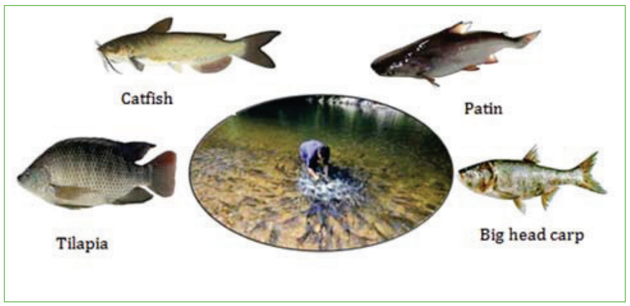
Nutritional value and potential of freshwater fish in rivers and mining pools of Malaysia

With the continuing depletion of marine fish resources we need to pay more attention to rivers, ponds and lakes as sources of fish for food.

By Babji A. S., Nur 'Aliah D., Nurul Nadia M.

Fish are a major source of protein for the Malaysian population. Proteins play numerous vital roles in the bodies of living organisms. They enter into the formation of body tissues such as muscles, skin, hair, cartilage, and ligaments. Proteins in the form of enzymes, hormones, antibodies and globulins catalyse, regulate, and protect the body through physiological activity. Proteins in the form of haemoglobin, myoglobin and various lipoproteins are responsible for the transport of oxygen and other vital substances within the body.

Because of their essential roles, proteins are a necessary part of our diet. Humans can become seriously ill if they do not eat enough suitable proteins.



The growing popularity of consuming fish in Malaysia has been noticeable in the past 10 years (Fisheries Dept., 2010). Consumers have become more aware of the benefits of eating fish and of consuming fish of high quality. However, marine fish resources are being depleted, resulting in ever-rising prices of seafood. Freshwater fish has been found to be a viable resource to meet the demand in the market. The Malaysian Fisheries Department, to increase the income of fish farmers, is now expanding the freshwater fish-rearing industry among agriculturists and fishermen (Karim, 1990). Malaysia is endowed with lavish flora and fauna providing its inhabitants with a unique source of balanced foods as well as medicinal products. Freshwater animals, fishes in particular, have long been associated with daily life in Malaysia (Fisheries Dept. 2010).

It has become increasingly important to look at our 'backyard' of rivers, mining pools and lakes for producing fish and other aquatic sources of food. Mining pools are irregularly shaped bodies of water, a consequence of Malaysia's huge tin-mining industry. Serving as water resource ponds to active mines, they are, however, left abandoned after the mine is exhausted. These pools have been, for decades, used for fish culture (Liong *et al*., 1988).

Patin (*Pangasius* sp.)

Catfish (*Clarias* sp.)

Because of the large number of freshwater bodies available, Malaysia has considerable growth potential for aquaculture, and the Malaysian Government has identified aquaculture as a priority industry for investment.

The major freshwater food fish species being produced in Malaysia are catfish (*Clarias sp*.), Tilapia (*Oreochromis niloticus*), Patin (*Pangasius sp*.), Javanese carp (*Puntius gonionotus*), common carp (*Cyprinus carpio*), big head carp (*Ctenopharyngodon idella*) and marble goby (*Oxyleotrix marmoratus*).

Aquaculture production in 2013 amounted to 260,773 tonnes, with major species being catfish, 28.4%, tilapia, 31.5% and patin, 11.2% (Malaysian Fisheries Institute, 2013). The desired production of fish is achieved by using formulated pellet feed with a protein content of 32–40% containing mainly fish meal, rice bran, and maize, fed at 3 to 5% of body weight.

Depending on the species of fish, both monoculture and polyculture are practiced. In most establishments of aquaculture, static water conditions with regular water exchange of

Nutritional content of freshwater fishes

Common name and species	Protein (%)	Total Lipid (%)	Total Saturated Fat (%)	Total PUFA (%)	EPA (%)	DHA (%)	Ca (mg)	Fe (mg)	Zn (mg)
Common carp *Cyprinus carpio*	17.83	5.60	1.08	1.43	0.24	0.11	41 1.	24	1.48
Tilapia *Oreochromis* spp.	20.80	1.70	0.77	0.48	0.01	0.11	10	0.56	0.33
Beef meat**	17.43	27.5	14-29	39-50	-	-	13	3.0	2.0
Lamb meat**	16.5	16.2-25.0	25-32	36-47	-	-	10	2.5	6.0
Pork**	15.50	25.5	12-16	41-51	-	-	8	5.0	6.0

PUFA, polyunsaturated fatty acid; EPA, eicosapentaenoic;DHA, docosahexaenoic acid.
*Retinol activity equivalent
** (Price & Schweigert 1971)

5–10% a day is a common management practice. To ensure optimal conditions, water quality is monitored regularly.

Freshwater fish nutritional content and protein quality

Freshwater fish have high protein content of 15–20%, which is a level comparable to that of beef, lamb and pork, but unlike beef, lamb and pork, most fish have a very low fat content ranging from 1–5%. The high protein content and low fat content mean that fish is a much healthier food than meat.

Fish is also a good source of calcium, phosphorus and iron, and vitamin B, particularly riboflavin and niacin (Tee *et al*., 989; Pomponi, 1999).

Proteins are large molecules made up of many small molecules of amino acids chemically bonded to each other. When we digest food, the proteins that we consume are broken down into smaller molecules for easy absorption and the smaller molecules such as amino acids are recombined in the body to make the specific proteins that the human body needs. The human body can also synthesize some amino acids but some others, known as essential amino acids must be obtained from food. Lysine is an essential amino acid required for a growth and development that humans have to obtain from food. It so happens that freshwater fish contains a high level of lysine and certain other essential amino acids, exceeding that found in other animal proteins such as milk and chicken eggs.

