

**INCORPORATION OF DRIED WATER HYACINTH, *Eichhornia crassipes* IN RED
TILAPIA, *Oreochromis mossambicus* x *O. niloticus* FINGERLINGS FEEDS**

MUBARAK EISA ABDELRAHMAN TIBIN

**Thesis Summited in the Fulfillment of the Requirement for the Degree of
Doctor of Philosophy in the Faculty of Fishery and Aqua-Industry
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November 2012

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DEDICATION

To the loving and sacred memory of my late father

EISA ABDEL-RAHMAN TIBIN

Who is now in mercy of Almighty Allah on 12th October, 2010, to my mother,
my wife and my daughter Maryam

Abstract of thesis presented to the senate of Universiti Malaysia Terengganu in the fulfillment of the requirement for the Degree of Doctor of Philosophy

INCORPORATION OF DRIED WATER HYACINTH, *Eichhornia crassipes* IN RED TILAPIA, *Oreochromis mossambicus* x *O. niloticus* FINGERLINGS FEED

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Traditionally, fish meal has been utilized extensively in aqua-feeds, mainly due to its high nutritional properties. However, various reasons dictate the utilization of sustainable alternatives and minimizing the dependence on this commodity in fish feeds. Lack of affordable fish feeds is one of the major constraints facing small- scale fish farmers as most of the fish feed is imported by majority of the countries practicing aquaculture. Hence, the aim of the present study was to evaluate the nutritional potential of the water hyacinth (WH), *Eichhornia crassipes* dried meal and also to investigate effects on nutrients digestibility growth performance and feed utilization of dried WH meal incorporated in feeds fed to fingerling hybrid red tilapia, *Oreochromis mossambicus* x *O. niloticus*.

The nutritional composition by performing biochemical analysis i.e. proximate, minerals content, amino acids (AAs) and fatty acids (FAs) composition in

different parts of the plant, i.e. leaf, stem and whole plant (WP) was estimated. Iso-nitrogenous (35%, crude protein) and iso-energetic experimental feeds incorporated with five levels (0, 10, 15, 20 and 25%) of the dried WH meal were formulated. The biochemical composition (proximate composition) and physical properties were also determined.

The apparent digestibility coefficients (ADCs) of the nutrients i.e. dry matter, crude protein, crude lipid, crude fiber and gross energy of the experimental feeds fed to red tilapia fingerlings (6.2 ± 0.30 g/fish). Triplicate groups of fish fingerlings (15 fish/ tank) were assigned with different experimental feeds. Feces were collected, the proximate composition and chromium content of feces were determined and the ADC of the nutrients was obtained. The growth performance, feed utility, incidence cost and profit index of all the experimental feeds were also estimated. Control feeds were feed 1 (0%, WH) and the commercial feed. Eighteen fiberglass rectangular tanks 150 L capacity were used for experiment. All tanks were connected to a recirculating system with aeration facilities. Each triplicate group of fish was randomly fed with one of the experimental feeds. The weight gain (%), specific growth rate (SGR), feed conversion ratio (FCR), and survival rates (SR), incidence cost and profit index were calculated from the data obtained. A complete randomized block design (CRBD) was used for these experiments.

The nitrogen free extract (NFE) was the most abundant nutrient in varied plant part was in the range between 43.30 and 55.18%. The crude protein content was low and significantly varied in range of 8.80 to 18.00%. The gross energy (GE) value in different part was found to range from 1922 to 2650 kcal/kg. For the minerals content, potassium was significantly the most abundant macro-element and ranged from 3.26 to 3.31%, whereas phosphorus was with the lowest content ranging from 0.23 to 0.28%. Iron was significantly the highest among micronutrients, in the range of 1143.65 to 1149.1.53 ppm. The amino acid composition ranged between 1.04 and 1.18 g/100g. Aspartic acid possessed the highest amino acid composition ranging from 3.81 and 3.03 g/100g. The essential amino acids, namely; methionine and tryptophan which are important to tilapia's normal growth, were found low in the different parts of the plant. Similarly, threonine was not detected in any of the analyzed WH parts. All the three parts of the plant showed low content of fatty acids. The proximate analysis of the experimental feeds was nutritionally balanced in term of crude protein level and gross energy content. All experimental feeds showed high stability in the water and the maximum leaching of the dry matter was in the range of 17.30 to 22.08%, after two hrs. of immersion in freshwater. The ADC of dry matter and crude protein were varying in all the experimental feeds, and ranging between 50.36 and 68.09% and 60.47 and 92.07%, respectively. The ADC of gross energy varied between 65.52 and 79.30%.

All the experimental feeds were accepted by all groups of fish. Appositive growth response was observed for all the experimental feeds as all fish groups were continually gained weight throughout the experimental period.

The present study revealed that dried WH meal is nutritionally potential and could be incorporated maximally up to 20% (on dry basis feed) with acceptable protein and gross energy digestibility, good growth performance and ideal feed conversion ratio for red tilapia fingerling reared in a recirculatory system.

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

**PENGGUNAAN KELADI BUNTING KERING, *Eichhornia crassipes* DI
DALAM PEMAKANAN BENIH IKAN TILAPIA MERAH, *Oreochromis
mossambicus* x *O. niloticus***

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Kebiasaannya, tepung ikan digunakan secara meluas dalam pemakanan ikan disebabkan oleh kandungan nutriennya yang tinggi. Walaubagaimanapun, terdapat beberapa sebab untuk menggunakan bahan alternatif mampan dan mengurangkan kebergantungan terhadap tepung ikan. Harga tepung ikan yang tinggi adalah merupakan salah satu kekangan besar yang dihadapi oleh penternak ikan kecil-kecilan. Ini adalah kerana kebanyakan tepung ikan diimport daripada luar negara. Oleh itu, tujuan kajian ini adalah untuk menilai potensi tahap nutrient yang ada pada tepung keladi bunting (WH), *Eichhornia crassipes* dan juga melihat kesan penambahannya dalam makanan terhadap pencernaan nutrien, prestasi pertumbuhan dan juga penggunaan makanan terhadap anak ikan hibrid tilapia merah, *Oreochromis mossambicus* x *O. niloticus*.

