Searching for Nature Stories 2009

Queen Elizabeth School
Old Students' Association Secondary School
(Group 20)

Water Quality Monitoring in Lau Fau Shan

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Content

1. Introduction and objectives

Oysters have been cultivated in Deep Bay for more than 700 years[1] and the oyster industry has been the livelihood of many residents in Lau Fau Shan (LFS). Fresh as well as dried oysters appear in traditional Chinese cuisine even to this date. Oyster sauce, as a by-product, remains a popular seasoning and dipping sauce on the dining table. Restaurant and shop owners also make a good living by selling oyster dishes or other products to their customers.

In 1950, the yield of oyster in LFS was nearly 1200 metric ton[2] but it had declined to only 53 ton in 1996[3]. It seems that the LFS oyster production is in risk of extinction. According to a survey conducted by Hong Kong Baptist University in December of 2007, 60% of oyster products from LFS contain Cadmium which exceeds the edible standard proposed by the Food Adulteration (Metallic Contamination) Regulations Hong Kong[4]. The issue aroused public concern on the consumption of oysters from LFS and Hong Kong people started to reduce the consumption of LFS oysters owing to the poor water quality and the high amount of heavy metal in LFS marine water causing the amount of heavy metal in LFS oysters accumulating the high amount of heavy metal.

Our school is located in the northwest of Hong Kong, near LFS. Some of our schoolmates and parents, who live at LFS, told us that the water pollution problem at LFS is not as serious as being published in the media. Connoisseurs of the LFS oysters return with favorable comments. They consider the LFS oysters delicious as well as nutritive. It is really a bad news to see Hong Kong people stop buying oyster products from LFS just because of worrying about the poor water quality of LFS.

Therefore, our team would like to investigate “whether the water pollution problem in LFS is serious or not?” In this project, the water quality of LFS will be investigated by using oysters as biological indicators. The heavy metal content and the amount of bacteria in oysters will be investigated.

If the results turn out promising, we would follow up with action plans to increase the understanding, interest and awareness of Hong Kong people about the oysters industry in LFS, as well as to highlight the needs to care for and cherish this unique, intangible heritage. Then, bundled with our eco-tourism plan, we would like to develop eco-tours in the north-west of Tin Shui Wai and its neighbouring areas including Tsim Bei Tsui, Pak Nai and LFS.

2. Research methods

2.1 Literature study

Researches through the internet, books, notes, field trips, interviews, etc. on the following topics were carried out:

- the basic information of oyster including life cycle, habitat, physiology, anatomy, distribution in Hong Kong, oyster industry in LFS, etc.
- Effects of heavy metal contamination to human, how to measure the amount of heavy metal in living tissue, etc.
- Laboratory menu and ways to investigate of the amount of bacteria in living tissue, etc.

2.2 Field trips

In order to know more about the habitat and water quality of LFS, five field trips were done. During the field trips, interviews, questionnaire survey, oysters as well as soil sampling were also conducted. The following table summarizes the schedule of our field trips:

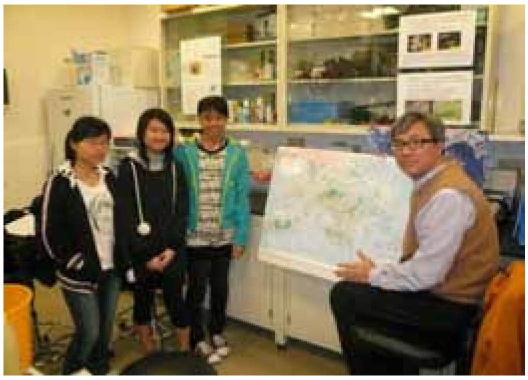
Date	Time	Location
15/01/2009	4:00pm-6:30pm	LFS, Sai Kau Tsuen, Tsim Bei Tsui & Pak Nai
22/01/2009	4:30pm-6:30pm	LFS, Sai Kau Tsuen & Pak Nai
13/02/2009	4:00pm-5:30pm	LFS & Pak Nai
23/02/2009	4:30pm-6:45pm	LFS & Pak Nai
09/03/2009	4:00pm-6:00pm	LFS & Pak Nai




2.3 Experiments

The water quality of LFS was monitored by measuring the amount of heavy metals (Cadmium and Lead) and amount of bacteria in oyster.

For investigation of the amount of heavy metal, thanks to the Department of Biochemistry, Faculty of Science, Chinese University of Hong Kong (CUHK), Dr. King Ming CHAN and Mr. Eric LIANG. They not only provided hardware support but also gave many useful advices for us to design and carry out the investigation. We had visited CUHK three times including preliminary discussion of the project and plan for experiment on 27 December 2008, laboratory works for heavy metal investigation on 16 and 23 January 2009.



