
**UNIVERSITI PUTRA MALAYSIA**

# *DIETARY CARBOHYDRATE REQUIREMENT OF LEMON FIN BARB HYBRID (Barbonymus gonionotus BLEEKER 1849 ♀ X Hypsibarbus wetmorei SMITH 1931 ♂) FINGERLINGS*

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**FP 2017 55**

# DIETARY CARBOHYDRATE REQUIREMENT OF LEMON FIN BARB HYBRID (*Barbonymus gonionotus* BLEEKER 1849 ♀ X *Hypsibarbus wetmorei* SMITH 1931 ♂) FINGERLINGS

By

**SULAIMAN MUHAMMAD ALIYU**

**Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfillments of the Requirements for the Degree of Master of Science**

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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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**October 2017**

**Chairman : Professor Mohd Salleh Kamarudin, PhD**
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Carbohydrates are the widely available and cheap source of dietary energy. The optimal inclusion of carbohydrate in a fish diet can help in reducing the cost of feed and farm operation. The present study was conducted to determine the dietary carbohydrate requirement of lemon fin barb hybrid including the optimal inclusion, the best carbohydrate source and the optimal starch-fiber ratio. Three separate feeding trials were conducted in 100 l glass aquaria in which fish were fed at 4-6% body weight twice a day for 60 days. All treatments were triplicated. Growth, survival, hepatosomatic index, viserosomatic index, body composition and nutrient retention of the fish were estimated.

In Experiment I, five isonitrogenous (30% protein) and isolipid (4%) test diets containing varying carbohydrate levels (20, 25, 30, 35 and 40 %) were tested. Tapioca starch was used as the carbohydrate source. No mortality was observed in the experiment. The maximal growth was achieved when lemon fin barb hybrid was fed 35% carbohydrate. However, the polynomial regression analysis indicated that the optimal dietary carbohydrate of the barb hybrid was 33.5%. The fish growth significantly dropped when the hybrid was fed more than 35% carbohydrate.

In Experiment II, five isonitrogenous (30% protein) and isolipid (4%) diets containing 35% carbohydrate with corn, tapioca and sago starches, and wheat and rice flour as carbohydrate starch source were tested. The results indicated that carbohydrate sources have no significant effect on the survival, growth and other physiological parameters of this hybrid.

In Experiment III, five isonitrogenous (30%) protein, isolipid (4%) diets containing 35% carbohydrate with varying starch:fiber ratios were tested. The results indicated that fish fed 30:5 starch-fiber ratio exhibited the highest growth but the hybrid fish were able to utilise fiber up to 10% diet (25% starch) without affecting fish growth and other physiological parameters.

In conclusion, lemon fin barb hybrid fingerlings could utilise a wide range of carbohydrate sources and required 33.5% carbohydrate at 6:1 starch-fiber ratio in its diet with 30% protein, 4% lipid and gross energy 17 kJ $g^{-1}$ for the optimal growth and best feed efficiency.

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

**KEPERLUAN KARBOHIDRAT DIETARI ANAK KERAI LAMPAM (*Barbonymus gonionotus* BLEEKER 1849 ♀ *X Hypsibarbus wetmorei* SMITH 1931 ♂)**

Oleh

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Karbohidrat merupakan sumber tenaga yang mudah didapati dan murah. Penggunaan paras karbohidrat yang optimal dalam makanan ikan dapat membantu mengurangkan kos makanan dan operasi ladang. Kajian ini telah dijalankan bagi menentukan keperluan optimal karbohidrat bagi kerai lampam termasuk paras penggunaan optimal, sumber karbohidrat yang terbaik dan nisbah kanji-serat yang optimal. Sebanyak tiga kajian pemakanan berasingan telah dijalankan menggunakan akuarium kaca 100 L di mana ikan telah diberi makan sebanyak 4-6% berat badan dua kali sehari selama 60 hari. Kesemua rawatan dilakukan dalam tiga replikasi. Pertumbuhan, kemandirian, indeks hepatosomatik, indeks viserosomatik, komposisi badan dan retensi nutrien ikan telah dianggar.

