Chapter II

Sensory Assessment of Black Tiger Shrimp (*Penaeus Monodon*)

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INTRODUCTION

Export of Thai frozen shrimp accounted for US$6.9 billion and totaled 450,278 metric tonnes in 1995. From 1985, the marked expansion of black tiger shrimp aquaculture was the major contributor to Thailand's becoming one of the world's largest frozen shrimp exporters. Approximately 80% of total export is derived from the aquaculture sector while wild catch has decreased substantially due to over exploitation of natural resources. In addition, the quality of the wild catch is rather low due to poor handling practices and lengthy storage time on board fishing vessels without proper icing. Major markets of Thai frozen shrimps are USA and Japan. Export to Canada accounted for approximately 4% of the total figure. However, Thailand has been a major supplier with a market share of around 42% in 1995.

Sensory assessment is officially enforced on imported food products by USA and Canada. Objective judgments can be achieved through extensive training especially by sensory experts of the import authorities. Sensory assessment is recognized as an effective monitoring procedure to evaluate quality of raw materials and for in-process quality control in Hazard Analysis and Critical Control Point (HACCP) based programs. Decomposition is a problem commonly found in low quality seafood products, which results in rejection of the shipment. These characteristics can be directly perceived by way of sensory tests. In order to confirm the initial sensory results, indole, a product of tryptophan degradation, is currently used by the US Food and Drug Administration (USFDA) to validate the sensory evaluation of shrimp decomposition. They have recommended a defect action level of ≥ 25 µg/100g.

In order to obtain a wide range of samples of diferent qualities for sensory training and establishing sensory profiles, preparation of authentic samples should be conducted through controlled spoilage runs. Inspectors should be trained using prepared samples with a known spoilage background as well as commercial samples. The following is the sample preparation step for the establishment of a sensory profile for black tiger shrimp.

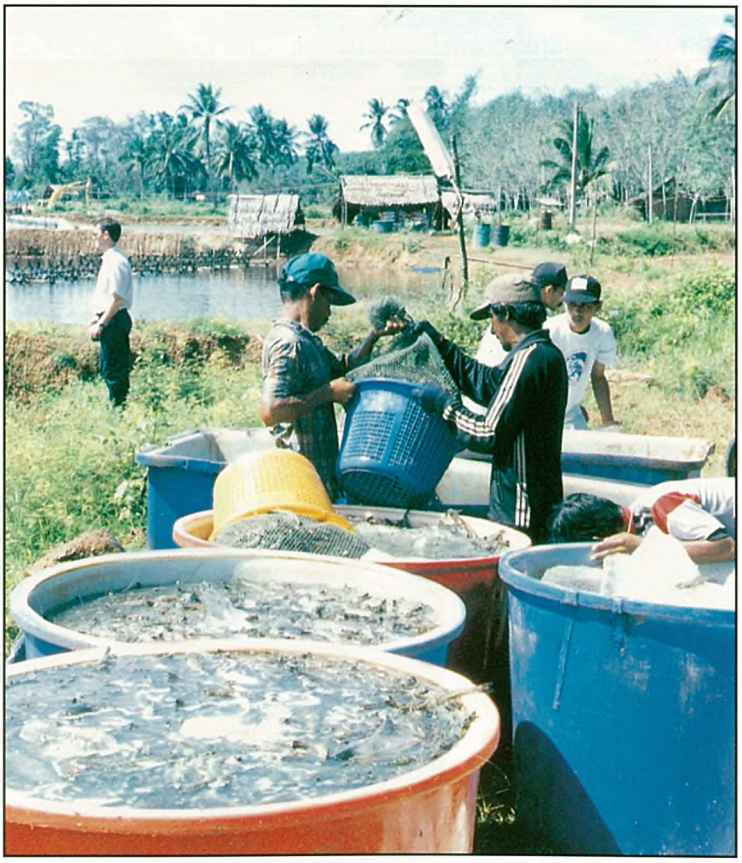
PREPARATION OF FROZEN BLACK TIGER SHRIMP SAMPLES

Live black tiger shrimp from a culture pond were shocked to death in iced water. The shrimp samples were then transferred in ice to a freezing establishment. One set of shrimp samples was stored at ambient temperature whilst another was stored between layers of ice. Shrimp were drawn at various intervals for processing into frozen raw and cooked peeled headless tail-on product. For ambient storage, shrimp samples to be processed into frozen raw products were drawn for analyses at 0, 6, 9, 12, 16, 20, 27, 32 and 43 hours and at 0, 3, 6, 9, 20, 27, 32 and 43 hours for frozen cooked products. For ice storage, black tiger shrimp were

drawn at 0, 1, 3, 4, 6, 8 and 10 days of storage for processing into frozen raw products. The frozen shrimp samples were stored at -18°C for further sensory and indole analyses.

