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PREFACE

This Conference Proceedings contains the written versions of all full paper contributions presented in the International Conference on Environment and Health (www.inceh.org). The conference took place at the Theather Room, Thomas Aquinas Building, Soegijapranata Catholic University campus in Semarang – Indonesia, May 22–23, 2013.

The conference was intended as a forum for the discussion of the scientific findings in the area of environment and health and their implementation in the community. Special session is dedicated to environment service learning featuring a number of service learning projects in leading universities in Indonesia as part of SLEA (Service Learning for Environmental Action) projects. Participants at this conference included a wide spectrum of audiences (policy makers, representative of industry, non-governmental organizations, researchers, academicians and students), which have interest on environment and health.

The conference covered a wide variety of environment and health concerns, therefore topics include among others but not limited to:
Environmental Health and Epidemiology
Environment and Health Psychology
Environment and Disaster Management
Environmental Inequalities and Justice
Environment Degradation and Social Problems
Water, Food, and Environment
Environmental Service Learning

We would like to thank all participants for their contributions to the Conference program and for their contributions to this Proceedings. It is our pleasant duty to acknowledge the financial support from the United Board for Christian Higher Educations in Asia (UBCHEA). We do hope that International Conference on Environment and Health (INCEH) will become annual event hosted by Soegijapranata Catholic University

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THE QUALITY CHANGES OF BLACK TIGER SHRIMP (*Penaeus monodon*) DURING HANDLING BY SEAFOOD SERVICE ESTABLISHMENTS

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ABSTRACT

Shrimp is very perishable and have a very limited shelf-life. Thus, appropriate handling during post-harvest is very crucial in order to extend the freshness and shelf-life of shrimp. Moreover, good handling also can prevent shrimp from pathogenic microorganism contamination, which may cause food poisoning. Shrimp is one of favorite seafood sold in various kinds of food service, starting from street vendors to restaurants. Each food service has different behaviors regarding seafood handling. The aim of this study was to evaluate the quality changes in black tiger shrimp during handling in different seafood service establishments in Semarang. Behavior of shrimp handling in food services was observed at three street vendors and two seafood restaurants. The shrimp sampling were done at different handling steps in those food services, including at the arrival, after washing, and after storage. The quality changes of the shrimp during handling were assessed using sensory, physicochemical and microbial analysis. This study showed that during handling in both type of food services the acceptance of the shrimp decreased gradually due to its appearance and texture changes. Quality of shrimp was influenced by its quality at procurement step and the storage condition. Proper handling resulted in a decrease of microbial counts. The recommendation for improvement of the shrimp handling will also be discussed. The challenge for implementation of the improvement of shrimp handling is not only related to food handlers in food services, but also to other food supply chain actors, such as fishermen, sellers, and distributors. Food safety literacy and appropriate behaviors of all actors involved in shrimp supply chain are required.

Keywords: *shrimp, food service, handling*

INTRODUCTION

Black tiger shrimp (*Penaeus monodon*) is one of popular seafood in Semarang. Many seafood restaurants and seafood street vendors provide shrimp as main courses in their menu. Shrimp becomes favorite seafood for many people, since it has a good taste and high nutritional values. However, shrimp is categorized as a very perishable food, which can easily deteriorate during handling and storing. In order to maintain shrimp quality and safety, appropriate handling must be applied by food handlers in food services.

The quality of shrimp can rapidly change during handling due to the activity of microorganisms and enzymatic reaction (Arvanitoyannis & Varzakas, 2009). These changes will effect not only on shrimp cooking quality but also on sensory and safety aspects.

Quality degradation in shrimp can be indicated based on some characteristics including, color,

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flavor, odor, and texture. Muscle color is an important factor in consumer perception of meat quality. Consumers mostly associate color with freshness (Korel & Balaban, 2011). Improper handling may cause discolorations, which indicated by excessive yellowning or orange-reddish tints, as a result of thermal abuse and exposure. Prolonged handling may impart a bleached appearance (Jones, 2000). The appearance of blackspot (melanosis) also shows the poor quality of shrimp as a result of poor handling. Melanosis is the most common discoloration in shrimp, appearing as blackened strips between the shell segments (Jones, 2000; Adachi & Hirata, 2011).

