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Sensory Evaluation of Hatchery-Reared Spotted Babylon (*Babylonia areolata*) and the Effects of Chilled Storage (4°C) on the Main Sensory Attributes

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ABSTRACT

In terms of features and taste, Spotted Babylon (*Babylonia areolata*) is still considered alien to most local seafood lovers. There is also very scarce information on the effects of storage on the quality of *B. areolata*. Thus a short study was carried out to provide information on the general features and sensory evaluation of *B. areolata*. The effects of refrigerated storage (4°C) on sensory attributes were also determined. *Babylonia areolata* comprise of a single conical coiled shell and a soft body. The soft body, which is inside the shells, is divided into head, visceral mass and the foot (edible part). *Babylonia areolata* meat has a typical fresh sea/seaweed odour, bright glossy orange colour, moist in appearance and firm and tight in structure. Cooked *B. areolata* has a general sweat fresh fish and/or shellfish flavour. A final thirteen sensory characteristics were identified to be important in determining *B. areolata* quality. As expected, the intensities of acceptable characteristics decreased, while the unacceptable characteristics increased with storage. *Babylonia areolata* held at 4°C were acceptable up to 6 days. At day 14 of storage, *B. areolata* had an offensive smell, become opaque, dull and soft in texture and were regarded unacceptable by the panellists.

Key words: Morphology, sensory evaluation, hatchery-reared, *Babylonia areolata*, refrigerated storage

INTRODUCTION

Babylonia areolata (Link, 1807) is an invertebrate belonging to the phylum Mollusca, class Gastropoda, Family Buccinidae as classified in the World Register of Marine Species (Bouchet, 2012). It is also known as the spotted babylon, babylon snail, babylon shell, maculated ivory whelk, ivory shell or Thai escargot. In Malaysia, it is known as *siput manis* and mostly found in Sabah and some part of Kedah. The meat of *B. areolata* is said to have good nutritional value, very tasty and fetches high price (Nhuan, 2011). The flesh and operculum have been claimed to possess some medicinal properties (Periyasamy *et al*., 2011). The current price of wild *B. areolata* in Malaysia is about US $ 12.00/kg.

Since, the year 2000, there has been many research on *B. areolata*, especially on growth (Xue *et al*., 2010), culture systems (Chaitanawisuti and Kritsanapuntu, 2000; Kritsanapuntu *et al*., 2007), diets and feed utilization (Kritsanapuntu *et al*., 2007; Zhang *et al*., 2009;

Sangsawangchote *et al*., 2010), nursing techniques (Sutthinon *et al*., 2007), reproductive performance (Sangsawangchote *et al*., 2010) and economic value (Chaitanawisuti *et al*., 2009). In addition, we have reported on the meat yield and biochemical chemical composition of adult cultured *B. areolata* (Noordin *et al*., 2014). There is however very limited information on the sensory attributes of wild or cultured *B. areolata* and the effects of storage on the main attributes of *B. areolata.*

The Fisheries Research Institute, Pulau Sayak, Kedah, Malaysia had recently tried to culture *B. areolata* in the hatchery and was successful. The information on *B. areolata* features and taste would be helpful to promote *B. areolata*, which is still considered alien to most local seafood lovers. Hence, this study is carried out to provide information on the morphology and sensory evaluation of hatchery-reared siput manis or Spotted Babylom (*B. areolata*). The effects of chilled storage (4°C) on the main sensory attributes of *B. areolata* were also evaluated.

