

EFFECTIVE COMMUNICATION AND INTERDISCIPLINARY RESEARCH ON THE IDEA THAT SIZE MATTER FOR SAFER LOKAN DELICACIES IN SABAH

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Many makeshift stalls have increased in numbers with the rise popularity of the grilled *lokan* along Sulaman Road near Kota Kinabalu better known as Salut. This development has helped increased the local community economy. For seafood only the species *Polymesoda expansa* of *lokan* is sold serving in three sizes: small(S), medium (M) and large (L). The study objective is to monitor the heavy metals concentration of *lokan* according to size and customer demand. Samples were analysed by Flame Atomic Adsorption Spectrometry (FAAS) individually. The results yielded the mean of heavy metals for Pb were $6.33 \pm 8.82_S$, $4.33 \pm 4.58_M$, $3.85 \pm 1.96_L$, for Cu were $15.96 \pm 16.86_S$, $11.41 \pm 10.60_M$, $6.61 \pm 5.66_L$, for Cr were $3.39 \pm 2.78_S$, $1.52 \pm 2.11_M$, $0.61 \pm 0.60_L$, for Cd were $1.90 \pm 1.00_S$, $1.35 \pm 1.34_M$, $0.70 \pm 0.38_L$, for Zn were $52.08 \pm 28.37_S$, $75.37 \pm 36.80_M$, $94.00 \pm 38.16_L$, respectively. The finding shows large size *lokan* contains less heavy metal than small size *lokan* except for Zn. Although larger *lokan* seem safer to eat, preliminary observation has shown that consumers prefer smaller *lokan* because it is cheaper than the larger ones. The study shows that most consumers are still unaware of the impact of heavy metals in *lokan* that they consume affecting their health adversely. There had been consumers that ate grilled *lokan* in the study area experiencing symptoms of heavy metals toxicity. It is believed that by favouring the larger and mature *lokan* will enable them to increase producing progenies for continuous abundant supply thus making it a sustainable income generation project. Changes of trend like consumers opting to eat large *lokan* because it is safer to consume will be an incentive for supplier to be more selective in harvesting bigger *lokan*. This study revealed that both sellers and consumers believe that an effective information campaigns can help not only for the safe consumption of *lokan* and other aquatic food from this area but also make their supply more sustainable. The findings of this study will be the basis for the formulating of the public health information campaign to all stakeholders with regards to safe *lokan* consumption and its sustainability.

Keywords: Bivalves, *Polymesoda expansa*, Heavy Metals, Biomonitoring, Correlation Coefficient, Public Health, Communication.

Introduction

Lack of knowledge due to poor or no communication can lead to adverse consequences at all levels involved (Jacobs et al 2015). A case in point is the *lokan* eateries at the Salut area which is about 20 kilometres away from Kota Kinabalu, the capital of Sabah. In this case, the affected parties are not only the *lokan* eateries operators. It include the fishermen,

lokan dealers and sellers, consumers and the government agencies involved like the local authorities, fishery department, public health agencies as well as the environment department. It is felt that one of the main reasons for this issue to be persistent is due to lack of knowledge and communication between the parties involved.

Community leaders of the Salut surrounding areas like Mengkabong where the Salut eateries operators get most of their *lokan* supplies begin complaining to the Universiti Malaysia Sabah research team when they visited the area that their catch are sometimes rejected by buyers from Kota Kinabalu due to the suspicion that it is unsafe to consume because it contain certain toxic material like heavy metal. They further complaints that when the mass media give negative coverage to their catch their sales fall.

The Mengkabong community leaders also complained that their catch have been dwindling and their environment condition is fast declining affecting the quality and quantity of the aquatic life of which their economy is heavily dependent upon. They believed that the quality of mangrove ecosystems of which their livelihood is closely link is threatened by the industrialisation and other developments in the community neighbourhoods producing toxic affluent affecting the environment adversely. The community leaders also complained that they have many times communicate their concern to the relevant authorities and political leaders but tend to fall on deaf ears. All these issues were raised to a group of Universiti Malaysia Sabah lecturers who participated in the corporate social responsibility exercise in early 2016.



Source: Abdnaddin



Mengkabong, Tuaran, Sabah

Thus, for this study two methods of research are employed. First, is to conduct scientific research and analysis to determine the validity of the complaints made by the Mengkabong leaders that their catches are declining in quantity and quality. Scientific tests were conducted by lecturers and students of the Faculty of Science and Natural Resources,

Universiti Malaysia Sabah. Second, for determining the level of information and state of communication an opinion survey was conducted to measure the respondents' knowledge.

Heavy metal pollution has been regarded as a serious threat to mangrove ecosystems globally. High concentration of heavy metals from biomagnifications through the food chain link can potentially affect human health (Borrell et al 2016, Park et al 2013, Figueira et al 2011). Biomonitoring by using bivalve molluscs such as clams, oyster and cockles are more comprehensive to gauge the health of the mangrove ecosystem than relying only on water or sediment analysis (Estrada et al 2017, Dabwan & Taufiq 2016). Benthic organisms such as bivalves accumulate heavy metals directly from water or sediments because they are filter feeders (Abdullah et al 2014). Furthermore, the level of heavy metals that bivalve accumulates fluctuate according to various kind of season (Maanan 2008).