For investigation of the amount of bacterial, a number of experiments were carried out from 4 to 18 February 2009 in the biology laboratory and molecular biology laboratory of our school.

Photo on right: Dr. CHAN and us.

3. Basic information of Lau Fau Shan

Lau Fau Shan is located along Deep Bay which is in the northwest part of Hong Kong. Oysters have been cultivated in Deep Bay more than 700 years.

In fact, LFS is almost the last place in Hong Kong which still has oyster industry. However, the urbanization and industrialization made the production of oyster has been affected since 70's. Thus the industry is decaying.

Source: Google Map

Path to oyster field in Lau Fau Shan

Bird view of Lau Fau Shan

4. Experiment for water quality monitoring

4.1 Reason for choosing oysters as biological indicator

It is thought that the amount of heavy metals in water would be too low for direct measurement. Oysters are filter feeders and will naturally concentrate anything present in the surrounding sea water. Therefore, the amount of heavy metal in oyster is investigated instead of direct measurement of the amount of heavy metal in the water.

Oyster is a groups of bivalve molluscs, most of which live in marine habitats or brackish water. They are members of the family Ostreidae. Oysters breathe much like fish, using both gills and mantle. They are known as filter-feeders which draw water in over their gills through the beating of cilia. Suspended food plankton and particles are trapped in the mucus of a gill and transported to the mouth. Then they eat, digested and expel the particles as faeces. Healthy oysters consume algae and other water-borne nutrients[5]

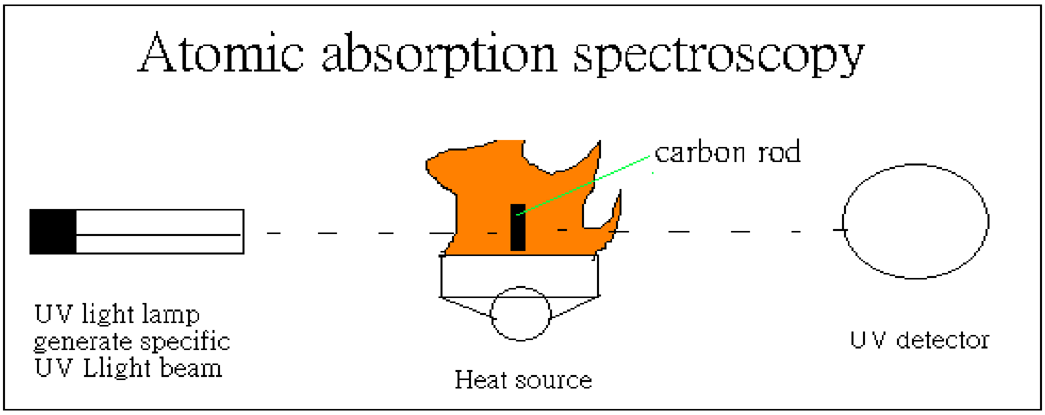
Besides, they filter up to five litres of water per hour and the feeding activity is the greatest in oysters when the water temperatures are above 10^{o}C. Oysters' filter the pollutants and either eat them or shape them into small packets that are deposited on the bottom where they are harmless. The absorbed heavy metals or bacteria can stay inside the oysters without being broken down or excreted. Therefore, oyster was used as biological indicator in this experiment.

4.2 Experiment for investigate the amount of heavy metals

4.2.1 The principles and design of the experiments

As the heavy metals in water are commonly come from industrial waste, by investigating the amount of heavy metal in oyster, the degree of the marine pollution problem caused by industrial waste of water in LFS can be studied.

Different heavy metal can absorb characteristic wavelength. The higher the amount of the heavy metal present in a sample, the higher the amount of particular wavelength will be absorbed by the sample. Therefore, atomic absorption spectroscopy is applied in this project to find out the concentration of heavy metal in oyster. Atomic absorption spectroscopy generates specific UV light in UV source with different wavelength, the oyster samples were put in the heat source. When the UV light passed through the vapourized sample, some of the UV light was absorbed by the sample and was detected by the UV detector. By compare the change of absorbance to a standard curve, the amount of heavy metal in the sample can be found.



Atomic absorption spectroscopy

4.2.2 Effects of lead and cadmium on human

In the experiment, two kinds of heavy metal lead and cadmium were chosen and their amount in oysters from LFS and different places were investigated and compared. The reason of choosing the metals is their effects on human which directly affect the health of human whom consumes oysters.

Lead[6]

Lead is a poisonous metal which affects practically all systems within the body. Excessive lead levels (lead levels at or above 80 micrograms per deciliter of blood) can cause convulsions, coma, and even death.