Aroma is one of the most important determinants of seafood quality and can profoundly affect consumer acceptability. The fresh shrimp will has mild and pleasant shrimp smell. Spoiled shrimp begin to emit and ammonia smell (Jones, 2000).

Temperature abuse and poor hygiene during shrimp handling may lead to the growth both spoilage and pathogenic microorganisms. *E. coli*, *Salmonella*, *Staphylococci* and *Vibrio cholera* have been indentified in black tiger shrimp (Arvanitoyannis & Varzakas, 2009). These microorganisms can pose negative effects on human health.

Each food service establishment has different behaviors in handling. The behaviors may be influenced by knowledge background, sanitation facilities, and personal hygiene behaviors. Those factors will determine the quality of food they cooked and served to consumers. Since shrimp is very sensitive to quality changes and one of the food poisoning sources, the observation on shrimp pre-cooked handling at different seafood services is required. The observation results may be used to get a better picture in what level the handling should be carefully done in order to get palatable and safe shrimp.

The aim of this study was to evaluate the quality changes in black tiger shrimp during handling by food service establishment in Semarang.

METHODOLOGY

This research focused on the effects of black tiger shrimp handling at seafood street vendors and restaurants in Semarang on its quality.

Data Collection

Visits to three street vendors namely SV1, SV2, SV3 and two restaurants namely R1 and R2 were undertaken by purposive random sampling method, during which shrimp handlers were interviewed to collect information. More data was collected through observation of services and facilities offered by the food services. The data collected was recorded on questionnaires with key questions of the food quality survey include among others source of the shrimp, quality criterion for shrimp selection, storage technique, procedure of handling (SNI 01—2728.3-2006), type of shrimp deterioration, and duration of handling from procurement until before processing.

Shrimp Sampling

Approximately 300 g sample was taken from each food service on the day of the procurement and was plastic packed and kept in the icebox prior to the analysis. The sample was taken at the arrival, after washing and after storage.

Microbiological Analysis

Sample preparation. - Samples were further prepared aseptically for microbiological analysis by cutting out using sterile tools for approximately 100 g. As much as 25 g of the samples was put into sterile plastic, 225 mL of sterile aquadest was added and homogenized for 2 minutes.

Total Plate Count (TPC). – After homogenization, samples were serially plated using the pour-overlay method on Plate Count Agar (PCA), and aerobically incubated for 24 hours at 35 ± 1 ^{o}C and counted as colony forming units (CFUs/g) according to SNI 01-2332.3-2006.

Organoleptics Test

The organoleptics test was performed by six-trained panelist. Shrimp samples from five food services were served taken from three different steps of handling. The panelists then were asked to score the freshness of the shrimp range from one to nine according to appearance, odor, and texture (SNI 01-2728.1-2006).

Physical Quality Measurement

Color measurement. – This measurement was performed using Chromameter Minolta according to Silva *et al. (*2005). Prior to the measurement, the Chromameter was standardized using white reference tiles (Y= 93,4; x= 0,3132; y= 0,3195). The results were expressed in three color aspects: L*a*b* and was done in triplicates.

Texture analysis. – Hardness and springiness of samples were measured with Texture Profile Analysis (TPA) method using LLOYD TA Plus. A ball probe with 500N capacity, test speed of 5 mm/s, trigger of 25 gf, normal length of 20 mm and 25% sample compression were applied in the measurement in triplicates.

Chemical Analysis

Moisture content. - Moisture content was determined by drying samples in an oven at 105°C until constant weight was obtained (Apriyantono *et al.*, 1989).

Total volatile basic nitrogen (TVB-N)/ Trimethylamine (TMA) Analysis. - The TVB-N and TMA were determined according to Apriyantono *et al*. (1989).

Data Analysis

Data in numbers were calculated using Microsoft Excel and presented as Means ± Standard Deviation; the data were recapitulated in tables and figures. Significant differences of physicochemical characteristics of shrimp among the food services during handling were tested using the One-Way ANOVA F-test, continued with Post-hoc Duncan. Analyses were conducted using SPSS software package (version 13.0 for Windows).