Dalam Eksperimen I, lima diet isoprotein (30%) dan isolipid (4%) yang mengandungi kandungan karbohidrat yang berbeda (20, 25, 30, 35 dan 40%) telah diuji. Kanji ubi kayu telah digunakan sebagai sumber karbohidrat. Tiada kematian dilihatkan dalam kajian ini. Pertumbuhan maksimum dicapai apabila kerai lampam telah diberi diet yang mengandungi 35% karbohidrat. Walau bagaimanapun, analisis regresi polinomial menunjukkan bahawa paras karbohidrat dietari yang optimal bagi ikan hibrid ini adalah 33.5%. Pertumbuhan ikan ketara jatuh apabila ikan diberi diet yang mengandungi lebih daripada 35% karbohidrat.

Dalam Eksperimen II, lima diet isoprotein (30%) dan isolipid (4%) yang mengandungi 35% karbohidrat dengan kanji jagung, ubi kayu dan sagu serta tepung gandum dan beras diguna sebagai sumber karbohidrat telah diuji. Keputusan kajian menunjukkan

bahawa sumber karbohidrat tidak memberikan kesan ketara kepada kemandirian, pertumbuhan dan parameter fisiologi ikan hibrid ini.

Dalam Eksperimen III, lima diet isoprotein (30%) dan isolipid (4%) diet yang mengandungi 35% karbohidrat dengan pelbagai nisbah kanji:serat telah diuji. Keputusan kajian menunjukkan bahawa ikan memakan diet dengan nisbah kanji-serat 30:5 menunjukkan pertumbuhan yang tertinggi tetapi ikan hibrid ini berupaya menggunakan serat sehingga 10% diet (25% kanji) tanpa menjejaskan pertumbuhan dan parameter fisiologinya yang lain.

Kesimpulannya, juvana kerai lampam berupaya menggunakan pelbagai sumber karbohidrat dan memerlukan 33.5% karbohidrat pada nisbah 6:1 kanji-serat dalam dietnya dengan 30% protein, 4% lipid dan 17 kJ $g^{-1}$ tenaga kasar bagi pertumbuhan optima dan kecekapan makanan terbaik.

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I certify that a Thesis Examination Committee has met on 13 October 2017 to conduct the final examination of Sulaiman Muhammad Aliyu on his thesis entitled "Dietary Carbohydrate Requirement of Lemon Fin Barb Hybrid (*Barbonymus gonionotus* Bleeker 1849 ♀ X *Hypsibarbus wetmorei* Smith 1931 ♂) Fingerlings" in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The Committee recommends that the student be awarded the Master of Science.

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## TABLE OF CONTENTS

## LIST OF TABLES

## LIST OF FIGURES

## LIST OF ABBREVIATIONS

| | |
|---|---|
| ANOVA | Analysis of Variance |
| AOAC | Association of Analytical Chemist |
| BW | Boby Weight |
| DM | Dry-matter |
| d | Day |
| D.O. | Dissolved Oxygen |
| DOF | Department of Fisheries |
| FAO | Food Agriculture organization |
| FCR | Feed Conversion Ratio |
| FM | Fish Meal |
| g | Gram |
| h | Hour |
| HCl | Hydrochloric acid |
| GE | Gross Energy |
| Kcal | Kilocalorie |
| l | Litre |
| m | Meter |
| ml | Milliliter |
| NaOH | Sodium hydroxide |
| NFE | Nitrogen Free Extract |
| $NH_3$ | Ammonia |
| PER | Protein Efficiency Ratio |
| ppm | Part per million |
| ppt | Part per thousand |

| | |
|---|---|
| SAS | Statistical Analysis System |
| S.E. | Standard Error |
| SGR | Specific Growth Rate |
| SRV | Survival Rate |
| WG | Weight Gain |

# CHAPTER 1

# GENERAL INTRODUCTION

## 1.1 Background of the study

Aquaculture in Malaysia has been established since the 1920's with the polyculture of Chinese carps, followed by marine shrimps in 1930's, blood cockles in 1940's and freshwater fishes in 1950's (Chua & Teng, 1979; Chua & Teng, 1980). A rapid development took place in the 1970's with the semi-intensive culture of shrimp and floating net cage culture of grouper (Kuperan, 1988). In the 1990's, intensive aquaculture began with a very high stocking density to increase production for sustainable industry while in the 2000's, the industry started to stress on fish health management and food safety from source to market (Kechik, 1995; DOF, 2015).