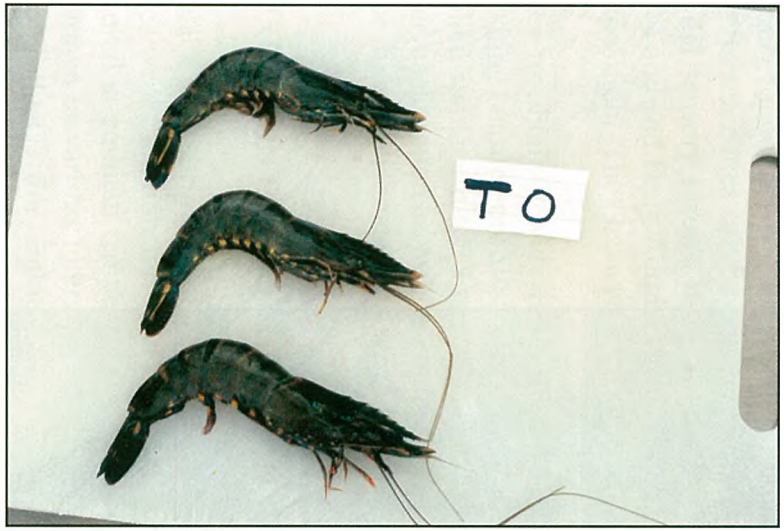
Shrimp of the best quality is obtained from the farm and iced immediately

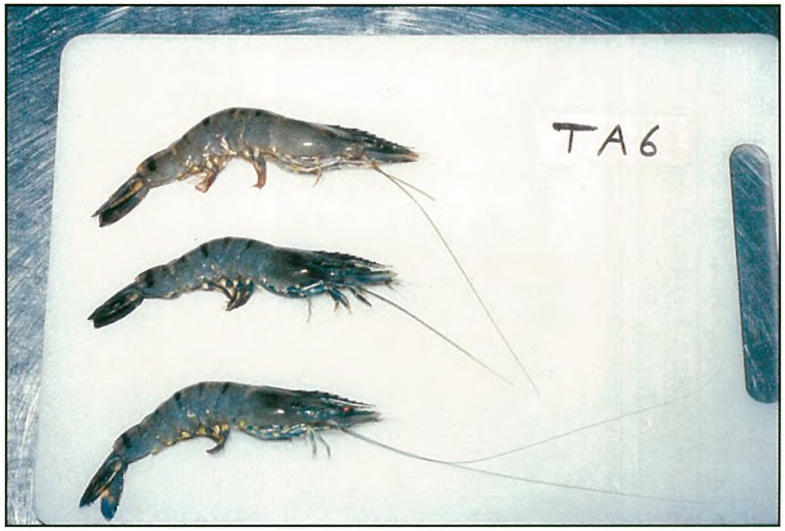
Farm Site



Icing of Shrimp at Farm

Samples were withdrawn at different hours in order to establish sensory quality profile





SENSORY EVALUATION TECHNIQUES

Sensory experts should demonstrate to trainee inspectors sensory evaluation techniques and explain the characteristics of acceptable and reject quality. This method is called "Descriptive Analysis", in which a group of highly trained or expert analysts examine the attributes of a product and provides a detailed descriptive profile of it (which can be put in a standard). With training and knowledge, sensory analysts can use descriptive analysis to communicate with each other regarding the qualities of a particular product. In the case of shrimp, or any seafood for that matter, odours and flavours can be easily grouped into four categories:

1. Odours that are typical of the species in question, these are the naturally occurring odours that are present at the moment of capture or harvest before there is any noticeable loss of quality;

2. Persistent, distinct and uncharacteristic odours and flavours described in the standard as taint which can be further divided into rancidity due to the oxidation of oils present in the product and abnormal odours which may result from the type of feed, environmental conditions (e.g. poor water quality or algae blooms) or processing conditions (e.g. scorched, acrid or metallic);

3. Persistent, distinct and uncharacteristic odours and flavours described in the standard as decomposed including but not limited to the following: ammonia, musty, yeasty, vegetable, sour, faecal, hydrogen sulphide, putrid;

4. Persistent, distinct and uncharacteristic odour and flavour of any material which has not been derived from the product and which posed a threat to human health (e.g. solvents, fuel oil, etc.) is categorised as critical foreign material.

It is important to remember that the "Descriptors" employed by a standard must be meaningful to the analysts who are expected to use the standard to evaluate a given product. This may require the development of other terms and descriptors when sensory attributes are translated into different languages or are used by analysts coming from a different cultural background. It should be kept in mind that when samples are examined, descriptors developed should be useful to everyone.