RESULTS AND DISCUSSION

Shrimp Handling Procedure

The source of shrimp of the SVs mostly came from traditional markets, where they could not have choices for quality shrimp. Moreover, by stored it for two days could cause worse quality of shrimp since there was no standard for shrimp/ice ratio and non uniform of ice during storage. The soaking- in-water thawing performed by SV1 and SV3 would potentially reduce the quality. It could get worsen if the duration of cooling in the ice box during opening hours were too long or even some were restored again for tomorrow (Table 1).

The quality changes of shrimp during handling

During handling the quality of shrimp seemed changed, which could be recognized by respondents through organoleptic test. This was described by the reduction of organoleptic score in terms of appearance, aroma, and texture (Table 2). However, the organoleptic score of all shrimp samples still above the minimal score required by SNI (minimal 7), except for samples taken from SV1. Since arrival, samples from SV1 showed discoloration of muscle and pinkish color in the head area. The color became more prominent after washing and storage. Pinkish tint could be a sign that the shrimp was not fresh anymore. Jones (2000) stated temperature abuse during post-harvest handling may cause the appearance of reddish-orange tint in shrimp.

One of freshness indicators of raw shrimp is texture. During handling, shrimp texture insignificantly change ($p < 0.05$), except in shrimp taken from SV2 and R1 (Table 4). The shrimp texture from SV2 became softer after storage, while shrimp texture from R1 became less firm. Fresh shrimp is relatively firm, and then becomes mushy and soft during iced storage (Nunak & Schleining, 2011). Erickson *et al.* (2007) have reported that during storage the texture became soft due to the protein degradation.

Seafood freshness and spoilage can be determined based on trimethylamine (TMA) and total volatile basic nitrogen (TVB-N) contents. The concentrations of TMA and TVB-N which indicate good quality of seafood are 15 mg/ 100g and 30 mg/ 100 g respectively (Ali *et al.*, 2010). Graph 1 demonstrated the chemical changes (TMA and TVB-N contents) of black tiger shrimp samples during handling. The graph depicted the differences of chemical quality of shrimp samples taken from arrival point from all food service establishments. This indicated the difference quality of shrimp received by food service establishments from suppliers. The lowest TMA and TVB-N concentration of initial shrimp samples (from arrival point)

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were found in sample from SV2. Both TMA and TVB-N contents of samples taken from all food service establishments increased during handling.

The significant increase of TMA concentrations ($p < 0.05$) during handling, especially after storage, was found in samples from SV1, SV2, and R1 (Graph 1a). The highest TMA concentration was observed in sample SV1 after storage, which was about 14.75 mg/ 100 g. However, the concentration of TMA in all samples still fulfilled the limit of good quality indicator of seafood (15 mg TMA/ 100g). TMA is produced by decomposition of trimethylamine oxide (TMAO), which is caused by bacterial activity and partly by intrinsic enzymes (Debevere and Boskou, 1996; Mitsubayashi *et al*., 2004). TMA is the main compound in seafood which is responsible for an undesirable fishy odor (McGee, 2004).

TVB-N found in shrimp samples showed the presence of ammonia (NH_3), which described spoilage phenomenon for seafood. Volatile bases are mainly caused by microbiological activity (Noseda *et al*., 2010). Graph 1b showed that the concentration of TVB-N in shrimp samples observed from all food service establishments not significantly increased during handling. TVB-N found in all samples was below 30 mg/ 100g, the maximum limit of good quality indicator. The concentration of volatile nitrogen bases increases after death, the increase is influenced by storage duration and conditions (Belitz *et al*., 2009). The result of TVB-N assessment was in agreement microbial load changes during handling (Graph 2). The reduction of microbial density could influence the formation of TVB-N.

Washing and storing shrimp at cold condition definitely suppressed the growth of microorganisms (Graph 2). The exemption was found in samples taken after storage from R2. This might occurred due to the storage condition applied by R2. During storage, shrimp was stored in ice box. However the ratio of shrimp to ice was not considered well. It probably caused insufficient temperature (not enough ice) for inhibiting the growth of microorganism. The microbial density in all samples was below 5 log cfu/ g, which still fulfilled standard required by SNI. The maximum microbial density based on SNI 01-2728.1-2006 is 5.69 log cfu/g.