Lead is considered to be particularly harmful for women's ability to reproduce as it is more easily absorbed into growing bodies and significantly affects the health of fetuses and young children. The harms include delays in physical and mental development like the puberty in girls, lower IQ levels, shortened attention spans, and increased behavioral problems. If lead enters the bloodstream, it leads to adverse effects on the central nervous system, the cardiovascular system, kidneys, and the immune system. In the human body, lead inhibits porphobilinogen synthase and preventing both porphobilinogen formation and the incorporation of iron into protoporphyrin IX, the final step in heme synthesis. This causes ineffective heme synthesis and subsequent microcytic anemia. As lead can affect our health in so many ways, it is worth for investigation of the amount of lead in oyster.

Cadmium[7]

Cadmium and several cadmium-containing compounds are known as carcinogens and can induce many types of cancer. Cadmium toxicity may be carried into the body by zinc binding proteins; in particular, proteins that contain zinc finger protein structures. There have been notable instances of toxicity as the result of long-term exposure to cadmium in contaminated food and water -- developed Itai-itai disease and renal abnormalities, including proteinuria.

Consuming food or drinking water with very high levels of cadmium severely irritates the stomach, leading to vomiting and diarrhea. As Cadmium can affect our health in so many ways, it is worth for investigation of the amount of cadmium in oyster.

4.2.3 Apparatus and chemicals:

1. Tissue paper
2. Electronic balance
3. Blender
4. Boiling tubes
5. Micropipettes
6. Whatman No.42 filter paper
7. Heater
8. Atomic absorption spectroscopy
9. Computer with software
10. 69% nitric acid

4.2.4 Reason for choosing oysters from China and USA.

Oysters from China and USA were chosen as oysters from China and USA are commonly sold in supermarkets; the public can easily eat them. Therefore, we would like to compare the heavy metal and bacteria content of them with oysters from LFS.

4.2.5 Precaution

- Prevent contamination of the oysters sample as it may affect the heavy metals content in the oyster and the result may be affected
- The temperature in step 5 should not be too high because heavy metals will evaporate in high temperature

4.2.6 Assumption

- Assume all the heavy metals in the samples in step9 is evaporated

4.2.7 Procedures for investigating the amount of heavy metals

1. The oyster samples bought from LFS were blotted dry for 5 minutes.
2. Their weights of the oyster were obtained using electronic balance and recorded in a table.
3. The oyster samples were homogenized separately.
4. 1 g of homogenized sample was put separately into a boiling tube.
5. 10 ml of 69% nitric acid was added into each boiling tube and heat up to 130℃ for 3 hours for digestion.
6. The digested solutions were cooled down and filter through Whatman No.42 filter paper.
7. The atomic absorption spectroscopy (AAS) was calibrated.
8. A standard curve of Cadmium (Cd) was set.
9. The samples were run in the AAS to test the concentration of Cd and the concentration of metal in the samples can be determined through the standard curve plotted.
10. Steps 7 - 9 were repeated to investigate the concentration of Lead (Pb).

sample was put into a boiling tube

pipette solution into AAS

Atomic Absorption Spectroscopy
"Flame On"

Atomic Absorption Spectroscopy
Monitoring of Results

4.3 Experiment for investigate the amount of bacteria

4.3.1 The principles and design of the experiments

Oysters are filter-feeders drawing water in over their gills through the beating of cilia. Suspended food plankton and particles as well as bacteria are trapped in the mucus of a gill, and from there are transported to the mouth, where they are eaten. By investigating the amount of bacteria in oyster, the degree of domestic pollution in water of LFS can be studied.

In this experiment, oyster samples were ground and extracts were spreaded onto agar plates with LB booth. The LB booth and incubator were used to provide nutrients and optimum environment for the growth of bacteria. After the incubation, bacterial colonies were observed, and the more the number of bacterial colonies found in the agar plates, the higher the pollution will be and vice versa.

Therefore, the experiment leads us know the degree of the marine pollution problem caused by domestic waste and understanding the degree of cleanness of water in LFS.

4.3.2 Apparatus and solution

1. Tissue paper
2. Alcohol
3. Measuring cylinders
4. Match
5. Blender
6. Stop watch
7. Incubator
8. Spread rod
9. Bunsen burner
10. Micropipettes and tips(Sterilized by autoclave)
11. Centrifuge
12. Agar plates (Sterilized by autoclave)
13. centrifuge tubes (Sterilized by autoclave)
14. Sterilized distilled water
15. Electronic balance

4.3.3 Precaution

- Wearing mask and gloves during step 11 as to prevent contamination of the plates
- Place the plates in the incubator upsides down to prevent the water drop into the plates

4.3.4 Assumption

- Assume all the colonies is from the bacteria in oysters
- Assume the bacteria is distributed evenly in the samples