Mankind has been relying on benthic organism such as bivalve since the early evolution of modern human for their protein resource (Kyriacou et al 2016). There are more than one thousand species of bivalves distributed in the South East Asia more diverse in this region compared to other parts around the world. A coastal area facing the South China Sea in the West Coast of Sabah State in Malaysia known as Salut is famous for its local delicacies of grilled marsh clam or popularly known as *lokan*. Only one species of marsh clam is served in this popular site here which is the *Polymesoda expansa* or locally known as lokan. To increase their income, the stalls owner has made a strategy by serving three sizes of lokan by size selection: small (S), medium (M) and large (L) to suit their customer budget (Figure 2).



Figure 2. A Salut eatery displaying *lokans* that had been sorted with three different sizes which are

small, medium and large in front of the stall with an example of grilled *lokan* (original photos).

Uncontrolled heavy exploitation of these *lokan* following customer demands especially the smaller size can cause a reduction of larger *lokan* size that has mature and able to at least once in its lifetime to complete the cycle of producing offspring (Lasiak et al 1991, De Boer et al 2000). This interdisciplinary research is to correlate how customer demand on *lokan* size can affect the sustainability of the *lokan* resource in the relation of safety consumption according to size in comparison of heavy metals concentration. The findings of this study will be the basis for formulating of the public health information campaign to all stakeholders with regards to safe *lokan* consumption and its sustainability.

The Scientific Research

Fresh samples of *lokan* (*Polymesoda expansa*) were bought from the makeshift stalls gathered along Sulaman road, Kota Kinabalu in an area called Salut (latitude 6°6'4.18"N, longitude 116°10'22.78"E) which is close to the Gayang-Telipok roundabout. A total of 90 samples were collected randomly from different stalls in February 2016 with 3 different size group of 30 samples each categorized according to length measurement of samples diameter including the shell as small (30mm~55mm), medium (60mm~75mm) and large (80mm~100mm).

Digestion and Heavy Metal Analysis

Each *lokan* individual height, width and length size was measured before the meat fleshes were dissected from the shell. Samples were cleaned with distilled water to avoid any contamination. Weight measurements of each individual *lokan* were taken before and after drying in an oven at 65°C to constant dry weight. For complete digestion, the dried *lokan* tissues were grinded with pestle and mortar. Each sample tissues were digested with 10ml concentrated HNO₃ for 2 hours. Then 1ml of H₂O₂ were added together for further digestion and heated to 90°C for 1 hour. Temperatures were raised to 130°C until samples were totally dissolved. Later, samples were cooled for 1 hour. Samples were diluted with distilled water until total volume of 100ml. Before sample analysis were conducted by using flame Atomic Adsorption Spectrometry (AAS) (Perkin Elmer Analyst 4100), samples were filtered with Whatman 45µm membrane. Measurements of each heavy metal concentration were done in triplicates.

Physical characteristic of *lokan*

Table 1: The physical characteristics of *P. expansa* that were used in this study

Physical characteristics	Sizes	Mean	SD	Min	Max
Length of shell (cm)	S	5.15	0.30	4.60	5.50
	M	6.71	0.51	5.60	7.60
	L	8.86	0.56	7.80	9.90
Width of shell (cm)	S	4.81	0.44	4.10	5.50
	M	6.30	0.49	5.40	6.90
	L	8.60	0.49	7.20	9.40
Height of shell (cm)	S	2.83	0.51	2.00	3.80
	M	3.77	0.48	3.00	4.50
	L	5.06	0.55	4.20	6.10
Weight of shell and tissue (g)	S	52.42	6.49	36.84	63.50
	M	67.87	6.43	59.36	86.76
	L	95.94	9.14	80.62	120.27
Width of tissue (cm)	S	2.84	0.29	2.20	3.60
	M	3.85	0.42	3.10	4.50
	L	4.60	0.39	3.90	5.30
Length of tissue (cm)	S	3.11	0.38	2.30	3.80
	M	4.18	0.27	3.60	4.60
	L	4.85	0.27	4.30	5.50
Wet weight (g)	S	6.66	1.25	4.31	9.50
	M	11.18	1.67	8.54	14.67
	L	19.40	4.32	13.00	28.16
Dry weight (g)	S	0.75	0.23	0.32	1.40
	M	1.13	0.25	0.64	1.69
	L	2.22	0.85	1.16	3.94

A total of 90 individuals *lokan* physical characteristics were measured which parameters involved length of shell (4.60 – 9.90_{range} cm), width of shell (4.10 – 9.40_{range} cm), height of shell (2.00-6.10_{range} cm) and length of tissue (2.30 – 5.30_{range} cm), width of tissue (2.20 – 5.30_{range} cm), and dry weight (0.32 – 3.94_{range} g), wet weight (4.31 – 28.16_{range} g) and total weight of shell and tissue (36.84 – 120.27_{range} g) for *lokan* (Table 1).

As mentioned there are three selections of grilled *lokan* servings that were offered to customers according to size which were categorized in small, medium and large. Result shows that there are no overlaps between the range minimum and maximum between each

size (Table 1). This indicates that the seller is very adept in sorting the sizes before it is offered to customers.

Assessment of heavy metal concentration in *lok an* tissues

The range of heavy metal concentration according to each size categorizes as shown in Table 2 for Plumbum (Pb) were $6.33 \pm 8.82_S$, $4.33 \pm 4.58_M$, $3.85 \pm 1.96_L$, for Cuprum (Cu) were $15.96 \pm 16.86_S$, $11.41 \pm 10.60_M$, $6.61 \pm 5.66_L$, for Chromium (Cr) were $3.39 \pm 2.78_S$, $1.52 \pm 2.11_M$, $0.61 \pm 0.60_L$, for Cadmium (Cd) were $1.90 \pm 1.00_S$, $1.35 \pm 1.34_M$, $0.70 \pm 0.38_L$, for Zinc (Zn) were $52.08 \pm 28.37_S$, $75.37 \pm 36.80_M$, $94.00 \pm 38.16_L$, respectively.

