Aquatic Weeds as an Encouraging Resource of Alternative Feed for the Tilapia *Oreochromis mossambicus*

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ABSTRACT

A series of experiments were carried out to ascertain the nutritional value of commonly available aquatic weed i.e., Lemna (AWL), aquatic hyacinth (AWW) and Azolla (AWA) as alternative feed sources for decreasing the expenditure of feed. Using those aquatic weeds as principal ingredient three (3) isonitrogenous (crude protein-30%) and isocaloric feeds were made. Three batches of juvenile fish of thirty (30) numbers per batch (Average weight-5.1 gm; L- 5.6 cm) were provided with 3different types of prepared feeds with AWL, AWW and AWA. Weight gain, PER (Protein Efficiency Ratio) and GSI (Gonado Somatic Index) are significantly high in the AWL, AWW and AWA fed fish than the NOR. The AWL has suitable amino acid and fat that enhances yield and quality of flesh. The better ω-3/ ω-6ratio is obtained from food supplied experiment trial comparison to control treatment.

KEY WORDS: AQUATIC WEED, FISH FEED, GONADOSOMATIC,ISOCALORIC, ISONITROGENOUS,JUVENILE

INTRODUCTION

In fish farming, fish feed occupies 55-65% farming expenses for fish culture (Singh et al. 2006). This traditional food is utilised for fish farming was costly as well as inadequate to meet the demand. Not only that, in some cases feeds are adulterated and non-hygienic. So, there is an urgent need to develop of hygienic and low-cost fish feed for fish farming. For producing alternative, low cost and fresh fish feed from non-conventional feed ingredients i.e., terrestrial and aquatic macrophytes play an important role for this purpose (Edwards et al. 1985; Wee and Wang 1987; Mondal and Ray 1999; Mmanda et al. 2020).

Aquatic weeds have been utilised as alternative fish foods for aquaculture from very ancient time and now perform a key substitute of fish food for culture. These alternative sources exhibited encouraging amount for amino acids as well as other vital elements as studied in the past (Bardach et al. 1972; Edwards 1987; Ray and Das 1995; Debnath et al. 2018). However,these elements are not evaluated in respect of lipid profile earlier. From fish feed which is consumed by fish, the beneficial fatty acids are synthesized (Horrobin and Manku 1990; Mulokozi et al. 2020). The advantageous influence of fatty acid from fish particularly upon heart patients has by now been well recognized. So, great effort was given for establishing any relation between fish feed and fatty acid deposition as well as yield (Cengiz et al 2003; Mukhopadyay 2009). Mossambique tilapia (*O.mossambicus*), the cultured fish was selected for its tolerance to unfavourable environment and diseases, (Suresh 2003; Mulokozi et al. 2020). The main aim for these trials are to establish the effect of such non-conventional as well as alternative low-cost feed ingredient on yield and fatty acid deposition of the fishes.

MATERIAL AND METHODS

All the experiments were conducted in tanks (1200 l) of aquaculture Engineering section of Indian Institute of Technology, Kharagpur, India. In total 12 cemented tanks were used. In each tank, 25 fingerlings of tilapia were cultured. Initial weights and lengths were recorded for growth calculation. Three prepared (AWL, AWW, AWA) and one control feed (NOR) were supplied to the fish. Each batch of fish was cultured with one type of feed. The nitrogen content and energy value of all feeds were similar. Except normal feed (NOR) in each formulated feed, one type of non-conventional source (aquatic weed) was used for protein sources. Besides aquatic weed which was the main ingredient of each feed, MOC, RB (rice bran) and coarse flour were used for preparing feed for tilapia.

By using different ingredients with proper ratio feeds were made as a pellets form (AOAC 1990). Then pellets were dried under sunlight or in hot air oven. After drying, feeds were kept in polythene bags for preventing moisture. Using two calculation formulae different biochemical compositions of feed were recorded (Maynard et al. 1979; Giri et al. 2000). By adopting formula of Chakraborty et al. (2010), growth

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performance and feed consumption are calculated (table 2). Lipids from all samples were collected (Bligh and Dyer 1959). Then MUFA was prepared (Christie 1982). Next FAME was made (Mangold 1969; Dahlgren 1979; Misra et al. 1984). ANOVA was run to determine the effect of food. GSI and HSI of the experimental fishes were measured by removing gonads and liver from the body respectively.

RESULTS AND DISCUSSION

The maximum growth in weight of (93.44g) was recorded from AWL supplied foods. The growth of other tanks was recorded as follows AWW (74.55g) AWA (70.11g) and NOR (58.32g) (Table 2). The maximum (13.8cm) and minimum (10.8cm) length of fish was observed from NOR and AWA supplied trial respectively. The food consumption value of different trials was calculated. As desire maximum (3.19gm) food intake was observed from AWL and lowest (2.01gm) from NOR. The total amount of feed intake (in g) in three treatments is not differed significantly. So, feed acceptability is almost similar in all treatments but it is significantly less in NOR treatment. As feed acceptability is low in NOR so feed conversion ratio (FCR) is highest in control experiment which is not desirable. The lowest (0.52) and highest (0.98) specific growth rate were observed in NOR and AWL fed treatment respectively. The protein efficiency ratio (PER) was significantly differed ($P<0.05$) from different treatments. The Value of PER (highest-2.56 in AWL and lowest-0.75 in NOR) was recorded during the experiment. The obtained value of HSI (highest-2.81 in AWL and lowest 2.41 in NOR) presented in table 3. The recorded GSI value shows same tendency as HSI values.