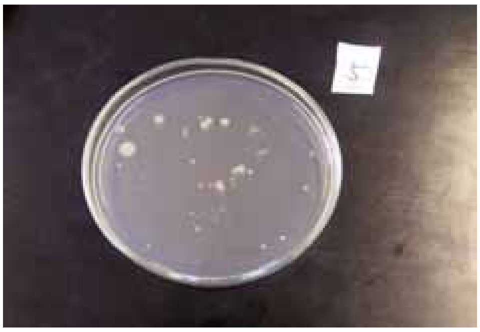
4.3.5 Procedures for investigating the amount of bacteria

1. 3 bottom laying oysters, 6 raft culture oysters from LFS (Hong Kong), 3 oysters from mainland China and 3 oysters from USA were used.
2. The oyster samples were blotted dry for 5 minutes.
3. Their weights of the oyster were obtained using electronic balance and recorded in a table.
4. An oyster from USA was put into a measuring cylinder and sterilized distilled water was added to 100 ml.
5. The oyster and distilled water in the cylinder were poured into a blender and blend/homogenized for one minute.
6. 1 ml of the homogenized sample was transfer into a sterilized centrifuge tube by a micropipette for act as stock in the fridge.
7. Another 1 ml of the homogenized sample was extracted to a new centrifuge tube and then 0.5 ml distilled water was added to it and centrifuge at 5000 revolutions per minute for one minute.
8. 0.1 ml of the supernatant was extracted from the centrifuged mixture and then transfer into another centrifugal tube. 0.9 ml of distilled water was added to the

centrifugal tube containing 0.1 ml supernatant so that the solution was diluted to 10 times and labeled as solution A.

9. 0.1 ml of the supernatant was extracted from solution A and 0.9 ml of distilled water was added to the 0.1 ml supernatant to dilute solution A to 10 times.
10. Followed the same dilution pattern till solution A was diluted to 1000 times.
11. 0.2 ml of the diluted mixture with 1000 dilution factor was introduced to a clean agar plate and spread by a spreader.
12. The plate was then incubated at 37℃ for 15 hours.
13. Steps 5-12 were repeated for other oyster samples.
14. After 15 hours, the number of bacterial colonies was counted for each agar plate.
15. The results were recorded in another table and compared.

Pipette sample solution



Incubated agar plate

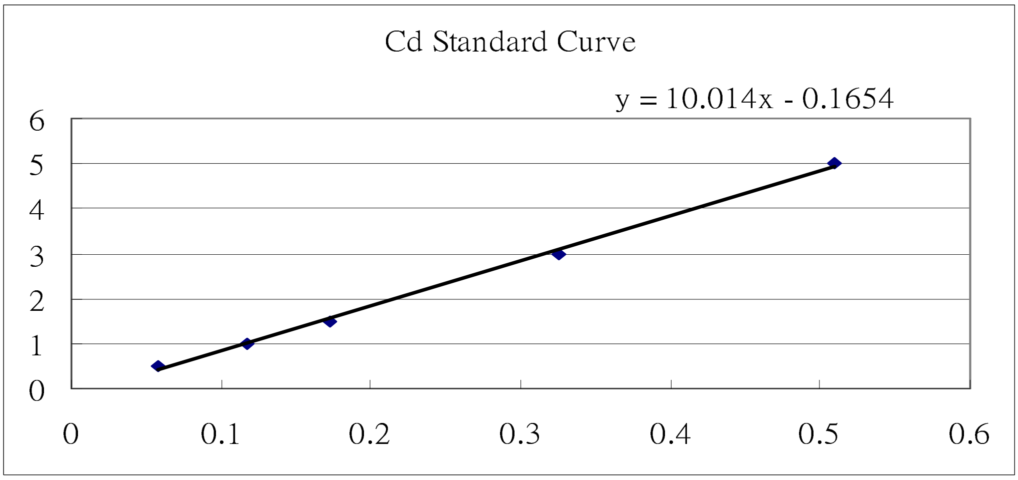
4.4 Results and Analysis

4.4.1 Results and Analysis of experiment for heavy metal

By serial dilution of standard cadmium solution and lead solution, several cadmium and lead solution with known concentration were prepared. The absorbencies of these known or standard solutions were measure and standard curves of cadmium and lead were drawn. Equations were derived from the standard curves for calculation of the heavy metals concentration in the samples. (Notes: in order to make the absorbance fall in the range of the standard curve, proper dilution of some samples were done)