It is interesting to note that the finding shows larger size *lok an* contain less heavy metals than smaller size *lok an* except for Zinc (Table 2). If the mean measurement of heavy metals concentration were assessed from a total number of 30 for each group, only Zinc and Cuprum values are below the maximum permissible level which has been set by Malaysia Food Regulation 1985 (Table 1) for all sizes. The range of Plumbum concentration for all three size group exceeds the permissible level in MFR 1985 which should be not more than 2.0mg/kg. However, Cadmium concentration in *lok an* tissues for larger size is safer to consume than other sizes. The larger *lok an* size level of Cadmium concentration mean value is below the maximum allowable limit whereas compared to medium and small size that exceeds the allowable limit guideline in MFR 1985.

The mean value range for each heavy metal concentration analysis from high to low level according to size indicates that small *lok an* size accumulates more Cuprum, Plumbum, Chromium and Cadmium metal concentration in its tissue except for Zinc (Table 1). Assessment of these heavy metal in relationship of from high to low concentration with *lok an* size can be summarised as small (high) >medium (medium) >large (low). On the other hand, assessment of mean Zinc concentration value shows that larger *lok an* accumulates more Zinc than smaller size in the tendency of large (high) >medium (medium) >small (low).

Table 2: Level of heavy metals concentration in *Polymesoda expansa* tissues categorised in three different group sizes (n=30 each size, N=90)

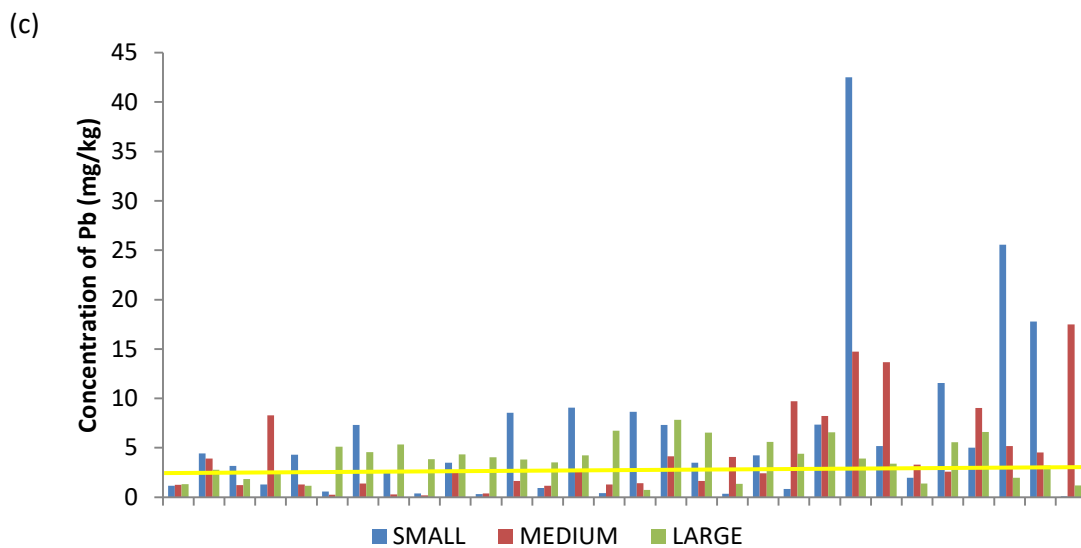
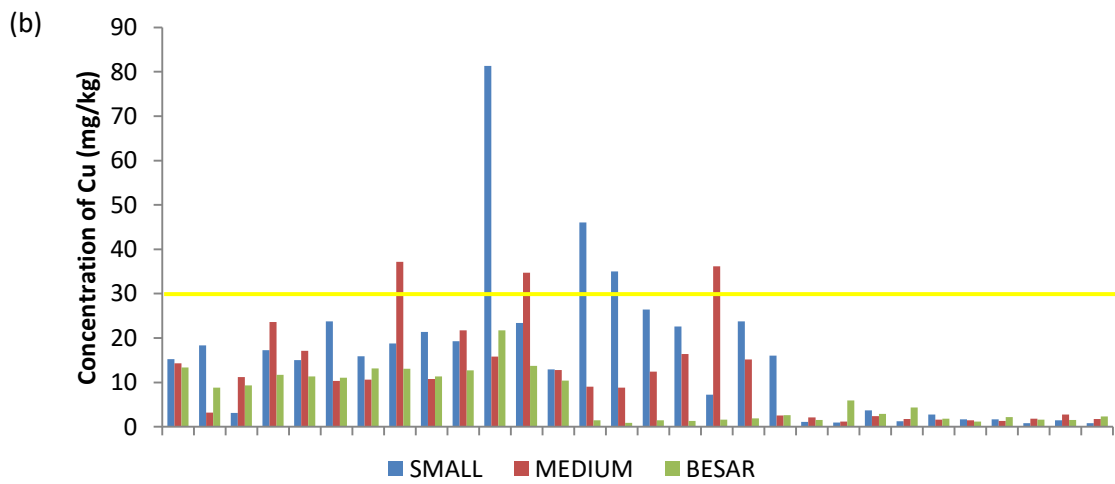
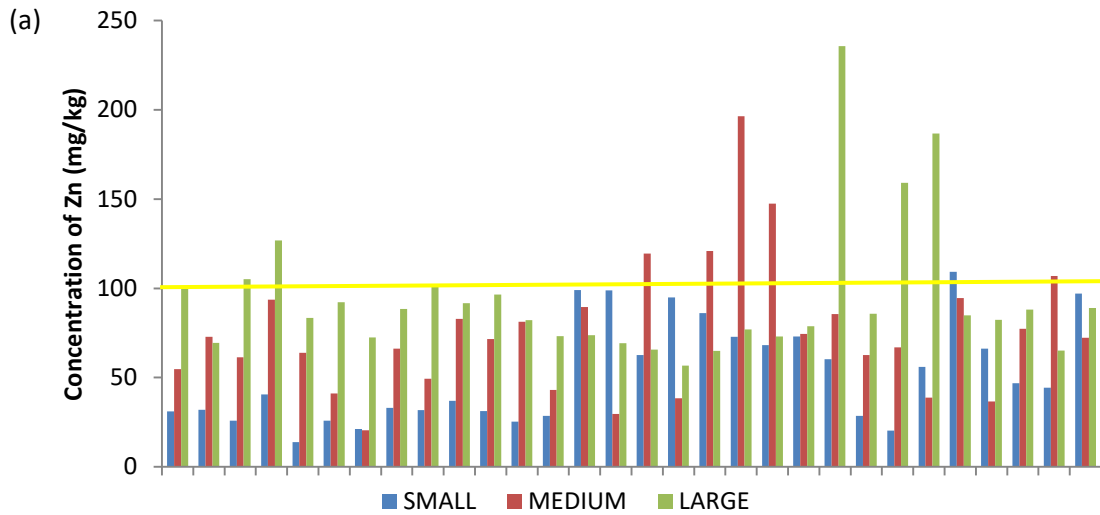
Heavy metal	Lok an size	Mean	SD	Min	Max
Zinc (ug/g)	S	52.08	28.37	13.90	109.31
	M	75.37	36.80	20.50	196.52
	L	94.00	38.16	56.77	235.71
Cuprum (ug/g)	S	15.96	16.86	0.82	81.32
	M	11.41	10.60	1.20	37.21

