

GROWTH PERFORMANCE AND  
BIOCHEMICAL CHANGES IN NILE TILAPIA,  
*Oreochromis niloticus* FED WITH VARYING  
DIETARY MALTOSE LEVELS

KERI ALHADI IGHWELA

Thesis Submitted In Fulfillment of the Requirement for  
the Degree of Doctor of Philosophy in the Faculty of  
Fisheries and Aqua-Industry  
Universiti Malaysia Terengganu

June 2013

## ***DEDICATION***

*This thesis is dedicated to my lovely parents and family for their support and time they gave to me in entire my life.*

Abstract of thesis presented to the Senate of Universiti Malaysia Terengganu  
in fulfillment of the requirement for the degree of Doctor of Philosophy

**GROWTH PERFORMANCE AND BIOCHEMICAL CHANGES IN NILE  
TILAPIA, *Oreochromis niloticus* FED WITH VARYING DIETARY MALTOSE  
LEVELS**

**KERI ALHADI IGHWELA**

**June 2013**

**Main Supervisor: Associate Professor Abol Munafi bin Ambok Bolong, Ph.D.**

**Co-Supervisor : Associate Professor Aziz bin Ahmad, Ph.D.**

**Faculty : Fisheries and Aqua-Industry**

Tilapia is the second most consumed farmed fish, after carp, and the most widely grown of any farmed fish. Significant feed price increases in recent years threaten sustainability of the industry. Therefore, the objectives of the current study are to understand the interrelationship between malt-extracted maltose levels in the feed with growth parameters, body composition, apparent digestibility coefficients, haematological and biochemical changes in blood serum of Nile tilapia *Oreochromis niloticus* fingerlings (mean initial weight, 2.1 ±0.2 g). The fishes were fed with practical-type diets formulated containing five levels of dietary maltose (0.0, 20, 25, 30 and 35%) extracted from malted barley.

The best specific growth rate (SGR) and feed conversion ratios (FCR) were obtained from fishes fed with 35% maltose, but had no significant difference compared with control, while fishes fed with 20% maltose exhibited the lowest SGR and the highest

FCR values. Conversely, protein efficiency ratio (PER) and net protein utilisation (NPU) were not different significantly from the control, except the fishes fed with 20% maltose had the lowest value ( $P < 0.05$ ). Both PER and NPU had a significantly positive correlation with weight gain, crude body of lipid and protein content ( $R^2 > 0.6$ ). In addition, the proximate compositions of crude body protein content did not significantly differ between the treatments. Whereas, the body lipid was significantly higher ( $p < 0.05$ ) in fish fed with 35% maltose, and lower in fish fed with 20% maltose.

The apparent digestibility of protein, lipid, gross energy and carbohydrate (NFE) were significantly higher ( $p < 0.05$ ) in fish fed with 20% maltose and lower in fish fed with 35% maltose. Protein digestibility had significantly positive correlation with digestibility of lipid, NFE and energy. However, the protein digestibility had a significantly negatively correlation with body lipid. Lipid digestibility had significantly positive correlation with both NFE and energy digestibility, and also NFE digestibility had a significantly positive correlation with energy digestibility.

The results of haematological changes showed no significant difference ( $P < 0.05$ ) between all groups in packed cell volume (PCV), haemoglobin (Hb), mean corpuscular haemoglobin (MCH), mean corpuscular haemoglobin concentration (MCHC) and mean corpuscular volume (MCV). While it was significantly different ( $P < 0.05$ ) between all groups in the red blood cells (RBCs) and white blood cells (WBCs) count, except in the fishes fed with 30% maltose it was not significantly different ( $P < 0.05$ ) as compared with control feed. Correlation analysis indicated that haemoglobin had a significantly

positive correlation with packed cell volume. Also the RBCs had significant negative correlation with WBCs. There was no significant difference ( $P < 0.05$ ) between all groups in monocytes and basophils, while the number of lymphocytes, neutrophils and eosinophils were non-significantly different ( $P < 0.05$ ) from control diet.

The results of biochemical changes showed no significant changes ( $P < 0.05$ ) in total protein, cholesterol, aspartate aminotransferase (AST), alanine aminotransferase (ALT) and lactic acid dehydrogenase (LDH) levels. The blood-glucose levels decreased significantly ( $P < 0.05$ ) in treatments groups compared to control. Triglyceride in serum had a highly significant ( $P < 0.05$ ) increase in fish fed with 30% maltose as compared to control group. Total protein had significantly positive correlation with AST, ALT and blood glucose, while LDH had significantly positive correlation with weight gain, PER and NPU. However, it had negative correlation with FCR, NFE digestibility and energy digestibility. In conclusion, these studies suggest that malt-extracted maltose plays a very significant role in Nile tilapia nutrition and contributed to their body-mass without any adverse effect on biochemical parameters.

