

The Suitability of Indole as an Index of Spoilage of Prawns

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The indole content in prawn meat from pre-processing centres around Cochin was in the range 0.5 to 3.1 $\mu\text{g } 100\text{g}^{-1}$. 43 percent of the sample contained only 1 $\mu\text{g } 100\text{g}^{-1}$ or less. On the other hand, the indole content in commercially frozen prawn samples collected from the local processing factories was between 0 to 20.6 $\mu\text{g } 100\text{g}^{-1}$. Only 28 percent of such samples contained 1 $\mu\text{g } 100\text{g}^{-1}$ or less of indole. This indicates an increase in indole content during processing operations prior to freezing. The indole content in the spoiled prawn meat discarded by the suppliers themselves after final checking was in the range 0.5 to 15.6 $\mu\text{g } 100\text{g}^{-1}$. The formation of indole in prawns during storage at ambient temperature and ice was also studied. During storage of *Heterocarpus woodmasoni*, *Penaeus indicus*, *P. monodon* and *Metapenaeus monoceros* at ambient temperature, indole content above 25 $\mu\text{g } 100\text{g}^{-1}$ was reached only after a period of 12 to 18 h. During storage of *P. indicus* for 22 days in ice the indole content increased from 0.5 to 5.0 $\mu\text{g } 100\text{g}^{-1}$.

Key words : Prawn spoilage, indole content, spoilage index

Scientific data on indole content in prawns of the export trade will be useful to the industry, policy makers and inspection authorities as some of the importing countries have prescribed the maximum permissible indole content as 25 $\mu\text{g } 100\text{g}^{-1}$ (Santoso *et al.*, 1992). Indole is an important decomposition product of shrimp (Chambers & Staruszkiewicz, 1981). Indole formation in shrimp is supposed to be due to the action of bacteria like *Proteus morganii* or *Escherichia coli* on shrimp protein (Struszkiewicz, 1974). Many bacteria contain the enzyme tryptophanase, which degrades the amino acid forming indole, ammonia and pyruvic acid (White *et al.*, 1959 Pedraja, 1970). It is known that the amount of indole produced is proportional to the extent of decomposition (Ponder, 1978). However, shrimp can decompose in the absence of indole-producing organisms also. Therefore, the presence of indole in shrimp definitely indicates decomposition but the absence

does not necessarily mean freedom from spoilage (Staruszkiewicz, 1974).

The quantity of indole formed in shrimp depends upon the composition of bacterial population, temperature and handling and storage practices. It was also reported that after a storage period of 3 days, indole levels increased rapidly in shrimp that were not iced properly and it was not lost during cooking or extended storage in ice (Chambers and Staruszkiewicz, 1981).

Determination of indole can provide a means of quality assessment in shrimps (Niola & Vallettrisco, 1986) and the Food and Drug Administration of the USA has stipulated its level as an indicator of decomposition in imported shrimp. While the indole level has been used to seize frozen salad shrimp (Cheuk & Finne, 1981) and its level in prawns with no identifiable decomposition odour has been fixed at

below 25 $\mu\text{g } 100\text{g}^{-1}$ (Santoso *et al.*, 1992), samples of prawns with > 25 $\mu\text{g } 100\text{g}^{-1}$ indole have been assessed as organoleptically acceptable (Solberg & Nesbakken, 1981).

A study on indole content in prawns was therefore carried out in this Institute in order to evaluate the suitability of indole as an index of decomposition. The levels of indole during spoilage of different species of prawns and in the commercial products were also investigated.

Materials and Methods

Sixty samples of peeled and deveined (PD) peeled undeveined (PUD) prawns of different species and size grades (300 g each) were collected from primary processing centres around Cochin. These samples were iced (1:1), sealed in separate polythene bags and transported to the laboratory within 2 h in boxes containing crushed ice. These samples included 10 samples of spoiled prawn meat discarded by the suppliers themselves. Sixtyfive samples of individually quick frozen (IQF) prawn meat (300 g) of different types and size grades were also collected from prawn processing establishments in and around Cochin. These samples were sealed in polythene bags and transported to the laboratory, and stored at -18°C pending analysis. Indole was extracted with light petroleum ether from trichloroacetic acid - precipitated shrimp muscle. The extracted indole was reacted and re-extracted with Ehrlich's reagent; and the rose complex formed was determined spectrophotometrically. (Cheuk & Finne, 1981). All samples were also analysed after thawing in running water out of contact with water.