	L	6.61	5.66	0.91	21.77
Plumbum ($\mu\text{g/g}$)	S	6.33	8.82	0.10	42.51
	M	4.33	4.58	0.18	17.50
	L	3.85	1.96	0.75	7.84
Chromium ($\mu\text{g/g}$)	S	3.39	2.78	0.00	11.35
	M	1.52	2.11	0.08	8.82
	L	0.61	0.60	0.05	2.28
Cadmium ($\mu\text{g/g}$)	S	1.90	1.00	0.41	3.69
	M	1.35	1.34	0.11	7.04
	L	0.70	0.38	0.11	2.06

This study measures individual *lokan* heavy metal concentration according to the sorted *lokan* size that is served in Salut area which has been categorised as small, medium and large as shown in Figure 2. In the total of 90 *lokan* tissue samples that were analysed for Cuprum concentration, only five tissues exceed the permissible value based on MFR 1985 (Fig. 2b). Interestingly, the entire individuals in large group are below the permissible Cuprum metal limit. The permissible limit for Zinc that has been set by MFR 1985 is 150mg/kg. Although Zinc is below the permissible safety limit by MFR 1985, there are actually few individual *lokan* that exceed the permissible limit set by MFR 1985 (Fig. 2a). On the contrary assessment of other heavy metals concentration than Zinc in *lokan* tissues shows tendency that larger *lokan* is much safer to consume rather than smaller size *lokan*.

Assessment of Plumbum concentration from average mean for each group *lokan* size exceeds the permissible limit of MFR 1985 (Table 1). Although there are individuals which does not exceeds the permissible limit of MFR 1985 (Fig. 2c). Small size *lokan* has higher level of Plumbum concentration compared to large size *lokan*. For Chromium, there is no set limit in the Malaysia Food Regulation 1985 (Fig. 2d). However Chromium concentration values of small and medium *lokan* size showed that many individual *lokan* samples exceed the maximum allowable limit based on International Atomic Energy Agency (IAEA-407). Only a handful few individual in the large group size had Chromium concentration level above the permissible limit.

Similarly only three individuals in the large group size of *lokan* had Cadmium concentration that is above the permissible limit. Majority of the individual in the small size of *lokan* had Cadmium concentration that exceeds the limit set by MFR 1985. These findings indicates that concentration of heavy metals in *lokan* tissue is safer to consume when *lokan* have grew larger compared to when *lokan* is still small and growing.