MATERIALS AND METHODS

Samples: The spotted babylon (*B. areolata*) (initial mean size of 0.3 cm) were reared in circular tanks (1.0 m in diameter) at a density of 200 pieces tank^{-1} in the hatchery at the Fisheries Research Institute Pulau Sayak, Kota Kuala Muda, Kedah, Malaysia from July, 2011 to February, 2012. The water temperature in the tanks ranged from 25.3-31.4°C during the experiment and the salinity range was at 29-30 ppt. The tanks were fitted with a flow-through water system and provided with aeration throughout the growth period. The gastropods were fed with trash fish at 5% b.wt., daily. In March, 2012, commercial sized (mean length; 5.13±0.39 cm and mean weight; 8.14±0.93 g), sexually matured *B. areolata* (about 8-9 months old) were harvested and transported in an ice cooled insulated box to the Fisheries Research Institute, Batu Maung, Penang, Malaysia for morphological description and sensory evaluation.

Sensory evaluation of *Babylonia areolata*: Sensory evaluation was conducted in the sensory lab of the Fisheries Research Institute (FRI), Batu Maung, Penang, Malaysia. A team of panellists (7 females, 3 males) aged between 22-55 years old were selected among the available trained panellists in FRI based on their availability, willingness to participate, descriptive ability and indication that their acceptability of *B. areolata* was either moderate or high.

The experiment was divided into two parts. In the first part, the panellists underwent training for 3 sessions per week for 2 weeks, assessing 5 main attributes (odour, flavour, colour, texture and overall appearance). In this session, the panellists were provided with manually shucked fresh cultured *B. areolata* in a plastic dish. The panellists were asked to generate the sensory characteristics that they considered important in describing *B. areolata*. Panellists sat at tables arranged to facilitate group discussion, no pre-determined ballot was used. Other samples including crab, shrimp, clam, fish (raw and cooked, fresh and aged), seaweed (fresh and aged seaweed), shrimp peel (fresh and aged) were also provided for comparison and reference purposes. We were unable to get wild *B. areolata* for comparison because of the unavailability of sample. Although, wild *B. areolata* is easily available in Sabah, it is still not convenient to bring the samples to FRI Batu Maung as the time taken to transport, it would not make the samples fresh to be used as reference in the sensory evaluation analysis. Flavour analysis was carried out on cooked *B. areolata* samples. For flavour, each panellist chewed a small bite of samples and recorded the notes and intensities. After taste was assessed after swallowing.

In the second part of the experiment, a final thirteen characteristics were chosen by consensus of the panellists and simple definition was developed. Intensities of responses were evaluated on a 14 cm unstructured line scale with two anchor points located at 1.0 in the left end, which indicated no intensity/weak, while the right end (7.0) represented the extreme/highest intensity. Sensory changes of *B. areolata* stored at refrigerated temperature were then carried out. The freshly harvested *B. areolata* samples were washed with tap water and divided into three groups. Each group was stored in a polypropylene container (36×24 cm) at 4±1°C for up to 12 days. *Babylonia areolata* samples were taken for sensory evaluation at 0, 1, 3, 6, 9 and 14th days of storage. The sensory evaluation was carried out in a dedicated room designed especially for sensory analyses, with partitions between subjects to minimize visual contact, neutral colours on the walls and tables, standard daylight and good ventilation. All samples were coded with three-digit random numbers and presented to the panellists on a tray in individual booths. The panel evaluated the samples without being informed of the storage time or the experimental approach using as guidance and fresh *B. areolata* (as reference).

Mean scores from the two sensory sittings were calculated using Microsoft Excel 2010. The scores of main sensory attributes against days of storage were plotted using the same software.

RESULTS AND DISCUSSION

Morphological description of *Babylonia areolata*: Morphologically *B. areolata* has two main components, single conical coiled shell and a soft body. The shell is relatively thin, ovate and light, apex pointed and whorls rounded with bands of rectangular brown patches on white (Fig. 1). The soft body, which is inside, the shells is divided into head, visceral mass and the foot (Fig. 2). The meat, which is the foot is a sliver of orange and cream flesh clamped tightly within a shell. The meat is cleaned compared to other mollusc, such as cockles and clams, where there could be sand or mud within. Once cooked, the meat can easily be taken out by pulling the foot and the visceral mass, which would usually be left behind in the shell. This separation is not possible in other shellfish, such as cockle, mussels and oysters, where the whole animal is being consumed including the gastrointestinal tract and the gill which is usually contaminated with bacteria.