Penaeus indicus, *Penaeus mondon* and *Metapenaeus monoceros* were collected from landing centres in Cochin, iced and brought

to the laboratory. The next day these samples were de-iced and then dipped in potable water till the sample attained ambient temperature. These samples were then kept at ambient temperature and at intervals, 500 g sample from each species were drawn and then dressed into PUD. The PUD meat was then analysed for indole and decomposition by the methods cited above. In the case of *Hetercarpus woodmasoni*, the samples were collected onboard FORV Sagar Sampada. These samples, frozen and stored onboard, were brought to the laboratory, thawed in running water and the studies continued as in the cases of the above three species. Fresh PUD *Metapenaeus dobsoni* was collected from a primary processing centre near Cochin, iced and brought to the laboratory. The sample was then de-iced, washed, drained, dipped in 10 times (w/v) 3% boiling brine for one minute and cooled in chlorinated water (5 ppm chlorine). After draining, the sample was exposed to ambient temperature and studied as above.

Fresh whole *Penaeus indicus* was collected from a market in Cochin in polythene bags (500 g), iced (1:1) with crushed ice and kept in a thermocol box containing crushed ice. The box was kept in a chill room maintained at 0 to 2°C . At intervals a bag of prawns was drawn and peeled. The PUD meat was analysed for indole and decomposition as before.

The size grades of the prawns were determined by the method prescribed by Codex Alimentarius Commission (FAO & WHO, 1977).

Results and Discussion

The percentage of commercial raw prawn meat and frozen prawn meat samples containing different ranges of indole con-

tent are given in Table 1. A close look at the data presented in the table reveals that indole content in the frozen sample is comparatively higher. In general, additional time is required for processing of frozen products. Consequently, quality deterioration will be more in frozen products compared to the raw, resulting in higher indole content. None of the raw or processed prawns were decomposed and the indole content was within the permissible limits of $< 25 \mu\text{g } 100\text{g}^{-1}$ (Santoso *et al.*, 1992).

The range of indole content in the spoiled prawn meat is shown in Table 2. The indole content was well below the limit, even though these samples were spoiled and discarded by the suppliers themselves as unfit for processing. As

Table 1. Occurrence of samples of commercial fresh and frozen prawn meats containing different ranges of indole content

Range of indole content, $\mu\text{g } 100\text{g}^{-1}$ prawn	Occurrence of samples, %	
	Fresh prawn meat	Frozen prawn meat
ND to 1	43	28
1 to 5	57	62
5 to 10	0	6
10 to 25	0	4
Above 25	0	0

ND = Not detected

Table 2. Range of indole content in spoiled prawn meat

Range of indole content in $\mu\text{g } 100\text{g}^{-1}$	Percentage of spoiled samples
ND to 1	10
1 to 5	80
5 to 10	0
10 to 25	10
Above 25	0

ND = Not detected

Table 3. Indole content of different species of prawns during storage at ambient temperature

	Storage time, h	Indole content, $\mu\text{g } 100\text{g}^{-1}$
<i>Heterocarpus woodmasoni</i>	0	3.7
	2	3.3
	4	3.7
	6	4.8
	8	4.3
	10	5.3
	12	6.5
<i>Heterocarpus woodmasoni</i> ; size: 140 nos kg^{-1}	0	1.5
	3	2.5
	6	2.5
	9	3.8
	12	5.0
	15	4.5
	18	25.0
	21	51.8
	24	48.8
<i>Penaeus indicus</i> ; size: 250 nos kg^{-1}	0	ND
	3	ND
	6	1.3
	9	1.3
	12	3.8
	15	26.3
	18	56.0
	21	57.5
<i>Penaeus indicus</i> ; size: 140 nos kg^{-1}	0	1.0
	3	1.5
	6	1.5
	9	1.9
	12	1.7
	15	27.5
	21	23.8
	24	75.0
<i>Penaeus indicus</i> ; size: 100 nos kg^{-1}	12	4.4
	14	10.0
	16	18.8
	18	92.5
<i>Peneaus monodon</i> ; size: 90 nos kg^{-1}	12	4.4
	14	3.8
	16	18.8
	18	120.0
<i>Metapenaeus monoceros</i> ; size: 250 nos kg^{-1}	12	11.6
	14	11.3
	16	42.5
	18	107.5
<i>Metapenaeus dobsoni</i> ; (peeled and cooked) size: 700 nos kg^{-1}	0	2.6
	3	2.5
	6	1.5
	9	1.1
	12	1.1
	15	1.0
	18	1.1
	21	1.0
	24	1.0