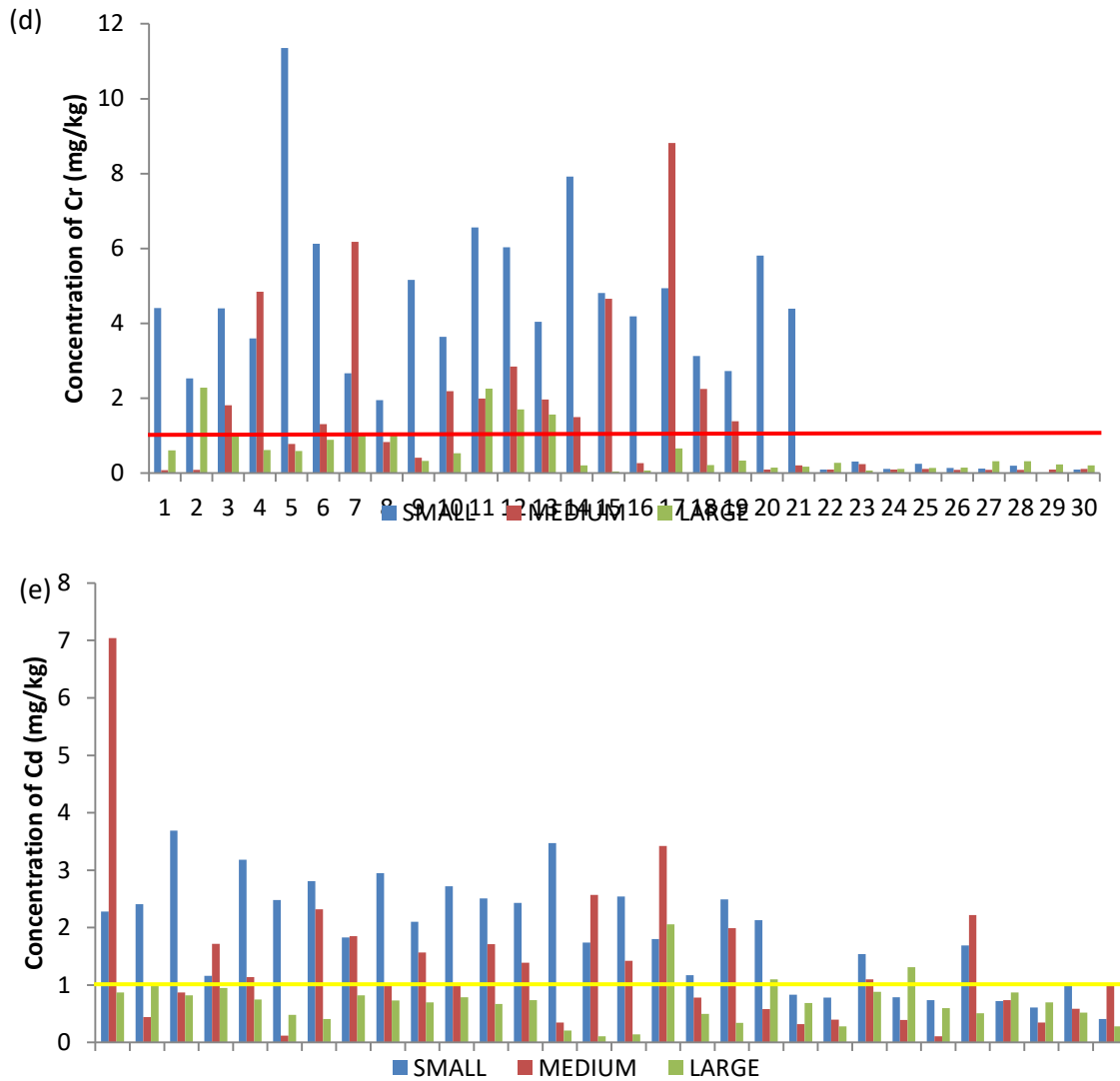


Figure 2. Concentration of (a) zinc, (b) copper, (c) lead, (d) chromium and (e) cadmium in individual *lokans* tissues according to size where blue bar is small size, red bar is medium size and green bar is large size. Yellow line is the standard maximum heavy metal concentration (mg/kg) limit according to Malaysia Food Regulation 1985 for safety consumption. While red line are maximum allowable limit based on International Atomic Energy Agency (IAES-407) for chromium.

Public awareness assessment

To assess public awareness in regards to knowledge on heavy metal concentration in bivalves and impacts, the study administered a survey in Salut area along Sulaman Road, Kota Kinabalu during lunch hour on non-working days. Patrons that were enjoying grilled *lokans* were selected randomly to participate in this survey. Two hundred respondents eating the *lokans* were randomly selected for this study.

The questionnaires were written in two languages, English and Malay language. There are three sections in the questionnaires which were design to enable personal and

spontaneous response. For the first section, the questionnaires recorded socio-demographic characteristics such as gender, age, origin (state), race, religion, body weight, height, occupation and educational level. In the second section, questions were structured to evaluate customer behaviour and preference in their *lokan* consumption. The final section explored the consumer knowledge with a set of 15 questions on a 5-point Likert scale (1) "totally disagree", (2) "disagree", (3) "not sure", (4) "agree" and (5) "totally agree". A total of 200 respondents were selected randomly to complete the questionnaire.

Results

Socio-demographic profiling

Table 3 presents the demographic characteristic of customers that were enjoying grilled *lokan* during lunch hour on non-working day. More than half of the respondents are females (61.7%). Majority of the respondent body weight are below 70 kilogram. Customers that came to Salut to enjoy grilled lokan were not only local people. Even consumers from neighbouring areas like Sarawak and Brunei and outside of Borneo also come to know the speciality grilled seafood offered in Salut area which is the bivalve lokan. It showed that grilled lokan has captured the heart of not only Malaysians from different ethnicities and cultural background but of visitors from outside the country making it one of the favourite local delicacies.

Almost half of the respondents are students which makes more than half of the total respondents below 25 years old. There are several government tertiary educational institutions around Salut area making it fast becoming a popular eating place for lunch among students and its staff.

Government servants make the second most popular customers for the Salut eateries. Most of them work in the government educational institutions and neighbouring offices. Thus, the total number of students and government officers make a combined 70% of the Salut eateries customers. About 70% of them also claimed they are regular customers.