Abstrak tesis yang dikemukakan kepada Senat Universiti Malaysia Terengganu sebagai memenuhi keperluan untuk ijazah Doktor Falsafah

PRESTASI TUMBESARAN DAN PERUBAHAN BIOKIMIA DALAM  
TILAPIA NIL, *Oreochromis niloticus* YANG DIBERI MAKAN DENGAN PARAS  
PEMAKANAN MALTOSE YANG BERBEZA

**KERI ALHADI IGHWELA**

**June 2013**

**Penyelia Utama : Prof. Madya Abol Munafi bin Ambok Bolong, Ph.D**

**Penyelia Bersama : Prof. Madya Aziz bin Ahmad, Ph.D**

**Fakulti : Perikanan dan Akua Industri**

Tilapia merupakan ikan kedua yang paling banyak digunakan selepas ikan carp dan paling luas berkembang berbanding ternakan ikan yang lain. Peningkatan harga makanan ikan yang ketara mutakhir ini telah mengancam kemampuan industri penghasilan makanan. Oleh sebab itu, objektif kajian ini adalah untuk memahami perhubungan di antara paras maltose diextract dari barli di dalam makanan dengan parameter-parameter pertumbuhan, komposisi badan, pekali pencernaan nyata, perubahan hematologi dan biokimia di dalam serum darah terhadap anak ikan Tilapia Nil (initial weight,  $2.1 \pm 0.2$  g). Ikan-ikan leah diberi makan dengan pemakanan praktikal yang mengandungi paras maltosa (0.0, 20, 25, 30 and 35%) yang diekstrak dari barli.

Kadar Pertumbuhan Spesifik (SGR) dan Nisbah Penukaran Makanan (FCR) yang terbaik telah diperolehi daripada ikan yang diberi makan dengan 35% maltosa tetapi tiada perbezaan yang signifikan diantara kawalan. Sementara itu, ikan yang diberi makan 20% maltosa menunjukkan kadar SGR yang paling rendah tetapi kadar FCR

yang paling tinggi. Sebaliknya nisbah Keberkesanan Protin (PER) dan Penggunaan Protin Bersih (NPU) tidak mempunyai perbezaan yang signifikan di antara kawalan kecuali bagi ikan yang diberi makan 20% maltosa sahaja menunjukkan nilai yang paling rendah ( $P < 0.05$ ). Kedua-dua PER dan NPU mempunyai korelasi positif yang signifikan diantara berat capaian, dan kandungan lipid dan protin ( $r^2 > 0.6$ ). Tambahan pula, komposisi proksimat kandungan protin mentah badan tidak menunjukkan perbezaan yang signifikan diantara rawatan. Sementara itu, bagi ikan yang diberi makan 35% maltose, kandungan lipid badan menunjukkan signifikan yang tinggi ( $p < 0.05$ ) berbanding dengan ikan yang diberi makan 20% maltosa.

Keboleh cernaan lipid, tenaga kasar dan karbohidrat adalah sangat tinggi ( $p < 0.05$ ) bagi ikan yang diberi makan 20% maltose berbanding dengan ikan yang diberi makan 35% maltosa. Penghadaman protein adalah berkadar langsung dengan penghadaman lipid, NFE and tenaga. Walaubagaimanapun, penghadaman protin berkorelasi signifikan secara negative terhadap lipid badan. Tambahan pula, penghadaman lipid menunjukkan korelasi signifikan secara positif terhadap NFE dan tenaga penghadaman serta penghadaman NFE yang mempunyai korelasi secara positif dengan tenaga penghadaman.

Keputusan perubahan hematologi menunjukkan tiada perbezaan yang signifikan ( $p < 0.05$ ) diantara semua kumpulan di dalam isipadu sel yang padat (PCV), hemoglobin (Hb), min hemoglobin korpuskular (MCH), min kepekatan hemoglobin korpuskular (MCHC) dan juga min isipadu korpuskular (MCV). Sementara itu, terdapat juga

perbezaan yang signifikan ( $p < 0.05$ ) diantara semua kiraan kumpulan sel darah merah (RBCs) dan sel darah putih (WBCs) kecuali tiada perbezaan yang signifikan ( $p < 0.05$ ) pada ikan yang diberi makan dengan 30% maltose berbanding dengan makanan kawalan. Analisis korelasi menunjukkan bahawa hemoglobin mempunyai korelasi positif yang signifikan dengan PCV. Sementara itu, RBCs mempunyai korelasi negative yang signifikan dengan WBCs. Tiada perbezaan yang signifikan ( $p < 0.05$ ) dicatatkan diantara semua kumpulan monosit dan basofil, manakala bilangan limfosit, neutrofil dan esinofil adalah tidak berbeza secara signifikan ( $p < 0.05$ ) daripada diet kawalan kecuali bacaan yang minimum pada ikan yang diberi makan 35% maltosa.

Manakala keputusan dari sudut perubahan biokimia menunjukkan tiada perbezaan yang signifikan ( $p < 0.05$ ) ke atas jumlah protin, kolesterol, aspartate aminotransferase (AST), alanine aminotransferase (ALT) dan paras asid laktik dehidrogenase (LDH). Paras glukosa darah menurun secara signifikan ( $p < 0.05$ ) di dalam kumpulan rawatan berbanding dengan kawalan. Sementara itu, trigliserida di dalam serum adalah sangat meningkat secara signifikan ( $p < 0.05$ ) apabila diberi makan dengan 30% maltose berbanding dengan kumpulan kawalan. Jumlah protin mempunyai korelasi positif secara signifikan dengan AST, ALT, dan glukosa darah manakala LDH mempunyai korelasi positif terhadap berat capaian, PER dan NPU dan berkorelasi negative diantara FCR, penghadaman NFE dan tenaga penghadaman. kesimpulannya. kajian-kajian ini mencadangkan bahawa maltose yang diekstrak daripada barli ini memainkan peranan yang ketara didalam pemakanan ikan tilapia Nil dan memberi sumbangan kepada jisim badan tanpa seberang kesan buruk terhadap parameter-parameter biokimia