The length and weight of *B. areolata* in this study ranged from 4.82-5.94 cm (mean length; 5.13±0.39 cm) and 7.33-10.26 g (mean weight; 8.14±0.93 g), respectively. The average weight of the flesh before cooking was 2.97±0.44 g or about 30-40% of the total body weight. The weight of the

Fig. 1: Morphology of *Babylonia areolata* single conical coiled shell

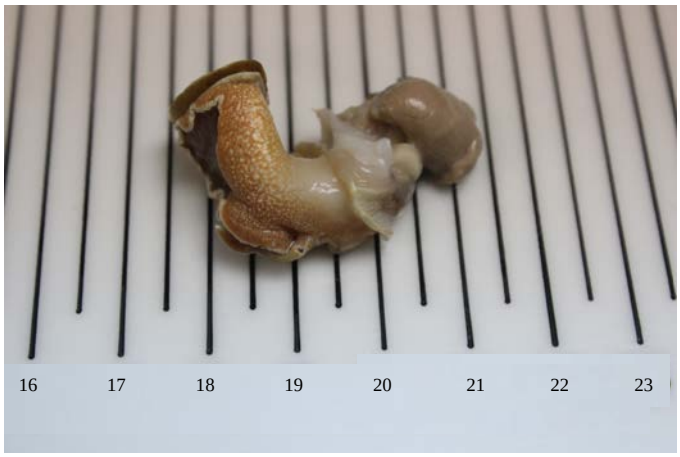

Fig. 2: Morphology of *Babylonia areolata* soft body

shell made up the bigger percentage (60.48-70.12%) of total body weight. This suggests that there is a potential for the shell to be exploited for other uses. Our observation is in accordance with Gifari (2011) who reported about 31-39% of flesh and 61-67% of shells in *Babylonia spirata* and two other mollusc *Meretrix meretrix* and *Pholas dactylus*. The average weight of the flesh after cooking was 2.75±0.16 g, which meant that there was a slight loss in weight (2-4%) upon cooking.

Sensory characteristics of *Babylonia areolata*: A total of 66 sensory terms/descriptors were generated from the panellist's opinion of the fresh raw, cooked and aged *B. areolata* samples (Table 1). The number of descriptive terms varied from 10-15 for colour, appearance and flavour and more than 15 for odour and texture. Opposite terms were included in the list to define all the characteristics from fresh to spoil. A total of thirteen sensory attributes were selected from the same and similar terms used by the panellists which were considered important in describing the quality or freshness of *B. areolata* (Table 2). Fresh raw *B. areolata* has a typical fresh sea/seaweed odour, bright glossy orange colour and moist appearance. The overall texture impression (on touch) was firm and tight. Cooked *B. areolata* has a flavour comprised mainly of fresh steamed fish and/or crab. When chewing the flesh, the sweetness begins to be released. There is no metallic smell or aftertaste. The fresh unique sweet flavour of *B. areolata* could be due to the high glycine, glutamic and aspartic acid content in them (Noordin *et al*., 2014). Glycine is commonly known to give sweet taste (Sikorski *et al*., 1990). In addition, glutamic acid and aspartic acid induce umami like taste that is peculiar to seafood (Sarower *et al*., 2012). The amino acids profiling results suggest that glutamic acid, aspartic acid and glycine could be responsible for the taste of *B. areolata*, as suggested by Ozden (2005), who claimed that glutamic acid, aspartame and glycine were the amino acids responsible for the product specific taste. The overall texture impression (on bite) was firm and crunchy. The meat flaked easily into fibres that stayed moderately firm throughout chewing without becoming mushy. The meat is also a bit slimy and not watery as compared to the meat of other mollusc (oysters, cockles and mussels). This is due to the mucus produced by the foot of the gastropod, which is usually used for crawling or to coat the external parts of the body in order to prevent desiccation of the exposed soft tissues. The foot mucus has some qualities of glue and