Nearly all the students' respondents said that they knew about the Salut eateries and eating *lokan* from classmates or friends rather than from the mass media. A few said that it is through their own discovery and wanting to taste something different. They also said they have influence some of their friends to come and enjoy the tasty and comparatively cheap sea food. Similar reasons were also given by the government staff frequenting this place. They also said they have recommended the Salut eateries and eating lokan to their families and friends.

Further, a majority of both students and the government servants said that they will still recommend their families and friends to this place despite it being not too organised or clean or that of the report that eating *lokan* is not very safe.

Table 3: Socio-demographic profiling of the first section of the questionnaire

Question No.	(Q) Description	Respondent Background	Percentage (%)
Q1	Gender	Female	61.70
		Male	38.30
Q2	Age (years)	≤ 25	62
		26 – 35	13
		≥ 36	25
Q3	Origin	Sabah	56.67
		Sarawak	28.33
		Others	15
Q4	Race	Dusun	15
		Bajau	18.33
		Chinese	33.33
		Malay	18.33
		Brunei	3.33
		Others	11.67
Q5	Body Weight (kg)	≤ 50 kg	25
		51-60 kg	32
		61-70 kg	23
		71-80 kg	12
		≥ 81 kg	8.30
Q6	Occupations	Student	46.67
		Businessman	8.33
		Housewife	6.67
		Self-employed	6.67
		Government officer	23.33
		Private sector	6.67
	Others	1.67	

Consuming lokan intake assessment

Majority of customers that have their lunch in Salut are regular customers (Table 4). According to the eateries operators interviewed large size *lokan* are rarely selected by

patrons that often come to Salut. They said customers in Salut area generally prefer small and medium size *lokan* because it is cheaper than the large ones.

Judging from the finding, more than half of the customers are not very concern of the heavy metal concentration in their *lokan*. However, about a quarter of the customers claimed they have experienced symptoms of heavy metals toxicity after *lokan* consumption in the Salut eateries and yet it did not deter them from frequenting it. This indicates there is not much public awareness regarding consumption of *lokan* with high concentration of heavy metals posing toxicological risks to consumers.

Table 4: Profiling of the section in questionnaire on consumer general attitude toward *lokan* and their size preference and consumption frequency.

Part B Intake Assessment			
Q8	Are you a seafood lover?	Yes	78.3
		No	21.7
Q9	How frequent do you eat <i>lokan</i> ?	First time	13.33
		Sometimes	73.33
		Always	13.33
Q10	Which size servings do you often choose when you dine here (Salut)?	Small	45
		Medium	46.67
		Large	8.33
Q11	Have you ever wanted to know the concentration of heavy metal in <i>lokan</i> according to size chosen?	Yes, I also want to know	38.33
		No, I never thought about it	46.67
		It is not important	15
Q12	After you ate <i>lokan</i> , did you ever felt ...	No symptom	80
		Nausea	13.33
		Vomiting	5
		Headache	1.67
Q13	Why did you pick Salut as an eatery?	Strategic location	33.3
		Friend treat	16.7
		Popular	20
		Close to home	1.7
		Delicious food	13.3
		Affordable price and cheap	15
Q14	How did you come to know Salut as a place that serve	Family	15
		Internet	8.3

	grilled <i>lokan</i> ?	Friends	60
		Family and Internet	3.3
		Family, Internet and Friends	1.7
		Close to home	11.7

Consumer environment concern and knowledge assessment

Originally there were only one or two makeshift stalls around mid-90s started to serve grilled *lokan* beside the Sulaman Road. Due to increase popularity of this local delicacies and numbers of tertiary institutions nearby, now there are many makeshift stalls sprouted both side along the Sulaman road at Salut area (Figure 3). These are not proper establishment and can be demolished in an instant. There are some concerns feeling about the hygiene though there is willingness to remain as a regular patron in these food stalls.



Figure 3. Makeshift stalls beside the Sulaman Road at Salut area (Original photos).

Table 5: Consumer’s level of Environmental Concern and Knowledge

Q	Part C Consumer’s Knowledge and Response	Mean	Level (Landell 1997; Azemi & Hashim, 2010)
Q15	I enjoy the food served at Salut	3.82	High
Q16	Facilities provided in this place should be upgraded	3.55	Moderate
Q17	Consuming more seafood bring more benefit than badness	3.07	Moderate

Q18	I still choose this place to eat lokan rather than other place	3.55	Moderate
Q19	I am satisfied with their hygiene	3.38	Moderate
Q20	I know where the <i>lokan</i> were collected	3.18	Moderate
Q21	Environment pollution effects aquatic marine resources quality.	3.87	High
Q22	I choose this place because the price is reasonable and food is delicious	3.78	Moderate
Q23	Local authorities should give some budget to build and upgrade this place	4.32	High
Q24	I know the hazard of heavy metals in food	3.30	Moderate
Q25	I know about what heavy metal is	3.12	Moderate
Q26	I will come to this place next time	4.03	High

Salut grilled *lokan* has obtained many loyal customers and a popular place for students to have lunch (Table 1). This is due to the reasonable price offered from this stalls compared to a proper restaurant establishment (Table 5). Therefore most of the customers are in agreement that local authorities should allocate budget to better the environment of the stalls and provide facilities because customers frequents these stalls are regulars and enjoy the local delicacies served at Salut eateries (Table 5).