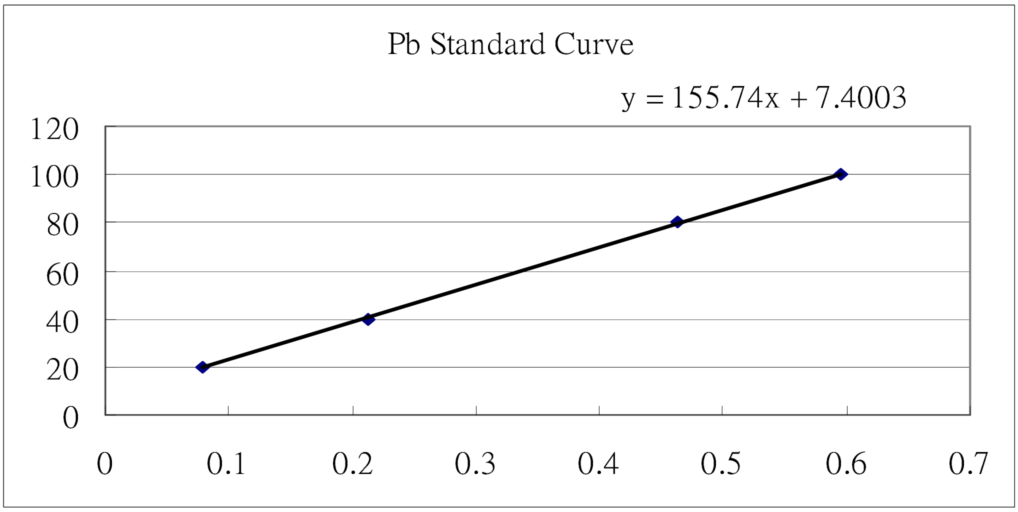
Standard curve calibration of cadmium

Concentration of Cd (ppb)	0.5	1	1.5	3	5
Absorbance	0.058	0.117	0.172	0.325	0.509



Standard curve calibration of Lead

Concentration of Pd (ppb)	20	40	80	100
Absorbance	0.079	0.213	0.463	0.596



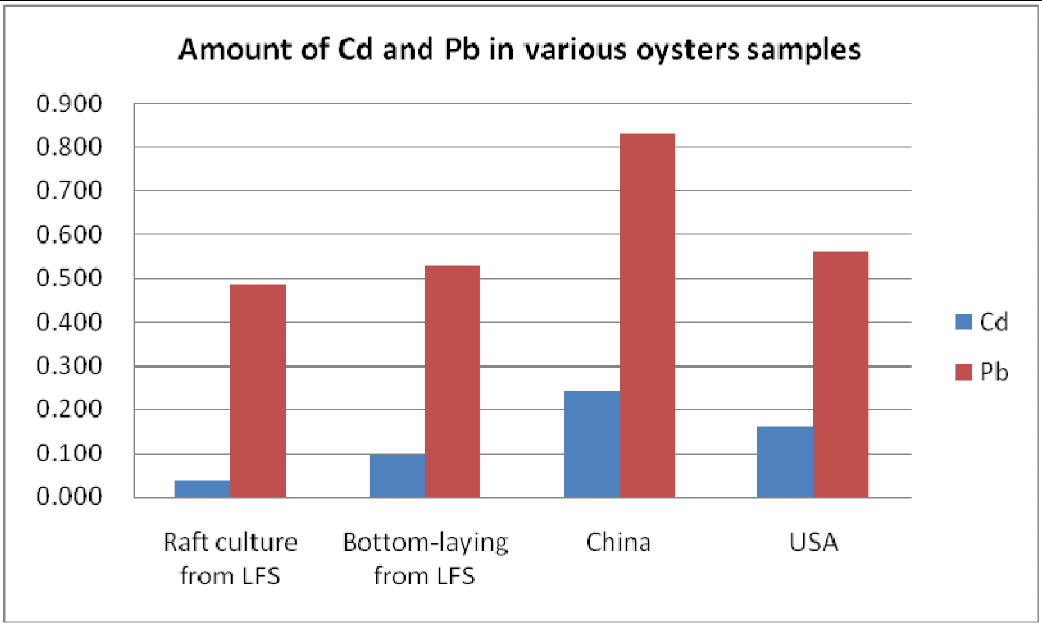
With reference to the table on next page, by substituting the value of the absorbance of the samples into the x of the equation above, the concentration in ppb (conc. *) of heavy metal in different samples was found. Then use the following formula to calculate the amount of heavy metal per unit mass of samples in ppm (conc. **).

$$\frac{\text{Concentration (ppb)} * 0.05}{\text{Mass of sample (g)}}$$

Finally, take the average of the concentration in ppm of heavy metal. The result is summarized by the following bar chart.

