WATER QUALITY AND SHELLFISH RELATED GASTROINTESTINAL DISEASE CASES IN KOTA BHARU

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DEDICATION

I dedicate this research work to my mother *Mek Kepiat a/p Chau Chan* and my late father *Eh Rak s/o Cha Bok* for bringing me up, guiding me in the right way and equipping me with knowledge and education.

To my beloved wife *Mek Keperum a/p Eh Pelian* for the sacrifices she made for me and

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Thanks for your prayers, attention and guidance at every step of my life…

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ABSTRACT

Shellfish or to be specific, the family of freshwater mussels and the species known as *Corbicula fluminea* or in the local dialect recognized as "etak" is one of the food peculiar to Kelantan. "Etak" is a filter feeder. Therefore, a lot of pollutants could be accumulated in the "etak's" tissues including pathogenic bacteria which are mainly contributed by improperly treated sewage discharged into the river. Besides direct contamination from the habitats, *C. fluminea* may also be contaminated during preparation and sale. The objective of this study is to identify the correlation between water quality, shellfish tissue contaminations and the cases of gastrointestinal diseases in Kota Bharu as well as to study the stage of bacteria contamination in the shellfish preparation cycle and to compare the bacteria concentration in river bed and selling points of shellfish. The methodology in this study involves water quality sampling and shellfish sampling, with lab analysis being done by accredited lab and secondary data was obtained from Department of Health, Kota Bharu regarding the cases of gastrointestinal diseases in Kota Bharu. There are two stages of shellfish sampling, the first stage is raw "etak" from the river bed and the second stage is process "etak". Three sampling stations were chosen. Shellfish tissues were analyzed by bacteriology lab of Fisheries Research Institute located in Batu Maung, Penang and water quality analysis was performed by accredited laboratory. During the study, bacterial contamination in raw *C. fluminea* or "etak" was found to be high and exceeded the standard especially for *Escherichia coli* and Fecal coliform. Raw *C. fluminea* was found to be unsafe for consumption. Bacterial contamination in processed *C. fluminea* or "etak" was also found to be high but lesser in concentration as compared to raw one. Bacteria contamination occurred mainly in the river bed although contamination during the selling process is also possible. High concentrations of bacteria in the river result in high concentrations of bacteria in "etak" tissues and these could possibly lead to high gastrointestinal diseases in Kelantan, particularly in Kota Bharu.

ABSTRAK

Etak merupakan sejenis hidupan air tawar yang mempunyai dua belah cengkerang dan hidup di dasar sungai, dimana nama saintifiknya ialah *Corbicula fluminea*. Kaedah pemakanan etak ialah dengan cara penapisan iaitu ia akan membuka cengkerangnya untuk membolehkan makanan masuk ke dalam tisu. Dengan kaedah ini semua benda termasuk pencemar yang terdiri dari bakteria yang disumbangkan oleh sisa kumbahan yang masuk ke dalam sungai tanpa dirawat juga akan memasuki dan berkumpul dalam tisu etak. Ini akan mengakibatkan penyakit bawaan makanan dikalangan penggemar etak. Objektif kajian ini ialah untuk mengenalpasti hubungan diantara kualiti air, tisu etak dan penyakit bawaan makanan di Kota Bharu, mengenalpasti peringkat kemasukan bacteria dalam etak dan membuat perbandingan kepekatan bakteria dalam etak mentah dan etak yang sudah diproses. Kaedah yang digunakan untuk menjalankan kajian ini ialah dengan mendapatkan data penyakit bawaan makan daripada Jabatan Kesihatan Daerah Kota Bharu. Data kualiti air sungai diperolehi daripada Jabatan Alam Sekitar disamping percontohan dibuat sendiri untuk menilai kepekatan bakteria *E. coli* di stesen-stesen yang dibuat kajian dan analisa makmal dibuat oleh makmal yang bertauliah. Sementara percontohan etak dibuat di tiga stesen yang telah dikenalpasti di Sungai Ketereh dan dihantar ke Institut Penyelidikan Perikanan untuk penganalisaan. Keputusan yang diperolehi ialah kepekatan bakteria di dalam etak mentah adalah tinggi melebihi piawaian dan tidak selamat dimakan mentah. Sementara kandungan bakteria di dalam etak yang telah diproses juga adalah tinggi tetapi lebih rendah jika dibandingkan dengan etak mentah, dimana kepekatanya melebihi daripada piawaian dan tidak selamat dimakan. Bakteria sebahagian besarnya memasuki tisu etak melalui habitat yang telah dicemari dan besar kemungkinan semasa penjualan. Kandungan bakteria yang tinggi dalam air sungai akan menyebabkan kandungan yang tinggi dalam tisu “etak” dan akhirnya mungkin mengakibatkan peningkatan kes penyakit bawaan makanan di Kelantan terutama di Kota Bharu.