Consumers are generally aware that environment pollution effects aquatic marine resources quality. However, the knowledge of how environmental pollution affects the quality of seafood to human health is minimal. Consumers of seafood are unsure whether consuming more seafood brings more benefit or are bad for their health. There is not much public awareness in regards of the hazard of heavy metals bioaccumulation in the food chain to public health.

Coefficient Correlation Assessment and Principle Component Analysis

Principle component analysis (varimax rotations) implicates four important components that conveyed reasons why Salut eatery is famous for its grilled *lokan* delicacies and why the place can thrive until today (Table 6). The total factors variants loading is 65.934% respectively. The primary factor which cover 30.617% factor loading described that consumers enjoy the grilled *lokan* in Salut due to its reasonable price. Although customers are satisfied with the hygiene condition, they would prefer if the local authority takes an initiative to better the eatery conditions ($0.521 < r < 0.590, p < 0.01$) (Table 7).

The second component of the PCA analysis which covers 15.547% factors loading correlates consumers have knowledge on heavy metals contamination in food ($r=0.667(p<0.01)$). Factor loading of 11.214% of component three imply the suitability of current infrastructure and benefit of Salut location as a place to enjoy the local delicacies which is grilled *lokan*. The place is in a strategic location and can easily access because it is located beside the main road. Moreover the customers have an option to suit their budget by the selection of portion offered according to *lokan* sizes in selection of small, medium and large ($-0.266<r<-0.397,p<0.05$).

The third or last component covers resource sustainability with 8.556% factor loading shows consumer is also concern about the *lokan* resources ($r=0.30 (p<0.05)$). Altogether, Salut has many loyal regular customers that wish to maintain this place as their favourite eatery for grilled *lokan* while hoping the infrastructure will be upgraded and there is a concern of the *lokan* resources sustainability.

Not all of people who came to the Salut makeshift stalls are seafood lover as shown in Table 4. Although *lokan* is one of the main popular local delicacies in this area, coconut pudding is also one of the local products available in Salut that helps to contribute more income for the sellers apart from offering fresh young coconut drink. This also benefits local communities in the Salut area or nearby as their livelihoods do not solely rely on aquatic marine resources but from land produce like coconut.

Table 6 Principle Component Analysis

	4 Component			
	Customer demand	Knowledge	Benefit Infrastructure	& Sustainability
Rotated Component Matrix				
Q15 I enjoy the food served at the Salut, Sabah	.787			
Q22 I choose this place because the price is reasonable and the food is delicious	.771			
Q26 I will come to this place next time	.724			
Q19 I am satisfied with their hygiene	.721			
Q18 I still choice this place to eat mussel rather than other place	.707			
Q23 Local authorities should give some budget to build and upgrade this place	.650			
Q24 I know the hazard of heavy metals		.872		

in food

Q25 I know about what is heavy metal	.857	
Q11 Have you think about how many weight of mussel that you have consumed per package?		-.820
Q17 Consuming more seafood bring more benefit than badness		.714
Q16 Facilities provided in this place should be upgrade		.512
Q21 Environment pollution effects aquatic marine resources quality.		.826
Q20 I know where the mussel been collected		.499

<i>Total Loading Initial Eigen values</i>	<i>3.980</i>	<i>2.021</i>	<i>1.458</i>	<i>1.112</i>
<i>% Variance</i>	<i>30.617</i>	<i>15.547</i>	<i>11.214</i>	<i>8.556</i>
<i>% Cumulative Variants</i>	<i>30.617</i>	<i>46.164</i>	<i>57.378</i>	<i>65.934</i>

Seasonal variation such as red tide or heavy rain which prevents local community from harvesting marine resources affects their livelihood. However, high demands of young coconuts from the eatery stalls can be an alternative source of income for people who live close to the Salut coast area when they could not harvest marine resources.

Table 7: The correlation coefficient survey analysis

Q	Q 1	Q 2	Q 3	Q 4	Q 5	Q 6	Q 7	Q 8	Q 9	Q 10	Q 11	Q 12	Q 13	Q 14	Q 15	Q 16	Q 17	Q 18	Q 19	Q 20	Q 21	Q 22	Q 23	Q 24	Q 25	
Q 1	1																									
Q 2	.079	1																								
Q 3	.129	.108	1																							
Q 4	-.033	-.033	-.033	1																						

	0	9	3						
	0	2							
	*	*							
		-							
Q	.0	.2	.0						
5	7	.0	1	2	1				
	9	1	5	6					
		1							
		.							
Q	.0	5	.1		.1				
6	9	0	0	.1	7	1			
	6	1	0	3	6				
		**		5					
		.		-					
Q	.1	4	.1	.	.0	.2			
7	9	2	3	4	0	4	1		
	3	5	8	6	2	7			
		**		1					
				**					

	-								
	.	-							
Q	4	.1	.0	.1	.0	.0	.0		
8	5	1	9	3	2	1	4	1	
	9	0	6	2	3	1	2		
	**								
Q	.0	-	0.	0.	.	.0	-	-	
9	9	.0	0	0	3	.1	.1	3	1
	0	5	0	0	9	2	4	1	
		9	0	0	4	9	1	3	
					**			*	
								-	
Q	4	-	.1	-	-	.0	-	.	
1	2	.1	5	.2	.1	6	.0	3	2
0	1	3	5	1	1	5	3	3	5
	**	3		1	3	3	3	5	6
								**	*
Q	-	.0	-	.1	-	.1	.0	-	-
1	.1	8	.0	0	.0	1	9	.1	.1
1	4	6	2	3	2	7	1	1	1
	2	3	3	7	7	1		9	0
Q	-	-	-	.2	.0	-	-	.0	.2
1	.1	.	.0	2	3	.0	.1	2	0
								5	.1