Komposisi nutrisi dengan melakukan analisis biokimia iaitu proksimat, kandungan mineral, asid amino (AA) dan komposisi asid lemak (AL) dalam bahagian-bahagian yang berlainan pada tumbuhan tersebut, iaitu daun, batang dan keseluruhan tumbuhan (KT) telah dianggarkan. Iso-bernitrogen (35%, protein mentah) / iso-bertenaga eksperimen makanan yang dimasukkan bersama dalam lima peringkat peratusan (0, 10, 15, 20 dan 25%) makanan KB kering telah dirumuskan. Komposisi biokimia (komposisi proksimat) dan ciri-ciri fizikal juga telah ditentukan.

Kejelasan pekali kebolehcernaan (PKK) nutrien, iaitu sebagai contoh; bahan kering, protein mentah, lipid mentah, serat mentah dan tenaga kasar bagi makanan eksperimen diberikan kepada benih ikan tilapia merah (6.2 ± 0.30 g / ikan). Tiga kumpulan benih ikan (15 ikan / tangki), (setiap satu mempunyai 3 replikasi) telah diberi makanan eksperimen yang berbeza. Najis telah dikumpulkan, komposisi proksimat dan kandungan kromium najis telah ditentukan dan PKK nutrien telah diperolehi. Prestasi pertumbuhan, utiliti makanan, kos insiden dan indeks keuntungan bagi semua makanan eksperimen juga dianggarkan. Makanan kawalan adalah terdiri daripada makanan 1 (0%, KB) dan makanan komersial. Lapan belas tangki gentian kaca berbentuk segiempat berkapasiti 150 L telah digunakan untuk eksperimen. Semua tangki telah disambungkan kepada sistem peredaran dengan kemudahan pengudaraan. Setiap kumpulan (tiga replikasi) ikan telah diberikan secara rawak dengan salah satu makanan eksperimen. Pertambahan berat (%), kadar pertumbuhan spesifik

(KPS), nisbah penukaran makanan (NPM), dan kadar kelangsungan hidup (KKH), kos kejadian dan indeks keuntungan dikira daripada data yang diperolehi. Reka bentuk blok rawak yang lengkap (RBBR) telah digunakan untuk eksperimen tersebut.

Ekstrak nitrogen bebas (ENB) adalah merupakan nutrien yang paling banyak terdapat di pelbagai bahagian tumbuhan dalam julat antara 43.30 dan 55.18%. Kandungan protein kasar adalah rendah dan berbeza dengan signifikan dalam julat 8.80-18.00%. Nilai tenaga kasar (TK) di bahagian yang berbeza telah didapati di antara 1922 hingga 2650 kcal / kg. Untuk kandungan mineral, kalium merupakan unsur - makro yang paling banyak iaitu pada kadar 3.26-3.31%, manakala fosforus mempunyai kadar yang terendah iaitu di antara 0.23-0.28%.

Besi adalah mikronutrien yang tertinggi yang di kesan pada kadar di antara julat 1143.65 hingga 1149.1.53 ppm. Komposisi asid amino adalah pada kadar di antara 1.04 dan 1.18 g/100g. Asid aspartik pula mempunyai komposisi asid amino yang tertinggi di antara 3.81 dan 3.03 g/100g. Asid amino perlu, iaitu; methionine dan triptofan yang diketahui penting untuk pertumbuhan normal tilapia, telah didapati mempunyai kadar yang rendah di bahagian yang berlainan pada tumbuhan.

Begitu juga, threonine tidak dapat dikesan dalam mana-mana bahagian KB yang telah dianalisis. Semua tiga bahagian tumbuhan menunjukkan asid lemak yang rendah. Analisis proksimat bagi makanan eksperimen menunjukkan pemakanan yang seimbang jika di lihat daripada segi tahap protein mentah dan kandungan tenaga kasar di dalamnya. Semua makanan eksperimen menunjukkan kestabilan yang tinggi di dalam air dan pengurusan maksimum bagi bahan kering adalah dalam lingkungan 17.30-22.08%, iaitu selepas dua jam direndam dalam air tawar. Nilai PKK bagi bahan kering dan protein mentah adalah berbeza pada semua makanan eksperimen, dan masing-masing mempunyai kadar di antara 50.36 dan 68.09% dan 60.47 dan 92.07%. PKK bagi tenaga kasar adalah berbeza di antara 65.52 dan 79.30%.

Kesemua makanan eksperimen telah dapat diterima oleh semua kumpulan ikan. Tindak balas pertumbuhan yang positif telah diperhatikan untuk semua makanan eksperimen kerana semua kumpulan ikan yang di uji mengalami pertambahan berat badan sepanjang tempoh eksperimen.

Kajian ini mendapati bahawa makanan KB yang kering adalah berpotensi secara nutrisi dan boleh digunakan secara maksimum sehingga 20% (dari segi makanan asas yang kering) dengan kadar pencernaan protein yang boleh diterima dan kebolehcernaan tenaga kasar, prestasi pertumbuhan yang baik dan

nisbah penukaran makanan yang ideal untuk anak benih tilapia merah yang diternak dalam system peredaran semula.