A table summarizes the raw data of absorbance of AAS and the calculated concentration of Cd and Pb in various oyster samples

	Cadmium				Lead			
	Abs.	Conc. * (ppb)	Conc. ** (ppm)	Average (ppm)	Abs.	Conc. * (ppb)	Conc. ** (ppm)	Average (ppm)
Raft culture	0.025	0.085	0.004		0.027	11.605	0.553	
	0.027	0.105	0.005		0.017	10.048	0.493	
	0.164	1.477	0.070		0.013	9.425	0.471	
	0.235	2.188	0.107		0.019	10.359	0.513	
	0.023	0.065	0.003	0.038	0.004	8.023	0.393	0.485
Bottom-laying	0.110	0.936	0.047		0.004	8.023	0.401	
	0.170	1.537	0.077		0.005	8.179	0.409	
	0.434	4.181	0.209		0.011	9.113	0.456	
	0.276	2.598	0.130		0.008	8.646	0.432	
	0.061	0.445	0.022	0.097	0.072	18.614	0.931	0.526
China	0.371	3.550	0.166		0.028	11.761	0.600	
	0.937	9.218	0.470		0.022	10.827	0.521	
	0.573	5.573	0.268		0.113	24.999	1.168	
	0.337	3.209	0.165		0.076	19.237	0.992	
	0.325	3.089	0.161		0.086	20.794	1.083	
	0.404	3.880	0.204	0.239	0.027	11.605	0.611	0.829
USA	0.342	3.259	0.163		0.031	12.228	0.611	
	0.376	3.600	0.180		0.051	15.343	0.767	
	0.162	1.457	0.073		0.020	10.515	0.526	
	0.400	3.840	0.192		0.003	7.868	0.393	
	0.383	3.670	0.183		0.013	9.425	0.471	
	0.342	3.259	0.163	0.159	0.028	11.761	0.588	0.559



Comparing the oyster samples from China, USA, bottom laying and raft culture oysters from LFS; the raft culture oysters in LFS have the least amount of heavy metal, followed by oysters from USA and bottom laying oysters in LFS, while oysters from China have the highest amount of heavy metal which is nearly double the amount of heavy metal in oysters from China.

4.4.2 Results and Analysis of bacterial culture

The tables below show the number of bacterial colonies in different oyster samples. It was found that oysters from USA contained the least amount of bacteria and oysters from LFS had the largest amount of bacteria. The following table summarizes the number of bacterial colonies in different oyster samples.

	Number of colonies per gram of oyster			
Type of oyster	Sample 1	Sample 2	Sample 3	Average
Bottom-laying from LFS	**107,175**	**107,015**	**120,095**	**111,428**
Raft culture from LFS	**75,510**	**79,160**	**81,520**	**78,730**
USA	**8,110**	**6,590**	**6,870**	**7,190**
China	**9,860**	**10,150**	**17,520**	**12,510**

4.5 Discussion of the experiments

4.5.1 Errors and Improvements of the experiment of heavy metal

For a fair test, only one manipulate variable will be varied. However, in this experiment, two variables including the sources of oyster and the sizes of oyster were varied. With reference to Cheung 1992, the experimental results will be affected by the difference in size of oysters' samples. It is found that smaller-sized oysters have a higher heavy metal concentration than larger oysters as the metabolism of smaller oysters is higher8.

To minimize the errors, oysters with similar size should be used. However, it is very difficult for us to buy similar size of oysters and ensures that their weigh are similar. That is an intrinsic error of this experiment and we hope can improve it by buying more oyster and select oysters with similar size in future studies.

Errors may also occur owing to the possible problems occurring with atomic absorption spectrometer included:

- The water in the atomic absorption spectrometer may not be cold enough.
- The amount of gas provided is not enough.
- The light emitted by the bulb in the spectrometer may not be accurate enough.
- The graphite rod may not target hole accurately.

As the errors are caused by the machine, the only step that can be taken is to repeat the experiment and take the average of the results to minimize the effect of the errors occurred.

4.5.2 Errors and Improvements of bacterial culture

Oysters are not freshly prepared so time may be provided for bacteria in oysters to reproduce and increase their population causing more colonies appearing on the agar plates

In order to minimize the problem, the fresh oysters should be stored in a thermo flask with -80^{o}C to minimize the reproduction and metabolism of bacteria and the experiment should also be done as soon as possible.

4.5.3 Discussion of the results

From the experimental results, it shows that the degree of domestic waste pollution of LFS is more serious than that of oysters from USA and China whereas the degree of industrial waste pollution of oysters from USA and China is more serious than that of LFS.

By compare the two methods of oyster culture (bottom-laying and raft culture), it shows that the domestic pollution in the water near the seabed in LFS is more serious than that in the surface water in LFS. This can explain why raft culture method is widely applied in oyster production in LFS.

From the results it also shows that all the oyster sample except China samples of our experiments contain less cadmium as required by the edible standard (2 ppm) proposed by the Food Adulteration (Metallic Contamination) Regulations Hong Kong.

For the amount of lead, the entire sample contain less lead than the standard (25 ppm) proposed by the Whole Health organization[9].