these materials were spoiled, much higher indole levels were expected. The reasons for comparatively low levels of indole content ($< 25 \mu\text{g } 100\text{g}^{-1}$) in the spoiled prawn meat may be due to: (i) Lack of indole formation in the early stages of spoilage (Farber, 1965; Solberg & Nesbakken, 1981; Boe *et al.*, 1982). (ii) Lack of indole producing organisms in the material (Staruszkiewicz, 1974; Chambers & Staruszkiewicz, 1981; Smith *et al.*, 1984). (iii) Suppression of the reproduction of the indole - producing bacteria due to the use of chlorinated water during primary processing (Smith *et al.*, 1984).

Table 4. Indole content of *Penaeus indicus* (260 nos kg^{-1}) during storage in ice

Storage time in ice, days	Indole content $\mu\text{g } 100\text{g}^{-1}$
0	0.5
2	1.5
4	0.8
6	1.7
8	2.1
10	2.3
12	3.2
14	2.8
16	3.4
18	4.1
20	4.8
22	5.0

During spoilage of different species of prawns at ambient temperature it was observed that decomposition started by 8 to 10 h. But from Table 3 it can be noted that the indole levels above the acceptance limit ($25 \mu\text{g } 100\text{g}^{-1}$) were reached only when the material was kept for 12-18 h. This observation is in agreement with those of Solberg & Nesbakken (1981) and Boe *et al.* (1982), but it contradicts those of Santoso *et al.* (1982). But in the case of peeled and cooked prawns the indole content did not increase even after keeping the material at

ambient temperature for 24 h. During cooking in brine, indole-producing organisms might have been destroyed and the cooked material might have decomposed in the absence of indole-producing organisms (Staruszkiewicz, 1974). Alternatively, the salt absorbed during cooking might have suppressed the proliferation of indole-producing organisms (Smith *et al.*, 1984).

The indole content during storage of *Penaeus indicus* in ice is given in Table 4. Decomposed odour was observed after a period of 14 days. But substantial increase in indole content was not observed even after 22 days. This may be due to the absence of indole-producing organisms.

From the study it is clear that high levels of indole content in prawns, i.e., $\geq 25 \mu\text{g } 100\text{g}^{-1}$ indicate spoilage. At the same time, lower levels do not necessarily mean freedom from spoilage.

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References

- Boe, B., Losnegard, N. & Xu, X.L. (1982) *Fisk. Dir. Skr. Ser. Ernaring* 2(2), 35
- Chambers, T.L. & Staruszkiewicz, W.F., Jr. (1981) *J. Assoc. Off. Anal. Chem.* **64**, 592
- Cheuk, W.L. & Finne, G. (1981) *J. Assoc. Off. Anal. Chem.* **64**, 783
- EIA (1986) *Pre-Shipment Inspection and Quality Control Manual on In-Process Quality Control of Fish and Fishery Products*, Quality Development Centre, Export Inspection Agency, Madras, India

FAO & WHO (1977) *Recommended International Standards for Quick Frozen Shrimps or Prawns*, Food and Agricultural Organisation of the United Nations and World Health Organisation, Rome, Italy

Farber, L. (1965) in *Fish as Food* Vol. 4 Part 2 (Borgstrom, G., Ed.), p. 81, Academic Press Inc., New York, USA

Niola, I. & Vallettrisco, M. (1986) *Industrie Alimentari* 25, 30

Pedraja, R.R. (1977) *Food Technol.* 24, 1355

Ponder, C. (1978) *J. Assoc. Off. Anal. Chem.* 61, 1089

Santoso, A., A.M. & Suhaetty, E. (1992) in *FAO Fisheries Report No 470 Suppl.*, p. 68, FAO, Rome, Italy

Smith, R., Nickelson, R., Martin, R. & Finne, G. (1984) *J. Food Prot.* 47, 861

Solberg, T. & Nesbakken, T. (1981) *Nordisk Veterinaermedicin* 33, 446

Staruszkiewicz, W.F., Jr. (1974) *J. Assoc. Off. Anal. Chem.* 57, 813

White, A., Handler, P. & Smith, E. (1959) *Principles of Biochemistry*, 5th Edn., p. 702, Mc Graw-Hill Kogakusha Ltd., Tokyo, Japan