UNIVERSITI PUTRA MALAYSIA

NUTRITIONAL AND SENSORY VALUES OF MUSCLES AND LIVER FROM CULTURED BAUNG Hemibagrus nemurus (Valenciennes, 1840) AND AFRICAN CATFISH Clarias gariepinus (Burchell, 1822)

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By

HESAMODDIN ABDI

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirement for the Degree of Master of Science

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DEDICATION

This thesis is dedicated to my wonderful wife, Mei, who has been a great source of motivation and inspire

Abstract of thesis presented to the senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Master of Science

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The most popular fish consumed in Malaysia are from the catfish families of Clariidae, Bagridae and Pangasiidae. In this study, two of these most commonly cultured and consumed catfishes, Asian redtail, *Hemibagrus nemurus* and African catfish, *Clarias gariepinus* were evaluated for chemical, nutritional and organoleptic properties. Fresh catfishes bought from local farm and wholesellers were transported to laboratory at Department of Aquaculture, Faculty of Agriculture, Universiti Putra Malaysia, Serdang, Selangor. Muscle was cut and analysed for moisture, ashes, protein and total fat contents as well as evaluation for fatty acid and amino acid profile. The same process was carried out for liver except for the profiling of amino acid. This study indicates a good nutritional condition for all fish samples (CF >1).

Results were compared between male and female *H. nemurus* and *C. gariepinus*. Female *H. nemurus* and *C. gariepinus* contained the lowest protein and fat. On the other hand, moisture found to be the highest in both females *H. nemurus* and *C. gariepinus*. Male of *H. nemurus* contained the highest amount of fat and ash. Liver of female *H. nemurus* contained the highest amount of ash and crude lipid but with lowest amount of moisture. Male *C. gariepinus* had the lowest amount of protein, ash and crude lipid. Moisture was found to be the highest in male *C. gariepinus*. The major fatty acids in Asian redtail catfish and African catfish muscle were C14:0, C16:0, C16:1, C18:0, C18:1n-9, C18:2n-6, C18:3n-3, C20:4n-6, C24:1, C20:5n-3, C22:5n-3 and C22:6n-3. All the above mentioned fatty acids were found in the liver of Asian redtail catfish and African catfish with the addition of C12:0, C15:0 and C17:0. The most abundant fatty acids in both species for liver and muscle were oleic acid (18:1n-9) and palmitic acid (16:0). Levels of aspartic acid, glutamic acid and threonine were significantly different between the two species and sexes as well ($P < 0.05$). Significant variations were observed in body composition, amino acid, fatty acids and sensorial properties of the two catfish species. The amino acid profile showed both catfish species to be good sources of essential amino acids except for tryptophan. Asian redtail and African catfish contained high levels of omega-3 and omega-6 PUFAs, respectively. Male and female *H. nemurus* found to have better color and taste which male *H. nemurus* showing the highest acceptance by panelists. In conclusion, this study showed that *H. nemurus* has better meat quality as compared to *C. gariepinus*.

Abstrak tesis dikemukakan kepada senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

NILAI NUTRISI DAN SENSORI FILET DAN HATI DARI IKAN BAUNG *Hemibagrus nemurus* (Valenciennes, 1840) DAN KELI AFRIKA *Clarias gariepinus* (Burchell, 1822) YANG DITERNAK

Oleh

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Ikan yang paling popular dimakan di Malaysia adalah dari famili Clariidae, Bagridae dan Pangasiidae. Dalam kajian ini, dua ikan duri yang biasa dikultur iaitu baung, *Hemibagrus nemurus* dan keli Afrika, *Clarias gariepinus* dinilai untuk komposisi kimia, nutrisi dan ciri organoleptik. Ikan segar dibeli dari penternak dan pemborong tempatan, dihantar ke Makmal Endokrinologi, Jabatan Akuakultur, Fakulti Pertanian, Universiti Putra Malaysia, Serdang, Selangor. Filet dianalisis untuk kandungan air, abu, protein dan jumlah lemak, dan juga profil asid lemak dan asid amino. Proses yang sama dijalankan untuk hati kecuali profil asid amino. Kajian ini menunjukkan keadaan nutrisi yang baik untuk semua sampel ikan (CF>1).

Keputusan dibandingkan antara jantan dan betina *H. nemurus* dan *C. gariepinus*. Filed betina *H. nemurus* dan *C. gariepinus* mengandungi peratus protein dan lemak yang paling rendah. Pada masa yang sama, kandungan air adalah tertinggi pada kedua-dua betina *H. nemurus* dan *C. gariepinus*. Jantan *H. nemurus* mengandungi lemak dan abu yang paling tinggi. Hati betina *H. nemurus* mempunyai jumlah abu dan lemak kasar yang paling tinggi tetapi dengan kandungan air yang sangat rendah. Untuk ikan jantan *C. gariepinus* mempunyai kandungan terendah untuk protein, abu dan lipid kasar. Manakala *C. gariepinus* mempunyai kandungan air yang tertinggi. Asid filet baung dan keli Afrika adalah C14:0, C16:0, C16:1, C18:0, C18:1n-9, C18:2n-6, C18:3n-3, C20:4n-6, C24:1, C20:5n-3, C22:5n-3 dan C22:6n-3. Kesemua asid lemak tersebut terdapat dalam hati baung dan keli Afrika dengan tambahan C12:0, C15:0 dan C17:0. Asid lemak yang paling kerap didapati pada filet dan hati kedua-dua spesis tersebut adalah asid oleik (18:1n-9) dan asid palmitik (16:0). Jumlah asid aspartik, asid glutamik dan threonin adalah ketara berbeza ($P<0.05$) di antara kedua-dua spesis dan jantina. Profil asid amino menunjukkan bahawa kedua-dua spesis ikan duri adalah sumber yang baik untuk asid amino perlu kecuali tryptophan. Baung dan keli Afrika masing-masingnya mengandungi omega-3 dan omega-6 PUFA yang tinggi. Jantan dan betina *H. nemurus* mempunyai warna dan rasa yang lebih baik dengan jantan memberikan nilai tertinggi dari segi penerimaan panel penilai. Kesimpulannya, kajian ini menunjukkan bahawa baung, *H. nemurus* mempunyai kualiti filet yang lebih baik berbanding dengan keli Afrika, C. *gariepinus*.