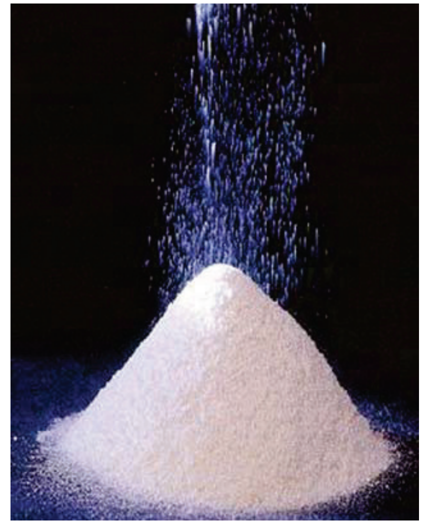
Foods of plant origin are rich in carbohydrates but poor in proteins, hence fish, rich in proteins and lysine but poor in carbohydrates, makes a good complement with rice in the Malaysian diet (Zanariah & Noor Rehan, 1988).

Bioactive peptides from freshwater fish protein

Peptides are proteins of relatively small molecular size that generally contain only 2–20 amino acid units in a chain. They are more absorbable through the intestine (by virtue of low molecular weights of less than 10 kDa) where they subsequently enter the circulatory system intact

Essential amino acid composition of food proteins

Amino acid	Percent of amino acid in protein			
	Chicken tissue	Egg	Fish (Clarias gariepinus)	Fish (Tilapia zilii)
Arginine	6.7	6.4	6.8	11.7
Cysteine	1.8	2.4	1.2	1.2
Isoleucine	4.1	8.0	5.2	5.0
Leucine	6.6	9.2	9.5	9.5
Lysine	7.5	7.2	10.6	10.4
Methionine	1.8	3.4	3.2	3.2
Phenylalanine	4.0	6.3	4.2	4.1
Threonine	4.0	4.9	4.8	4.8
Valine	6.7	7.3	5.3	5.18



Bioactive peptide powder

to exert various physiological effects. They may also produce local effects in the digestive tract. Food-derived bioactive peptides have been found to have a wide range of physiological functions including antihypertensive, antioxidative, opioid agonistic, immunomodulatory, antimicrobial, prebiotic, mineral binding, antithrombotic and hypocholesterolemic effects.

Bioactive peptides have been identified in a range of proteins including milk and muscle (e.g. beef, chicken, and fish muscle). Bioactive peptides from food proteins can be used as functional food ingredients, or nutraceuticals and pharmaceuticals to improve consumer health and prevent diseases (Joseph *et al*., 2011). With the increasing knowledge on the functional properties of peptides or fish protein hydrolysates, many researchers are now carrying out studies on the development and application of fish-derived functional foods, nutraceuticals and pharmaceuticals (Barrow and Shahidi, 2008; Toldra *et al*., 2012).

Antihypertensive peptides have attracted much attention due to their ability to prevent hypertension. They are capable of suppressing the elevation of blood pressure by inhibiting the catalytic action of a regulatory enzyme involved in the hypertension reaction (Li *et al*., 2004).

As for prevention or reduction of oxidation process, natural antioxidants, especially from food proteins, may have potential health benefits with little or no side effects, providing an alternative to the synthetic antioxidants (Bernardini *et al*., 2011). The bioactive peptides with antioxidative properties may have great potential for use as nutraceuticals and pharmaceuticals.

The peptides also have useful antimicrobial properties that can be used in the food industry as well as in the pharmaceutical industry. Antimicrobial peptides from fish could provide a new source for development of novel antimicrobial drugs in the future. These antimicrobial peptides can serve as vaccines in the future to inactivate specific pathogens, and they can also be used in food preservatives, and supplements. It is important to discover new antimicrobial substances because of the rise of pathogenic bacteria that are resistant to conventional antibiotics (Najafian and Babji 2014).

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Protein	6.04%
Fat	0.80%
Carbohydrate	12.12%
Moisture	79.45%
Ash	1.59%
Water activity	0.981
Calories content	40kcal

Roselle hydrolyzed collagen drink

Commercialization of fish peptides

Roselle hydrolyzed collagen drink is a commercial product incorporating bioactive peptides. Other food supplements in the form of capsules, tablets or powdered drinks are also seen as necessary and more acceptable in modern society when compared to the traditional way of obtaining peptides in the form of soups prepared from protein sources such as chicken and fish in the tedious and time consuming traditional way.

Peptides in the form of supplements are more consumer-friendly and have become widely available over the last few years. China Peptide, a global leader in peptide production is a good example of response to the growing demand for such convenient distribution of peptide-based food supplements. Research and development in the area of peptides has been stepped up over the past 20 years globally with major breakthrough in functional properties being reported from plant and animal sources, so that in addition to the well-known 'Essence of Chicken' we now have products such as 'Essence of Haruan,' brewed with Ginseng, Tongkat Ali and other well-known herbs such cordyceps and acai berry.

The Malaysian Government through the Prime Minister's Office (Pemandu) and the Ministry of Science Technology and Innovation (MOSTI) have provided significant funding for peptides R&D using local protein sources such as sea cucumber, freshwater fish, bird nest and selected plants. The agro-based farmers will benefit from the use of fresh water fish to meet growing demands for health supplements.

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