Table 1: Sensory terms generated by the panelist of *Babylonia areolata* meat

Characteristics				
Odours	Texture (touch and bite)	Appearance	Colours	Taste
Sea	Hard	Bright	Orange	Sweet
Fresh	Firm	Glossy	Pale orange	Steamed fish
Sea breeze	Elastic	Iridescent	Off-orange	Steamed crab
Fishy	Tight	Moist	Creamy orange	Steamed crab
Seaweed	Rubbery	Smooth surface	Cream	Steamed clam
Neutral	Soft	Lustre	Brownish orange	Umami
Steamed snapper	Tender	Fairly pale	Translucent	Sea
Fishy	Flaccid	Dull	Fairly pale	Bland
Fresh crab	Crunchy	Opaque	Grey discolour	Slightly salty
Pungent	Chewy	Slimy	Grey-orange	Slightly bitter
Old garbage	Springy	Shrivel		Less sweet
Rotten shrimp	Soft	Slightly wrinkle		
Decaying seaweed	Jelly-like	Limp		
Rotten shellfish	Dry	Flaccid		
Offensive smell	Less cohesive			
Putrid	Mushy			

Table 2: Simple definitions of selected characteristics for determining the freshness and quality of *Babylonia areolata*

Characteristics/terms	Definitions
Odour	
Sea/seaweed	Aromatics associated with sea
Fishy	Aromatics associated with fish that distinctively characterize it as fish yet fresh
Shellfish, crab	Aroma peculiar to fresh crab
Offensive smell	Aroma associated with rotten shrimp, decaying seaweed, old garbage, rotten shellfish
Appearance	
Bright	Reflection of light by certain angle; giving out or reflecting a lot of light
Glossy	Shining of surface
Dull	Loss of brightness
Slimy	Covered by or having the feel or consistency of slime
Colour	
Orange	Colour associated with orange colour
Grey discolour	Colour defect due to transformation to grey colour
Texture	
Firm	Having a solid, almost unyielding surface or structure
Tight	Stretched and not loose
Flaccid	Lacking in firmness and looking limply

lubricant, allowing them to crawl up vertical surfaces without falling off. The sweetness and the crunchiness of *B. areolata* meat were not perceived in the meat of aged cooked *B. areolata*. The flavour becomes bland, slightly salty and bitter.

Sensory changes of *Babylonia areolata* during refrigerated storage: The results of sensory evaluation of *B. areolata* stored at 4°C indicated that freshness significantly changed with time. At the beginning of the study, fresh *B. areolata* had a typical fresh sea/seaweed odour, bright glossy orange colour and moist appearance with firm and tight structure. As expected, the intensities of acceptable characteristics decreased, while the unacceptable characteristics increased with storage (Fig. 3a-d). *Babylonia areolata* held at 4°C were acceptable up to 6 days. Moderate intensity was observed at around day 6 of storage for most of the sensory descriptors. At day 14 of storage at 4°C, *B. areolata* had an offensive smell, become opaque, dull and soft in texture and were regarded unacceptable. To our knowledge there is almost no available report on sensory evaluation of *B. areolata*, so we decided to compare our results with other mollusc. Our results are comparable to Gokoglu (2002) on fresh mussels (*Mytilus galloprovincialis*) stored at 4°C, which is acceptable up to 4 days, while air packed green mussels (*Perna viridis*) on polystyrene trays at 4°C were