The results deviate from the finding of HK Baptist University in 2007 many due to different sampling times or seasonal change[10]. Also, from the interview of an oyster farmer - Mr. Mok, who works as an oyster farmer for more than 30 years, he stated that there were seasonal and occasional change of the water quality that would cause a wide death of oyster such as in 1976 and 2007.

According to the weather report of Hong Kong Observatory in 2007, the year 2007 in Hong Kong was drier than usual. The annual rainfall of 1706.9 millimeters was about 23 per cent below normal[11]. On the other hand, the year 2008 was wetter than usual. The annual rainfall of 3066.2 millimeters was about 29 percent above normal[12]. According to the information of Automatic Weather Station in LFS the Daily Total Rainfall (mm) at LFS in 2007 is 1395.5mm and that in 2008 is 2408mm[13.]

The reports support that the rainfall affect the water quality. Recently, City University of Hong Kong had found that the concentration of cadmium in oysters in Hong Kong is higher than the standard[14]. Their result is not mach with ours. However, according to the Hong Kong Observatory; we found that there a trace of rainfall was recorded during the January 2009, making it the driest January since 1994. Also, only 1.1 millimeters of rainfall was recorded in February 2009, much below the normal figure of 52.3 millimeters[15.] That suggest the results i.e. the water quality may affected by rainfall.

The experiment results prove that the water quality of LFS is not as worse as most of citizens thought. In fact, the industrial pollution in LFS may be less serious than the oysters' farm where oysters from USA and China.

The only thing that should be worried is that the domestic pollution of LFS is the most serious in the three area of oysters' cultivation. Besides, according to the report from environment protection department in 2007, the water quality in LFS is the poorest in Hong Kong owing to it lower amount of dissolved oxygen and high amount of Pathogenic E. coli[16] i.e. domestic or agricultural pollutants. It can be said that the sea water in LFS is slightly poor as the result of our experiment shown that the amount bacteria in oysters from LFS cultivated by bottom-laying method is slightly higher than the standard of one hundred thousand units proposed by America department[17]. While the other three kinds of sample including raft-cultivated oysters contain bacteria content lower than standard.

It can be said that the quality of water near the sea bed of LFS is poor while that near the water level is acceptable as sediment and pollutants always settled down at seabed.

However, the number of bacteria found in our experiment is much fewer than the results (number of bacteria range from 3,500,000 to 10,000,000 unit per gram of oyster) of Hong Kong Polytechnic University[18]. It may be explained by an inappropriate step in our experiment that is centrifuge the sample may cause some bacteria to settle at the bottom and fail to be used in spreading of sample on the agar plate.

By the way, the experiment is not meaningless as it can be concluded that the domestic pollution in LFS is the most serious among the three area and the safety of not being harm by the bacteria, oyster consumers are reminded not to eat raw LFS oyster and the oyster should be thoroughly cook before eating.

If people consume the oysters which contain many bacteria they may be harmed by the bacteria. Therefore, another experiment was carried out to see how long would take to kill the bacteria.

4.6 Further investigation

Beside investigate the amount of bacteria in oyster, how long it needed to cook the oysters from LFS before all the bacteria in the oyster were killed was also studied in order to give health advice to oyster customers and house-wives.

4.6.1 Apparatus and solution

1. Stop watch
2. Micropipettes
3. Centrifuge tubes
4. Bunsen burner
5. Beaker
6. Test tubes
7. Agar plates
8. Diluted raft culture oyster solution in the experiment of investigating the amount of bacteria (the blended mixture)
9. Spreader
10. Spread rod
11. Incubator
12. Sterilized distilled water

4.6.2 Procedures

1. 1ml of the oyster mixture and 1ml of distilled water were added into a test tube.
2. 1ml of the solution in test tube was transferred into centrifuge tube
3. The centrifuge tube was centrifuged with 5000 revolution for 1 minute.
4. 0.5ml of the supernatant and 0.5ml of distilled water was added into a test tube.
5. A boiled water bath was prepared.
6. The solution was boiled for 20s.
7. The solution was cooled down.
8. 1ml of the solution was transferred to an agar plate and spread.
9. The steps 1-8 were repeated to change the time that the solution were boiled (40s, 1 minute, 2 minute, 3 minute, 4 minute, 5 minute, 6 minute, 7 minute, 8 minute).
10. The agar plates were put into incubator for 15 hours at 37℃.
11. The number of colonies was counted.