Chemical analysis for the concentration of indicators of decomposition is often used to confirm the results of sensory analysis. In the case of shrimp, indole is widely recognised as a good indicator of certain types of spoilage. It is generally accepted that samples showing levels of indole above 20 to 30 micrograms per 100 grams are decomposed and that trained sensory analysts will usually reject such samples for the presence of odours and/or flavours indicating decomposition. The absence of these indicators does not necessarily meant that the product is not decomposed since some indicators are only formed in the presence of certain types of bacteria, at certain temperatures.

To determine sensory profile of frozen black tiger shrimp, the frozen shrimp samples previously prepared were thawed and evaluated by placing the samples in order form best to lowest quality. Sensory changes of both raw and cooked products were observed and

decision on acceptability was made by the assessors. The samples were also analysed for indole contents as well, using the method specified in AOAC (1990). *Tables 1* to *3* exhibit indole contents and sensory characteristics of frozen raw and cooked black tiger shrimp processed from raw material stored at ambient temperature and in ice respectively.

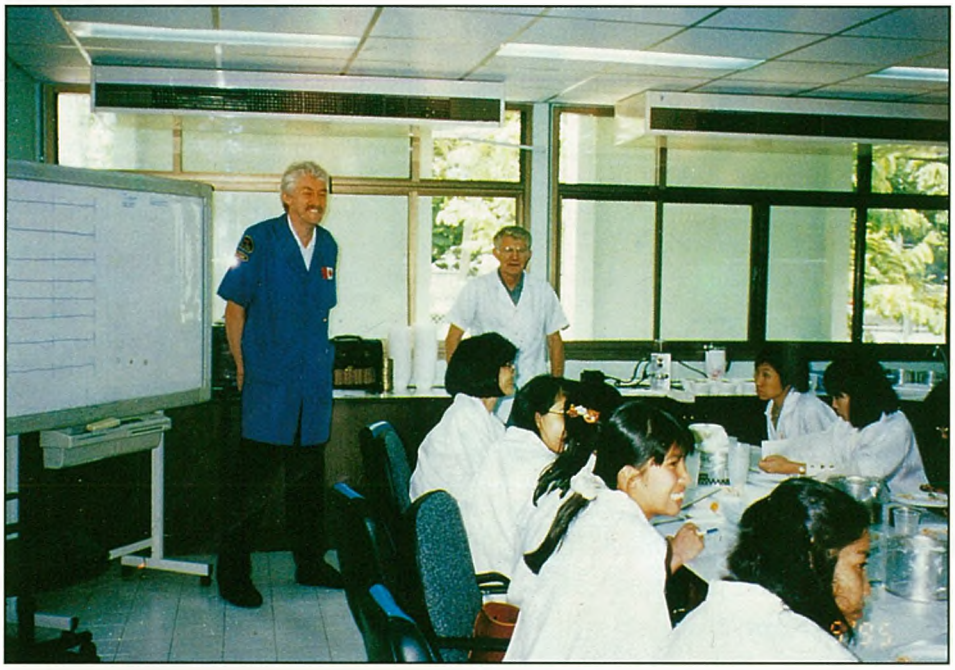
Table 1. Sensory Characteristics And Indole Contents of Frozen Raw Black Tiger Shrimp Processed From Raw Material Stored At Ambient Temperature

Storage hour(s)	Indole (µg/100g)	Sensory quality level	Characteristics
0	0.3	Acceptable	Firm, resilient, bright, glossy, grassy or seaweedy odour
6	0.2	Acceptable	Firm, resilient, uniform colour, fresh odour
9	0.3	Acceptable	Firm, slightly faded, slightly discoloured, fresh odour
12	0.3	Acceptable	Slightly soft, slightly slimy, slightly discoloured, slightly stale
16	0.1	Acceptable	Slightly opaque, slightly discoloured
20	0.6	Acceptable	Slightly discoloured, neutral odour,
27	0.5	Acceptable	Firm, slightly discoloured, slightly stale
32	0.4	Borderline acceptable	Not resilient, some red discoloured, slightly opaque, slightly slimy, slightly putrid
43	5.6	Borderline fail	Not resilient, discoloured, opaque, musty, slightly putrid, slightly ammonical

Table 2. Sensory Characteristics And Indole Contents Of Frozen Cooked Peeled Black Tiger Shrimp Processed From Raw Material Stored At Ambient Temperature

Storage hour(s)	Indole (µg/100g)	Sensory quality level	Characteristics
0	0.7	Acceptable	Bright, uniform, fresh and sweet odour
3	0.5	Acceptable	Bright, uniform, fresh and sweet odour, slightly cold storage odour
6	0.4	Acceptable	Neutral odour
9	0.2	Acceptable	Slightly opaque, slightly stale, slightly musty
20	0.2	Acceptable	Opaque, slightly stale
27	0.2	Acceptable	Some translucent, some opaque, bleached, slightly stale
32	0.3	Acceptable	Slightly stale, slightly musty
43	7.3	Borderline acceptable	Discoloured, stale, old odour, slightly musty