CONCLUSION(S)

Different food service establishments showed different behaviors in shrimp handling, especially in washing, storing, and applying the amount of ice for preserving shrimp freshness. Washing and storage were very important for maintaining the quality of shrimp. Besides those two steps, the quality of shrimp was influence by the quality of shrimp origin. Thus, proper sorting method was required to get the good quality of shrimp before further handling steps.

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Table 1 Fresh black tiger shrimp handling from procurement until before processing at five food services

Specification	Shrimp Handler				
	SV1	SV2	SV3	R1	R2
1. Source of shrimp	Peterongan Traditional Market	Kobong Traditional Market	Tambak Lorok Fish Market, Tanjung/Kobong Traditional Market	Supplier	Supplier
2. Procurement time and Frequency	09.00 am; every two days	06.00 am; every day or every two days	06.00 am; every two days	10.00 am; every two or three days	10.00 am; every three days
3. Selection criteria	Texture: hard and compact	Texture: elastic Appearance: wholesome	Texture: hard	Selection was done by the supplier	Texture: hard Odor: fresh Color: blackish green
4. Size uniformity of ice; shrimp & ice ratio	n.a.	Non uniformity; not available	Non uniformity; not available	Non uniformity; not available	n.a.
5. Shrimp handling*					
Arrival	Sorting according to the texture	Sorting according to the texture	Sorting according to the texture	Sorting according to the texture	Sorting according to the texture
First washing	Running clean water	Running clean water	n.a.	Running clean water three times	Soaking in a plastic container, was added with lemon juice
Sortation	Upon arrival	Upon arrival	Upon arrival	Upon arrival at the restaurant	Upon arrival at the restaurant
Washing II	After storage, soaking in water once	-	After storage, soaking in water one or two times	After storage, soaking in water once	-
Weighing	Based on size: large (13 pieces) and small (15 pieces); was done prior to cooking	Estimation	Estimation; was done prior to cooking	Weighing per portion (four pieces)	Weighing per portion (150 g)
Packing	Plastic container	Plastic container	Plastic container	Transparent plastic bag + Plastic container	Transparent plastic bag + Plastic container
Storage	In the freezer; moved to ice box with ice addition prior to opening hours	In the ice box with ice addition	In the ice container with ice addition; moved to plastic container with ice addition prior to opening hours	In the freezer	In the ice box with ice addition
6. Size uniformity of ice; shrimp & ice ratio	Non uniformity; 8 kg of crushed ice in one ice box	Non uniformity; 2 kg of shrimp: 4 kg crushed ice	Non uniformity; no certain ratio of shrimp and ice	No ice; in the freezer	Non uniformity; no certain ratio of shrimp and ice
7. Storage condition	Together with other seafood	Together with other seafood	Together with other seafood	Together with other seafood but with barrier	Together with other seafood
8. Duration of handling before storage	± 10 minutes	± 10 minutes	± 10 minutes	± 10 minutes	± 15 minutes

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* = Steps of handling process according to SNI 01-2728.3-2006
n.a. = Not available

Table 2. The changes of sensory characteristics of black tiger shrimp during handling at different food handlers

Shrimp handler	Sampling time	Sensory parameters		
		Appearance	**Aroma**	**Texture**
SV_1	Arrival	6.92 ± 0.67	6.92 ± 0.67	6.92 ± 0.67
	After washing	6.75 ± 0.87	6.92 ± 0.67	6.92 ± 0.67
	After storage	6.67 ± 0.78	6.67 ± 0.78	6.50 ± 0.90
SV_2	Arrival	8.00 ± 0.74	7.83 ± 0.72	7.83 ± 0.72
	After washing	7.92 ± 0.62	7.67 ± 0.49	7.75 ± 0.45
	After storage	7.67 ± 0.49	7.50 ± 0.58	7.58 ± 0.51
SV_3	Arrival	7.17 ± 0.83	7.00 ± 0.74	7.08 ± 0.79
	After washing	7.08 ± 0.79	7.00 ± 0.74	7.08 ± 0.79
	After storage	7.00 ± 0.74	6.92 ± 0.67	7.00 ± 0.74
R_1	Arrival	7.75 ± 0.62	7.70 ± 0.52	7.75 ± 0.75
	After washing	7.67 ± 0.78	7.33 ± 0.49	7.50 ± 0.67
	After storage	7.58 ± 0.67	7.33 ± 0.49	7.50 ± 0.52
R_2	Arrival	7.33 ± 0.49	7.25 ± 0.45	7.17 ± 0.83
	After washing	7.33 ± 0.49	7.17 ± 0.39	7.08 ± 0.29
	After storage	7.25 ± 0.45	7.17 ± 0.39	7.25 ± 0.45