4.6.3 Result and analysis

Time (minute)	1/3	2/3	1	2	3	4	5	6	7	8
No. of bacterial colonies in sample 1	3	2	0	0	0	0	0	0	0	0
No. of bacterial colonies in sample 2	4	1	0	0	0	0	0	0	0	0
No. of bacterial colonies in sample 3	2	1	1	0	0	0	0	0	0	0
Average no. of bacteria colonies	3.00	1.33	0.33	0	0	0	0	0	0	0

It shows that no bacterial colonies were found after 1 minute cooking of the oysters. Therefore, it is suggested that the oyster in LFS should be cooked for more that 1 minute before consumption.

4.7 Conclusion of the experiments

The degree of industrial waste pollution of LFS is the least serious compared with that of oyster farms in USA and China while the degree of domestic waste pollution of LFS is the most serious compared with that of oyster farms in USA and China and the water quality of water near the seabed is poor.

Therefore, some actions should be taken to minimize the domestic pollution in LFS for cultivation of clearer oysters so that the oyster industry in LFS can be preserved.

5. Further actions for water monitoring in LFS and oyster industry in Lau Fau Shan

During the time that we were doing our project, we found that LFS is a very special place and we also thought that it is an intangible heritage too. Therefore, we would like to do more to protect the oyster industry in LFS.

According to our survey (appendix 3), one of the reasons why the oyster industry is declining is that the citizens lack the knowledge and understanding about oyster industry. In order to increase the understanding, interest and awareness of Hong Kong people about the oysters industry in LFS, as well as to highlight the needs to care for and cherish this unique, intangible heritage, the following program or plan are designed and launched.

5.1 Produce teaching package of oyster production in LFS for primary or secondary students.

At the present moment, three topics include the history of LFS oyster production, the life cycle and habitat of oyster – why LFS/ Deep Bay is a suitable place for oyster farming, and compare the different methods of oyster farming in LFS. Trial lessons or talks are under arrangement with our sister primary school and hopefully, the lessons or talks could be conducted at the post-exam activities of the second term of2008 -2009.

5.2 Produce video clips about oyster industry in LFS and put them on YouTube.

A video clip about the oyster industry and an experiment that last for about 2 minutes was prepared and already put on the YouTube. The link is

http://www.youtube.com/watch?v=7Shj-wIKQ44&translated=1

5.3 Arrange Eco-tours

To provide a firsthand experiment of the oyster industry in LFS and the culture of Tsim Bei Tsui, Pak Nai and LFS, three eco-tours are arranging to the parents of our school Parent Teacher Association in the beginning of May 2009, to the students of our sister primary schools in the end of June and to the senior citizen of Elderly Academy in the mid of July.

The following is a tentative plan for a 4 hours tour:

Tsim Bei Tsui (bird-watching and gei wai pond) ⟶ LFS (having seafood meal & know more about the oyster industry) ⟶ Pak Nai (enjoying the sunset)

5.4 Send letters to various stakeholders (refer to appendix 5)

To make conservation of an intangible heritage such as oyster industry of LFS success, stakeholders from various sectors have to play their roles actively and make their contribution, for example:

1. Government – to design policies, road as well as town planning and other infrastructures,
2. Antiquities Advisory Board – to formulate relevant policies and laws to protect the heritage.
3. Agriculture, Fisheries and Conservation and Advisory Council on the Environment – to take care of the nature and monitor the water quality of Deep Bay.
4. Media – to publicize the information about oyster industry of LFS, treasure the beauty the LFS.

5. Tourism board or travel agents – to arrange eco-tour and enhance the economy of the LFS.
6. Education Bureau – to put the conservation of LFS oyster industry and conservation of intangible heritage into the curriculum of NSS liberal study.
7. Chairman of Intangible Cultural Heritage Advisory Committee

5.5 Share our passion and knowledge about oyster industry in LFS.

We have tried to explore the possibility of sharing our passion and knowledge of oyster industry in LFS to various audience for example we had present our project to members of Rotary Club at 25 Feb, 2009 and plan to hold talks to students of our sister school on June 2009.

6. Conclusion

By using oyster as a biological indicator, it shows the amount of cadmium and lead range from 0.038 to 0.097 and 0.485 to 0.526 respectively, moreover the number of bacteria per gram of oyster range from 78,730 to 111,428. It is hard to say it is serious polluted or not. As it is definitely pollute by industrial and domestic pollutants, however, the pollution level of LFS oyster still within the edible standard proposed by the Food Adulteration (Metallic Contamination) Regulations Hong Kong[4].

We thought that the water pollution in LFS is not very serious but it may become very serious if nobody takes a step to improve and reduce the pollution problem on Deep Bay.

Indeed, LFS is a very unique place in Hong Kong. Many Hong Kong people would like to protect the oyster industry (refer to appendix 3). Therefore, we have done actions in the conservation of oyster industry in LFS. We hope that our actions can draw people attention to the intangible heritage in LFS and being companies with us to protect the heritage and let the water quality of LFS becomes better.

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