Sensory experts and panels exzmining black tiger shrimp



Sensory experts and panels working on descriptors

Sensory testing in progress

Table 3. Sensory Characteristics And Indole Contents Of Frozen Raw Black Tiger Shrimp Processed From Raw Material Stored In Ice

Storage hour(s)	Indole (μg/100g)	Sensory quality level	Characteristics
0	0.4	Acceptable	Firm, resilient, bright and uniform colour, fresh and sweet odour
1	0.4	Acceptable	Firm, resilient, slightly discoloured, fresh and sweet odour
3	0.2	Acceptable	Firm, slightly discoloured, slightly stale
4	0	Acceptable	Opaque, bleached, slightly discoloured, neutral odour
6	0.2	Acceptable	Slightly discoloured, milky appearance
8	1.7	Borderline reject	Opaque, slightly discoloured, musty, slightly putrid
10	174.4	Reject	Soft, opaque, bleached, red discoloured, strong putrid

From the above tables, it was found that black tiger shrimp stored at ambient temperature for more than 32 hours should not be processed as a raw product, since the samples could be rejected for decomposition. However, it was still found that frozen cooked peeled black tiger shrimp made from raw material stored at ambient temperature for 43 hours were borderline acceptable. For ice storage, black tiger shrimp should not be stored for more than 6 days.

When storage time increases, deterioration begins and the following characteristics could be found; discolouration, soft texture, slimy surface, milky appearance, stale, sour, musty and putrid odour. The discolouration, red or orange off-colour development in shrimp, is due to denaturation of astaxanthin-protein complexes and oxidation of red astaxanthin to orange astaxin and/or to the presence of a cryptaxanthin-like yellow pigment. Off-odour development in the shrimp appears to be divided into two categories: (a) musty and cooked shrimp odours due to chemical and/or enzymatic activity, and (b) putrid and sour odours due to bacterial activities. Cooked shrimp and musty odours occur in some samples which have little increase in bacterial levels, while putrid shrimp odours occur only in shrimp with high bacterial levels.

The indole contents in *Tables 1* to *3* show an increasing trend. The significant changes should be caused by substantial growth of indole forming bacteria. *Proteus* is believed to be responsible for the formation of indole. It has the ability to convert tryptophan in shrimp to indole. From the above tables, the values in some reject samples are much lower than the actionable level of 25 μg/100g established by USFDA. Thus, indole is of value in assessing the history of shrimp if high temperature abuse is suspected. The index is of less value if the spoilage has occurred in ice or at low temperature. It can be concluded that while indole levels indicate decomposition, decomposed shrimp may not contain indole. The level of indole in frozen shrimp is an indicator of pre-freezing quality and not the result of a substantial increase during frozen storage.

SENSORY PROFILE OF BLACK TIGER SHRIMP

Judgment on shrimp sensory quality is basically made based upon odour of decomposition. However, other characteristics such as appearance and texture could be used in association with odour for making more accurate decision. *Table 4* shows the sensory profile of black tiger shrimp of various quality levels which can be used as a guideline for shrimp product inspection.

Headless Shrimp

Cooked Shrimp

Table 4. Sensory Profile Of Frozen Black Tiger Shrimp

Quality level	Characteristics			
	Odour	**Appearance**	**Texture**	**Colour**
Passable	Fresh, sweet, neutral, grassy-seaweedy	Translucent	Firm	Uniform, colour typical of species
Borderline passable	Slightly stale, slightly yeasty, slightly fishy	Translucent	Slightly soft	Slightly discoloured
Borderline fail	Musty, slightly sour, fishy, old sock odour	Slightly opaque, black spots	Tough, soft, dehydrated	Bleached or faded
Fail	Putrid, ammonical, faecal, chemical-fuel contaminants	Opaque, cooked appearance	Soft, mushy	Discoloured

LOT ACCEPTANCES

Decision is made to inspect a shipment of frozen shrimp products in accordance with the standard for sensory attributes. Samples will be drawn in a random and representative manner based on the number of units in each lot using an AQL 6.5 sampling plan established by Codex Alimentarius Commission. Samples to be evaluated for quality will be thawed under controlled conditions to minimise any additional quality loss. All of the shrimp in each sample unit will be evaluated and categorised for compliance with the standard. When the total number of shrimp in a sample unit which are determined to be tainted and /or decomposed exceeds 10% then that unit will be considered to be defective. A lot will be considered unacceptable when the number of defective units exceeds the acceptance number for the sample size designated in the sampling plan (note that the acceptance number for decomposition is lower than for taint). A lot will be considered unacceptable when any single instance of critical foreign material occurs.

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