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This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Master of Science. The members of the Supervisory Committee were as follows:

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CHAPTER 1

INTRODUCTION

Aquaculture or farming of fish under controlled conditions is globally on the rise and during 1990s global production growth rapidly from 10 to 29 million metric tons while tonnage of wild-caught fish remained at the same level (Naylor et al., 2000). The total production of cultured fish increased from 41.9 million tones in 2004 to 55.1 million tones in 2009 and this industry covered 46% of total food fish production in 2008 (FAO, 2010). More than 220 worldwide fish and shellfish species are under farmed category (Naylor et al., 2000). This can be due to the wild fish stocks capacity limitation as well as pollution (Kent, 2005) and health issues in open seawater regions, which leads to decrease public demands for fish or product from wild-caught species. Well-managed aquaculture is accepted as best solution to reduce pressure on wild fish stocks for environmental conservation (Kent, 2005).

Overall food security improves in quality and quantity by aquaculture (Kent, 2005) and now 100 percents of trout in United States of America is farm raised (Hardy, 2003). It was reported that 25% of all fish consumption by human produced from aquaculture in 2000 (Naylor et al., 2000). In fact, majority found farmed fish more beneficial for health compared to wild fish (Hardy, 2003). Growth of aquaculture sector is not same for all countries. Asia alone contributes 90% of global output (Naylor et al., 2000). Moreover, 89.1 % of worldwide production is from Asia–Pacific region (FAO, 2010). Malaysia is one of the Asia–Pacific country that played an important role in technical development of aquaculture in the past decade. The aquaculture production in this country rose from 170 tons/capita in 2000 to 210 tons/capita in 2007 (FAO, 2011). In addition, government of Malaysia distributed RM82 million to support development of the aquaculture industry (Junaidi and Hashida, 2010). In Bangladesh, about 63% of total animal protein supply comes from fish (Islam and Joadder, 2005). In comparison to other countries average fish consumption is one of the highest, in South East Asia. It was about 49 kg/capita in 2000 and rose to 53 kg/capita in 2005 (Abdullahi et al., 2011). Malaysia is among the highest consumers of fish and seafood with the reported amount 62 kg per capita in 2006 (Ministry of Health, 2006).

Seafood and in particular fish products are highly recommended to human for having health benefits and being low-fat source of minerals and protein with high amount of omega-3. High cholesterol leads to incidence of heart disease but this cholesterol can be reduced with the intake of omega-3 (Sidhu, 2003; Burger and Gochfeld, 2009). Excessive cholesterol can also cause mental disorder (Groot et al., 2012). Catfish comes second to Nile tilapia with 36.7% of the total production in Malaysia (FAO, 2010).

Catfish in particularly African catfish is one of the most fast growing and commonly consumed fish in Malaysia (Wan Norhana, 2012) but market research have shown that this species is not economically valuable due to their high food intake demands. On the other hands, Asian redtail (Baung) is a popular food fish in southeast Asia (Molnar et al., 2006) and considered a commercial species in Malaysia due to its popularity and high market price (Rainboth, 1996; Mukhlis., 2008; Adebiyi et al., 2011). Therefore, study on nutritional and organoleptic values of these two species will shed an insight that causes the differences in market price. Nowadays there is a tendency to consume catfish due to its pleasant flavor, nutrition and health benefits. Preference of consuming farm-raised catfish over wild caught catfish was reported by House et al. (2003).

Faucorineau and Laroche (1995) reported that food safety, nutritional value and organoleptic analysis are three important indicators for quality evaluation of food products, It is generally accepted that essential amino acids and fatty acid are two most important factors for the estimation of nutritional value especially in seafoods (Krzecekowski and Stone, 1974; Kuley et al., 2008; Wu et al., 2010). In addition Yousaf et al (2011) mentioned that proximate composition (protein, crude fat, moister and carbohydrate) as another vital factor for the estimation of fish products nutritional value. Chemical composition as well as amino acid and fatty acid profile can be variable related to species and sex (Yeannes and Almandos, 2003; Yousaf et al., 2011). Therefore, expecting nutritional value and organoleptic evaluation differences between species as well as male and female of same species is not that far fetched.

There is a direct relation between fish production and its waste. Increase of fish waste production causes financial waste as well as environmental pollution. Rejected parts include bones, head, skin and liver. These discarded parts contained essential fatty acid compounds that can be used in the production of fishmeal and fish oil.

1.1. Objectives of the study

1. To determine and compare the proximate composition of muscle and liver between the species and sexes of *H. nemurus* and *C. gariepinus*.

2. To determine the amino acids and fatty acids profiles of the muscle and liver of *H. nemurus* and *C. gariepinus*.

3. To evaluate and compare the organoleptic characteristics of the muscle between species and sexes of *H. nemurus* and *C. gariepinus*.

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