Determination of Heavy Metal in Pelagic Fish, Demersal Fish and Shellfish

Noor Zuhartini. Md Muslim, and Hafizah. Saim

Abstract—This study aimed to determine the amount of heavy metals (Cd and Pb) in edible part of selected pelagic fish, demersal fish and shellfish that available in Malaysian local market. Pelagic fish refer to the fish that live near the surface or in the water column of coastal, ocean and lake waters while demersal fish is the fish that live on or near the bottom of the sea or lakes. Shellfish refer to mollusks and crustaceans. The block digestion method was used for the mineralization of these samples prior to the quantitative determination by graphite furnace atomic absorption spectrometry. As a result of this determination, it was found that the amount of heavy metals in pelagic fish was the lowest while the highest in shellfish. However the amount of heavy metals in these studied fish and shellfish were lower than guidelines and regulations set by the Malaysian Food Act and Food Regulations 1983.

Keywords—Demersal fish, heavy metals, pelagic fish, shellfish

I. INTRODUCTION

Fish is widely consumed in many parts of the world by humans because it has low saturated fat, high protein content and also contains omega fatty acids known to support good health [1]. Fish also contains advantageous fatty acid profile, resulting from the consistent content of essential polyunsaturated fatty acids, such as eicosapentaenoic and docosahexaenoic acid [2]. Nutritionists also consider fish to be an important source of high-quality proteins, minerals, vitamin D and essential fatty acids such as omega 3 [3] and is recommended by the National Nutrition and Health Program (PNNS) to consume fish at least twice a week [4].

Meanwhile, shellfish such as scallops, shrimps, crab, and other crustaceans and mollusk contain quite high concentrations of carotenoids [5], low levels of fat and essential amino acids [6] and also possess a relatively higher content of vitamins and minerals [7]. For an instance, bivalve mollusks have much higher concentration of vitamins such as folate, and cobalamin, and minerals such as magnesium, phosphorus, iron, selenium and iodine [7].

Today it is generally accepted that fish and shellfish is important in a healthy and balanced omnivorous human diet [8]. However, the evaluation of risks and benefits of the consumption of these products has been particularly controversial. Even though, fish and shellfish are very important human foods, but they exposed to chemicals in polluted and contaminated waters [9]. Toxicologists tend to regard fish and shellfish as a major vector for toxic substances of metal trace elements and persistent organic pollutants [3]. The bioaccumulation of heavy metals by fish and shellfish make these food items can be rich source of metal [10]. The interactions of heavy metals with usual elements form diet have an important role in acute and chronic toxicity [11]. The most important forms of aquatic pollution are heavy metals since they accumulate in aquatic organisms and may transfer to humans in the food chain [12].

Make thing worst, heavy metals are non-biodegradable inorganic chemicals, so it cannot be metabolized and will not break down into harmless forms. For an example, the elimination rate of cadmium is slow (an average 2.00 mg/day) and prolonged excessive cadmium in ingestion will cause cadmium accumulation inside the human body [13]. By that, population can be contaminated with heavy metals by ingestion these contaminated fish and shellfish. Thus, exposure to heavy metals is an important problem of environmental toxicology since most of these metals are toxic to humans, animals and plants.

Because of greater awareness of this problem, the research has been interested in determining the heavy metals in marine fish (pelagic and demersal) and shellfish. Even if the water around the study area are not yet polluted, still we need to find the existing levels of heavy metals in commercial fish and shellfish in order to know whether these metals concentrations are within the safety limits that had been set by the country or otherwise. For the above reasons, the concentration of heavy metals cadmium (Cd) and lead (Pb) in common species of fish and shellfish will be determined in this study. These elements will determine in samples of edible muscle tissue of each species.

II. MATERIAL AND METHODS

Samples (fish and shellfish) were purchased from local markets in Kelantan, Malaysia. Since these samples were purchased raw, the samples were immediately placed into an ice compartment and brought to the laboratory for further analysis. In the laboratory, the edible portion of the samples was mixed, grind and remixed to obtain a single homogeneous composite sample of the product. For shellfish, only the soft content was grind. After that each samples was accurately
weighed to approximately 0.5 g directly into test tubes. Then it was digested with concentrated HNO₃ in low temperature for 1 hour and then fully digested at high temperature (140 °C) for 3 hours by using digital heating block digester. The digested samples will then diluted to 50 mL volume with double-distilled water. After filtration, the prepared sample was determined for Cd and Pb by using graphite furnace atomic absorption spectrophotometer (GF-AAS).

III. RESULT AND DISCUSSION

The amount of heavy metals (Cd and Pb) that were found in fish and shellfish were listed in Table 1.0. It was found that the amount of heavy metals in pelagic fish was the lowest while the highest in shellfish. However the amount of heavy metals in these studied fish and shellfish were lower than guidelines and regulations set by the Malaysian Food Act and Food Regulations 1983 [14]. The permissible limits set by Malaysian Food Act and Food Regulations 1983 for Cd is not over than 1 ug/g and Pb is not over than 2 ug/g.

<table>
<thead>
<tr>
<th>No.</th>
<th>Types</th>
<th>Local Name</th>
<th>English Name</th>
<th>Cd (ug/g)</th>
<th>Pb (ug/g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>D</td>
<td>Kikek</td>
<td>Ponyfish</td>
<td>0.130</td>
<td>0.019</td>
</tr>
<tr>
<td></td>
<td>D</td>
<td>Pari</td>
<td>Long-tailed butterfly ray</td>
<td>0.150</td>
<td>0.110</td>
</tr>
<tr>
<td>3</td>
<td>P</td>
<td>Cencaru</td>
<td>Hardtail scad</td>
<td>0.025</td>
<td>BDL</td>
</tr>
<tr>
<td>4</td>
<td>P</td>
<td>Selayang</td>
<td>Round scad</td>
<td>0.032</td>
<td>0.005</td>
</tr>
<tr>
<td>5</td>
<td>P</td>
<td>Kembung</td>
<td>Indian mackerel</td>
<td>0.041</td>
<td>0.004</td>
</tr>
<tr>
<td>6</td>
<td>P</td>
<td>Seler pucat</td>
<td>Yellowtail scad</td>
<td>0.031</td>
<td>BDL</td>
</tr>
<tr>
<td>7</td>
<td>M</td>
<td>Lala</td>
<td>Bay scallop</td>
<td>0.340</td>
<td>0.180</td>
</tr>
<tr>
<td>8</td>
<td>M</td>
<td>Sotong</td>
<td>Squid</td>
<td>0.870</td>
<td>0.006</td>
</tr>
<tr>
<td>9</td>
<td>C</td>
<td>Ketam</td>
<td>Crab</td>
<td>0.930</td>
<td>0.094</td>
</tr>
<tr>
<td>10</td>
<td>C</td>
<td>Udang</td>
<td>Prawn</td>
<td>0.380</td>
<td>BDL</td>
</tr>
</tbody>
</table>

D = Demersal fish, P = Pelagic fish, M = Molluscs, C = Crustaceans and BDL = Below detection limit.

REFERENCES


ACKNOWLEDGMENT

The authors are grateful to the financial support provided by the Universiti Sains Malaysia via Incentive Grant. Thanks are also to the staffs of analytical chemistry laboratory for the help extended during the work.