24	42.0

Fig. 2 depicts the changes in moisture content during storage in ice. It started to increase from the 4th day of storage from an initial value of 75-76% and reached 79.4% by the 15th day.

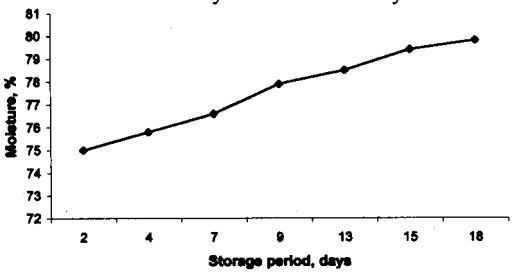

Fig. 2. Changes in moisture during iced storage of *P. indicus*.

The changes in yield as headless and PUD during ice-storage are shown in Fig. 3. The yield as HL was around 66%. The yield as PUD increased from 52% to 56.5% after 9 days of storage. Absorption of water was high after 7 days (Fig. 2) and this might be the reason for the increased yield. The weight loss on cooking (Fig. 4) also showed a gradual increase and it increased from 30.6% on second day to 43.33% after 15 days of storage.

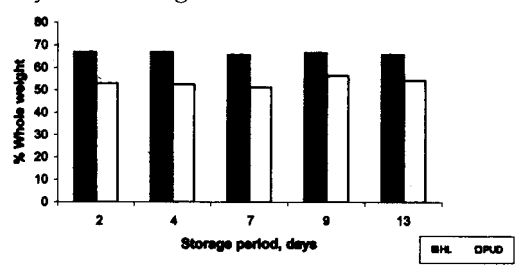

Fig. 3. Yield of HL and PUD from *P. indicus* during storage in ice.

The sensory characteristics of iced samples are given in Table 3. Blackening and slightly hanging head appeared after 4 days in ice. Development of blackening in wild *P. indicus* during storage in ice was studied by Velankar & Govindan (1959). They observed some darkening of the prawn from the 3rd day and over 70% had blackened in 8 days. In the present study the body shells were intact upto 9 days but the meat near the head portion showed browning. In physical appearance the whole prawn was acceptable for 9-13 days while the cooked meat was in acceptable condition upto 15 days.

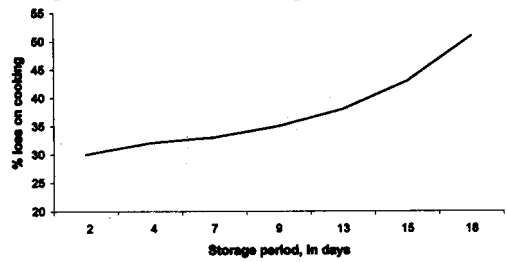

Fig. 4. Changes in cook drip loss during storage of *P. indicus* in ice.

The decrease in NPN content could be attributed to the leaching of soluble components when the fish muscle tissue lost its non permeable nature and started absorbing water from the melting ice. It can be seen from Fig. 2 that water absorption by the meat started after 4 days in ice. This has a bearing on the loss of non protein nitrogen components. The increase in non protein nitrogen components at the end of the storage may be attributed to the hydrolysis of protein by bacterial enzymes. The bacterial load increased significantly by that time.

The TVBN content was found to be very high, (39.2 mg/100g) in the sample iced for two days. High TVBN content (42.35 mg/100g) was reported in fresh *Metapenaeus affinis* (Susamma *et al.*, 1962). But Velankar & Govindan (1959) reported a TVBN content of 12 mg/100g in whole *P. indicus* after 2 days in ice and observed only a very slow increase as storage progressed. In fish meat the acceptable

Table 3. Sensory changes during iced storage of *P. indicus*

Storage period days	Whole prawns/raw meat	Cooked meat
0	Bright, shining, bluish green shade to the shells, firm meat, rigor	Firm, slightly tough, sweet, light pink
2	Light greenish blue shade, shells intact, rigor over	Sweet odour and taste, light pink colour, firm
4	Slight blackening at the head portion, sea weedy odour, light bluish green shade, slight separation of shell between body and head portion, body shell intact	Sweet odour, juicy and tender, light pink colour, sweet taste
7	Blackening at the head portion, head slightly hanging, light bluish colour, body shell firm and intact	Sweet odour and taste, light pink colour, soft and firm
9	Blackened head portion, slight brown colour to the meat near the head portion, head hanging, body shell firm	Sweet, soft and firm, moderately pink
13	Blackening at the head portion and near the tail, slight decayed weedy odour, brown colour to the meat near the head portion, head detached in few cases, body shells soft and slightly detached	Slightly sweet and sea weedy odour, slightly sweet, firmness reduced
15	Slight blackening to the body shells too, head and tail completely blackened, decayed weedy odour	Slight indifferent odour, firmness reduced, no off taste
18	Blackening, head portion completely detached, spoiled odour	Spoiled odour, slight spoiled taste

limit of TVBN is 30 mg/100 g (Connell, 1980). It is reported that soon after catch an indigenous enzyme system in the meat of prawns may produce ammonia by deamination of adenosine and adenosine monophosphate (Finne, 1982; Sikorski & Pau, 1994). Also, the feed and the food habits may have some effect on the formation of volatile base nitrogen. Haard (1992b) reported that the amount of free amino acids and other NPN differ considerably between cultured and wild fish of the same species. The increase in TVBN in the later stage of storage may be attributed to the bacterial spoilage.

Even if the prawns are iced immediately after capture it is difficult to control blackening. In the present study *P. indicus* developed blackening in 4 days. Chinivasagam *et al.* (1995) observed black spot in tiger prawns stored in ice for 3 days, but ice slurry could prevent blackening up to 22 days.

It is difficult to give an absolute value for shelf life of ice-stored *P. indicus* when all the quality parameters are taken into account. Based on bacteriological parameters, the product was acceptable for 13 days. In actual practice the meat is washed thoroughly which reduce the bacterial load significantly. Physical observation of whole prawns and the meat for the purpose of processing and storage indicated that they were acceptable for more than 9 days and the cooked

product was found acceptable up to 15 days.

The studies showed that *P. indicus* underwent rapid changes, even within hours after catch, especially with respect to flavour and appearance when stored at 30±2°C. Chilling and storage in ice retarded these changes considerably and the shelf life depended on the type of product going to be formulated out of it. The study revealed that there was no significant difference between cultured and wild *P. indicus* as far as the quality changes during ice-torage was concerned.

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