Note: Based on SNI 01-2728.1-2006 the requirement of organoleptic score for fresh shrimp is minimal 7, with 9 is the best score and 1 is the worst score

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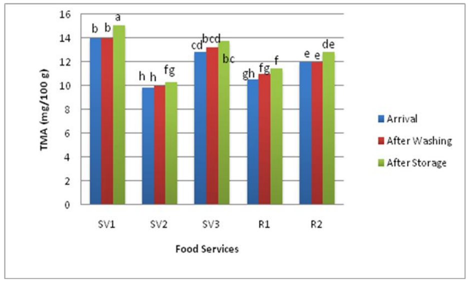
Table 3. The changes of black tiger shrimp appearance during handling at different food handlers

Shrimp handler	Sensory parameters		
	Arrival	**After washing**	**After storage**
SV_1			
SV_2			
SV_3			
R_1			
R_2			

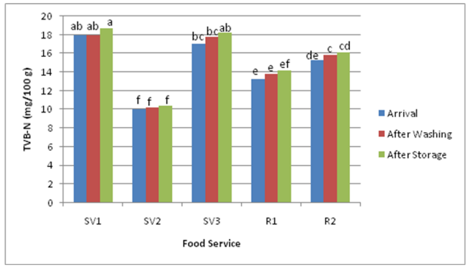
Table 4. The changes of black tiger shrimp texture during handling at different food handlers

Shrimp handler	Sampling time	Texture	
		Hardness (gf)	Springiness (mm)
SV_1	Arrival	1980.58 ± 72.79^{abcd}	3.42 ± 0.37^{bcde}
	After washing	1974.35 ± 60.66^{bcd}	3.37 ± 0.43^{cde}
	After storage	1943.25 ± 39.14^{d}	3.17 ± 0.28^{e}
SV_2	Arrival	2147.64 ± 112.42^{a}	3.94 ± 0.13^{a}
	After washing	2115.26 ± 66.91^{abc}	3.92 ± 0.12^{ab}
	After storage	2091.62 ± 83.86^{bcd}	3.75 ± 0.22^{abcd}
SV_3	Arrival	$2021.18 \pm 113.61^{abcd}$	3.62 ± 0.13^{bcde}
	After washing	$2005.67 \pm 146.42^{abcd}$	3.58 ± 0.12^{bcde}
	After storage	1964.95 ± 102.98^{cd}	3.52 ± 0.27^{de}
R_1	Arrival	2084.23 ± 109.27^{ab}	3.93 ± 0.27^{a}
	After washing	2066.21 ± 90.71^{abcd}	3.74 ± 0.36^{abc}
	After storage	2051.90 ± 74.76^{abcd}	3.48 ± 0.37^{bcde}
R_2	Arrival	$2044.96 \pm 121.83^{abcd}$	3.88 ± 0.17^{bcde}
	After washing	$2043.27 \pm 108.04^{abcd}$	3.77 ± 0.33^{bcde}
	After storage	$2030.07 \pm 111.38^{abcd}$	3.59 ± 0.18^{cde}

Note:
All data presented were means ± Standard Deviation.
The different superscripts in the same column indicate the significant differences ($P < 0.05$).

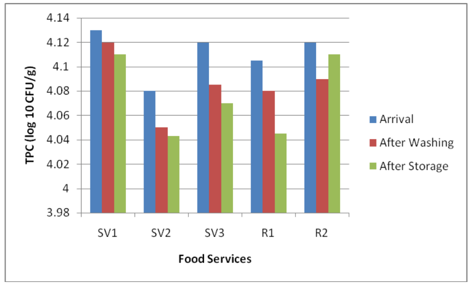


(a)



(b)

Graph 1. *Chemical quality of black tiger shrimp at five food services: (a) TMA (mg N/100 g); (b) TVB-N (mg/100 g)*



Graph 2. *Microbiological quality of black tiger shrimp at five food services according to the Total Plate Count*