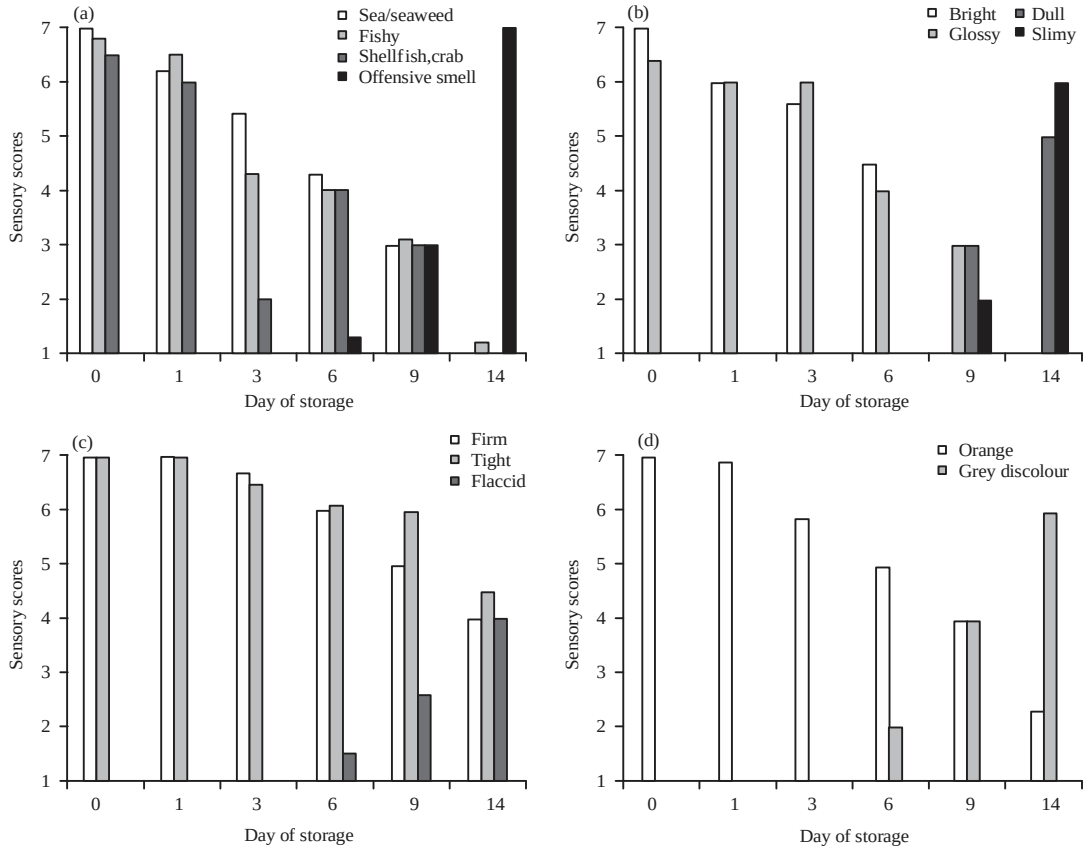

Fig. 3(a-d): Sensory scores of (a) Odour, (b) Appearance, (c) Texture and (d) Colour of raw *Babylonia areolata* meat stored at 4°C. Sensory scores are given as mean (n=10). The results were the average of duplicate samples from two sensory sitting

acceptable up to 6 days (Masniyom *et al*., 2011). Cao *et al*. (2009) however reported a higher shelf-life of 10-11 days for Pacific oysters (*Crassostrea gigas*) stored at 5°C. In this study we found that odour as the most important characteristics associated with fresh *B. areolata* freshness compared to appearance and colour. Similarly, Dore (1991) also suggested odour as the best parameter that indicates the state quality of oysters This attribute can easily be used by dealers, retailers and consumers in evaluating the freshness of *B. areolata*.

CONCLUSION

Babylonia areolata comprises of a single conical coiled shell and a soft body. The soft body which is inside the shells is divided into head, visceral mass and the foot. The edible part is the foot which is a sliver of orange and cream flesh. Fresh *B. areolata* meat has a typical fresh sea/seaweed odour, bright glossy orange colour, moist in appearance and firm and tight in structure. The present work has identified thirteen sensory attributes that are important in evaluating *B. areolata*. Freshness of *B. areolata* held at 4°C was acceptable up to 6 days.

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