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Shellfish, or specifically in this study freshwater mussels and species identified as *Corbicula fluminea,* is one of the faunal filter feeders. *C. fluminea,* known as "etak" in Kelantan dialect, can be found living in the sandy bottom of Kelantan's main rivers and other rivers in Kelantan including tributaries (Figure 1.1). This species brings about the local economic activities, such as income generation by trading. "Etak" is one of the most popular foods for Kelantan people; they consumed "etak" very long time ago and treated it as a snack (Figure 1.2). River pollution and the preparation process of "etak" are two major factors which contribute to bacterial contaminations in "etak". Thus, it is suspected as the cause of gastroenteritis diseases among consumers. In Kelantan, it is common to find people build houses on the riverbanks. This has led to the sewage and sullage being discharged directly into the river. On top of that, floating houses and floating toilets can still be seen along Kelantan River and some of the tributaries. There is no proper sewage management for commercial areas in major towns in Kelantan including Kota Bharu Municipality areas. Wastewater and sullage from these commercial areas is also directly discharged into Kelantan River and other rivers. Preparation of *C. fluminea* or "etak" only involves marinating with spices and then after that cooking with smoke or heating under the sun for several minutes before making it ready for consumption.

Therefore, “etak” is considered as half cooked food which is not very safe for consumption.

Figure 1.1 : Fresh water mussels *C. fluminea* or “etak”

Figure 1.2 : “Etak” seller can be found by the road side in Kota Bharu Municipal area

1.2 Objectives

1.2.1 To identify the correlation between water quality, shellfish tissue contaminations and the cases of gastrointestinal diseases in Kota Bharu;

1.2.2 To study the stage of bacteria contamination in the shellfish preparation cycle; and

1.2.3 To compare the bacteria concentration in river bed and selling points of shellfish.

1.3 Scope and limitations of study

1.3.1 This study will concentrate on fresh water mussels namely *C. fluminea* species or "etak"; and

1.3.2 The study area will include on Kota Bharu District and Kota Bharu Municipal Area.

1.4 Statement of Need

Fecal contamination from raw sewage harms shellfish beds. Untreated sewage contains micro-organisms that cause disease directly through the consumption of contaminated shellfish, and indirectly through contact in contaminated water. Shellfish contamination very much depends on the habitat conditions. The quality of river will form the quality of shellfish and the shellfish will eventually cause the food borne diseases such as gastroenteritis to the consumers.

The deterioration of river water quality in Kota Bharu District river is strongly correlated to the contamination of shellfish, eventually causing gastrointestinal diseases to the consumers. Bacteria can contaminate shellfish tissues at the bed or habitat which is river and also during the preparation and selling process. Final hypothesis shows that the bacteria concentration in shellfish at the river bed is found to be higher than at the selling points.

Since *C. fluminea* or "etak" has become special snack for the Kelantanese, therefore only people in this state know how to prepare and consume it. It is extremely necessary to conduct a special study to determine the pollution contaminations to avoid gastrointestinal disease among the people. There are about 100 harvesters in Kelantan and about 45 sellers situated at Kota Bharu, Tumpat, Pasir Mas and Kuala Krai districts. About two tonnes/harvester/month of "etak" being harvested with an income of approximately RM 2,400/harvester/month. The price of raw "etak" is about RM 1.20/kg and the processed "etak" about RM 2.40/kg, which means that the sellers will get double the income of harvesters. There are total 200 tonnes/month of "etak" being sold and consumed by the Kelantanese. This amount when divided by the total populations of Kelantan for year 2006 which is about 1.5 million, makes the Kelantanese consumption of "etak" about 5 gram/person/day on average. This is considered to be a big amount being penetrated in to the bodies if adverse contaminants are found in the "etak" tissues. Bacteria can enter "etak's" tissue in a number of ways, the most popular one is entering from the river where its habitat is, and the second is through the preparation method of shellfish and depends on whether it is being cooked, half cooked or consumed raw.

The way adopted for preparing "etak" is also not very hygienic as smoke is used to cook it which only makes it half cooked and is not safe for the consumption. Bacteria or pathogens might get contaminated with "etak" during the selling process as well, because the selling area some times is polluted especially at bus stand and road side. Besides that, the sellers themselves are not administered by the Ministry of Health or Department of

Health. There are no routine health check-ups of the sellers to make sure they are free from illness or diseases that can contaminate the “etak”.

The other important factor involves the quality of the river which is considered as “etak” habitat. Most of the river water gets polluted by bacteria *Escherichia coli* and fecal coliforms. Direct discharge of sewage and sullage, run off from the feed stalk, floating houses, floating toilet, discharge from wet market, discharge from restaurant, discharge from commercial area and discharge from urban run-off are the sources of river pollution in terms of bacteria.