Intake Assessments

2	0	2	9	5	9	9	7	0	3	1	1									
	7	7	0				1	0				5								
		9																		
		*																		
			-																	
Q	.1	-	.1	.	.1	.2	-	-	.0	.1	-	-								
1	5	.0	4	2	0	2	.1	.1	7	6	.1	.2								
3	5	2	7	7	4	0	4	6	0	9	1	3	1							
		6		9			1	9			0	2								
				*																
Q	-	.2	.0	-	-	.1	2	.1	-	-	.0	-	-							
1	.1	3	4	.0	.0	2	6	0	.1	.1	7	.0	.1							
4	9	0	0	4	1	8	3	7	6	2	9	8	5	1						
	7			0	9		*	7	7	2		9	2							
Q	.	.2	.0	.	-	-	.1	.	.2	3	.	.	.1	-						
1	3	1	0	2	.1	.0	0	4	3	0	2	2	6	.0	1					
5	0	1	3	1	8	7	3	6	6	2	6	7	9	7						
	*			1				6		*	6	1	2							
				*				**		*	*									
Q	.2	.1	-	-	-	-	.0	-	-	.1	.	-	-	-						
1	2	0	.0	.1	.0	.0	4	.0	.1	8	2	.1	.0	.0	2	1				
6	2	1	2	4	9	2	4	4	8	0	8	1	1	1	9					
			0	7	2	4		5	6		5	0	5	3	*					
											*									
Q	.2	.1	.0	-	.0	.1	.0	.0	.0	.1	.	-	.1	.0	3	.1				
1	5	1	7	.1	9	9	8	0	3	6	3	.1	8	8	2	8	1			
7	1	0	4	6	7	0	4	6	8	9	9	8	4	5	1	4				
				1							7	9			*					
											**									
Q	.	.2	.1	-	-	-	.1	-	.2	.1	-	.	-	-						
1	4	3	3	.1	.1	.0	0	.1	0	2	.0	3	.1	.1	5	.1	.1			
8	1	1	8	6	3	8	3	5	8	4	7	2	7	6	7	0	5	1		
	**			6	0	3		5			3	3		0	**					
											*									
Q	.0	.0	.1	-	-	-	.	-	.0	-	.0	-	-	.1						
1	2	9	0	.1	.0	.1	2	.0	3	.0	5	.2	.0	4	3	.0	.0	3	1	
9	1	8	8	0	3	8	9	8	3	4	8	2	9	0	5	1	1	6		

Consumer's Knowledge and Response

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Conclusion & Recommendations

One of the significant findings of this study is that the larger *lokan* is safer to consume than the smaller ones. Base on this study it is critical that the appropriate authority be informed that the size of not only *lokan* but other aquatic life be regulated. This is not only to ensure that the fishermen conduct sustainable practice to guarantee that their livelihood is not jeopardise by maintaining a good supply of their catch but also to maintain its quality and quantity. Further, it can ensure that the ends users can safely consume their harvest so that their catch can become more marketable and well known for its safety and quality.

The findings also proved that the fishermen lamentation about the water where they harvest the aquatic creatures is increasingly becoming contaminated due to all kinds of development projects as the truth. With this finding, relevant authorities should take immediate action to remedy the situation before it becomes too late to save. They can begin by regular monitoring the area so as to preserve its quality and beauty before it is too late. By preserving its freshness and beauty it can be promoted as a tourist attraction. As such, the residents can be encouraged and given financial assistance to develop home stays to supplement their incomes as their catch had decreased in quality and quantity.

As for the Salut food stalls the findings clearly showed that it has its own regular clients plus some tourists. Thus, the appropriate authorities should take immediate steps to make it more presentable and hygienic. However, it should be done via consultation, not just through top to bottom communication and enforcement of laws which can lead to extortion and corruption which would lead to higher prices of their food. By doing so, it will make the Salut food stalls as another tourist attraction where sea food can be enjoyed at reasonable prices and safe to consume.

The study also showed that communication among the various stakeholders as poor to almost non-existent. Non-governmental organisations like environmental groups and consumers associations should assist the Salut food stall operators as well as the Mengkabong fishermen to communicate their problems effectively to the relevant authorities. They should invite the mass media to provide positive coverage and not only write negative stories about the fishermen and stall operators when something unexpected occurred.

We would recommend the relevant government agencies to be more proactive rather than being merely reactive. They should make regular visits to both areas so that issues or

problems arising can be settled quickly and effectively. The relevant government agencies can form special task force to effectively solve any issues or problems arising. Also, they can have regular dialogues or two-way communication with all stakeholders involved to find solutions agreeable for all parties concerned to resolve the issues.

Further, it is suggested that the UMS research group can help to monitor the quality of the target environment with regard to its water quality and the aquatic creatures' conditions. The findings can be given to the relevant authorities to take the appropriate actions. It can also help to design communication strategies like campaign to save the environment and eat safe seafood. Also, they can help with implementing communication campaigns and producing educational materials like posters, leaflets and features to educate all parties concerned to ensure sustainable practice to all stakeholders including the consumers for safe consumption of sea food.

In addition the UMS group can organise special events to attract support and media coverage which can help the Mengkabong and Salut groups to solve their problems. For selected occasions the UMS group can organise news conference to get positive coverage.

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