Malaysian aquaculture production was about 407,387 tonnes in 2016 with a total value of RM 3.6 billion (Table 1). There has been a continuous decreasing trend in the production since 2012 due to disease outbreaks (early mortality syndrome (EMS) for shrimps and streptococcus for tilapia). Freshwater aquaculture contributed 22% to the total aquaculture engaging about 19,197 farmers. The three top dominant freshwater species cultured were African catfish (45%), red tilapia (27%) and pangasid catfish (12%) while carps including Chinese, Indian and local carps contributed only 11% (DOF, 2016).

**Table 1.1 : Malaysian aquaculture production for 2006-2016**

| Year | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 |
|---|---|---|---|---|---|---|---|---|---|---|
| Marine | 141,719 | 258,447 | 317,769 | 425,649 | 404,288 | 470,619 | 397,312 | 413,783 | 394,320 | 304,039 |
| Freshwater | 62,733 | 95,918 | 135,238 | 155,398 | 122,218 | 163,756 | 132,892 | 106,731 | 112,145 | 103,348 |
| **Total** | **203,452** | **354,365** | **453,859** | **581,048** | **526,506** | **634,375** | **530,204** | **520,514** | **506,465** | **407,387** |

(Source: DOF., 2017)

The dominance of alien species in Malaysian freshwater aquaculture is worrying as some of these are invasive that can cause a major ecological disaster if they accidentally escape to the natural waters. Thus, there is an urgent need to develop the aquaculture of indigenous fish as a counter measure especially those that have been overfished or endangering to become extinct either for commercial or conservation or both.

In 2004, a new indigenous carp hybrid was produced by the Department of Fisheries Malaysia (DOF) from male lemon fin barb (*Hypsibarbus wetmorei*) and female silver barb (*Barbodes gonionotus)*. The new hybrid possesses external features of lemon fin barb but exhibit feeding habit and rapid growth of silver barb (Suharmili et al., 2015). The hybrid reaches maturation at 250 g and can be easily bred in captivity (Ismail et al., 2016). It can achieve 200-250g size in three months of the culture period and are usually used for the production of smoked and salted dried fish. However, the fry can reach around 600g in 6 months and are sold as fresh or live food fish. With good meat quality, texture and sweet flesh, this hybrid is becoming a high-value carp species worth up to USD 7.21 $kg^{-1}$.

Due to the absence of its specific commercial diet, farmers feed lemon fin barb hybrid with commercial tilapia or catfish diets and supplement them with napier grass, *Pennisetum purpureum* or water spinach, *Ipomea aquatica* cuttings to reduce feeding cost and total reliance on commercial feeds (Suharmili et al., 2015). Recent research showed that lemon fin barb hybrid requires 30% protein (Suharmili et al., 2015), 4% lipid (Ismail et al., 2016) and gross energy 17 kJ $g^{-1}$ (Kamarudin in press). The role of carbohydrate in the nutrition of lemon fin barb hybrid, however, has yet to be established.

Generally, animal diets require carbohydrates as the main source of energy for proper growth. The nutritional effects of carbohydrate are influenced by several factors such as inclusion level, carbohydrate source, water-binding capacity, handling techniques, digestion and absorption rate, and fermentation ability, which play an important role in the digestive system (Kamalam et al., 2017). The important of carbohydrate in fish nutrition cannot be overlooked as it can provide a protein sparing effect (Zamora et al., 2013). The effect makes more protein be made available for physical growth and thus maximises protein retention and decreases nitrogen release which in excess may affect the water quality (Wilson, 1994; Lee, 2015; Wang et al., 2016). Appropriate inclusion of carbohydrate has improved the growth performance of so many fish species, reducing production cost by reduction in feed cost, and increase feed quality by increasing floatability, durability and water stability. More recent research have shown that some crude fiber can be used as growth promoters acting as prebiotics and improving the health status of the fish without any anti-nutritional effect (Azaza et al., 2015; Adorian et al., 2016).

## 1.2 Research Objectives

The general objective is to determine the dietary carbohydrate requirement of lemon fin barb hybrid. The specific objectives of this study were:

1. To determine the optimal dietary carbohydrate requirement of lemon fin barb hybrid.
2. To evaluate selected carbohydrate sources for lemon fin barb hybrid
3. To determine dietary optimal starch-fiber ratio for lemon fin barb hybrid

Knowledge on the carbohydrate nutrition of this hybrid will help in reducing feed and fish production cost, and ensuring the sustainability of the hybrid culture.

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