Table 1. Chemical ingredient of three aquatic weeds (lemna, water hyacinth and azolla)

Composition	AWL	AWW	AWA
DM	91.61	91.42	91.31
Organic matter	82.82	81.58	82.65
Crude protein	25.14	20.17	20.36
Crude lipid	8.07	6.95	8.80
Ash	8.79	9.84	8.66
Nitrogen free extract	41.23	44.55	44.07
Fibre	8.38	9.91	9.42
Calorific value	4.76	4.69	4.65

For description of fatty acid profile minimum 14 fatty acids (FA) are required, yet 15 FAs recorded (Ackman 2000). At running trail, 26 FAs were recorded from different samples (carcass and food). Outcome was identical to the findings of temperate and tropical aquaculture (Zenebe et al. 1998; Ackman et al. 2002). Regarding fatty acids, experimental fish showed variation with IMC. The fatty acid profile of present fish had a great relation with other findings (Andrade et al.1995; Zenebe et al.1998; Mmanda et al. 2020; Bag 2021). Particularly 20:3n-9 FA indicated the FA deficiency by its presence (Watanabe 1982; Bag 2021).

The fatty acid (saturated) was estimated greater in amount when compared to MUFA, DUFA and PUFA. In AWA fed fish, the saturated fatty acid (SFA) content (%) was maximum (55.2) and lowest value (47.4) was recorded from NOR fish. As far as MUFA (Mono Unsaturated Fatty Acid) content (%) was concerned the highest value (26.9) also obtained from AWW fed fish. In case of PUFA (Poly Unsaturated Fatty Acid) content highest value was observed in NOR (15.06) followed by AWA (14.8), AWW (13.43) and AWL (14.33). The ω3fatty acid which was vital for human health, recorded highest (13.8) in AWL fed fish. On the contrary ω6 fatty acid was measured highest (9.5) in NOR. The ω3/ ω6 proportion was maximum (1.94) from AWL fed treatment succeeded by AWA (1.54), AWW (1.42) and NOR (1.20).

During trials, main parameters of water for the experimental tanks were in tolerable range for tilapia (Ballarin and Hatton 1979). The fish fed with AWL feed obtained highest weight gain. This refers the AWL feed accepted by cultured fish was fine. For this reason, highest feed acceptability was observed in AWL fed treatment. The low FCR value was desired for any fish culture. Low FCR indicates low loss of fish feed which reduced the cost of feeding. It can also make fish farming more profitable. Another important parameter i.e., PER which was appreciably superior in AWL feed treatment as compared to the others which implied that better and balanced quality of protein must be available in AWL feed where Lemma was the key ingredient (Bag 2021).

Table 2. Yield of tilapia using experimental feeds (After Duncan 1955).

	NOR	AWL	AWW	AWA
I W	6.12±.12	6.10±0.11	6.12±0.12	6.25±0.11
FW	58.32±0.62	93.44±0.72	74.55±0.12	70.11±0.58
I L	5.6±0.15	5.7±0.21	5.4±0.20	5.7±0.23
F L	10.8±0.22	13.8±0.20	11.5±0.20	10.8±.20
F I	2.01±0.30	3.19±0.30	3.10±0.30	3.08±0.30
S G R (%day-1)	0.52±0.06	0.98±0.18	0.77±0.19	0.72±.18
F C R	3.31±0.19	3.26±0.27	3.73±0.13	3.88±0.11
P E R	0.75±0.05	2.56±0.06	1.80±.07	1.77±0.07
H S I	2.41±0.05	2.81±0.05	2.62±0.06	2.60±.05
G S I	.85±.03	2.70±0.05	2.08±0.07	2.05±0.06

In our experimental fish the above-mentioned FA (fatty acid) was absent. This finding reflected that those fish were not lack of fatty acid. For other fish like Bass in America, the same observation was reported (Gatlin and Nematipour 1993; Bag 2021).When ω3/ω6 ratio was low then it enhanced the thrombogenicity. Linolenic and linoleic acid require almost similar type of catalyst (Li et al. 1999). The ω3PUFA was comparatively beneficial than ω6 fatty acids. ω3 fatty acids prevent thrombogenesis whereas ω6 fatty acids prevent atherogenesis (Christensen et al. 2001; Dewailly et al. 2001; Bag 2021). The ω3/ω6fatty acid ratio of experimental creatures placed the fish in Type II lean fish category. In the present trial, fish fed with AWL feed shows the tendency of increasing ω3 FAs. This increasing tendency of ω3FAs enhanced value of ω3/ω6 ratio which provides health benefits to human particularly heart patients (Bag 2021).

Table 3. Fatty acid profile of NOR, AWL, AWW and AWA fed fish

Composition	NOR	AWL	AWW	AWA
S F A				
13:0	4.1	2.7	4.3	3.7
14:0	2.0	1.2	2.0	1.5
16:0	31.0	28.9	28.9	30.6
17:0	0.98	2.1	2.8	2.3
18:0	7.9	9.0	8.9	8.4
20:0	0.5	0.3	00	0.5
22:0	0.3	8.1	7.8	6.8
24:0	0.7	1.1	1.6	0.5
Σ SFA	47.4	54.4	54.4	55.2
Monoene				
14:1	0.8	0.5	0.7	0.5
15:1	0.2	0.1	0.3	0.4
16:1	7.6	7.8	7.9	7.9
17:1	0.4	0.9	1.0	1.1
18:1ω9	12.7	12.1	12.6	14.0
20:1ω9	1.2	1.3	1.6	0.8
22:1ω11	1.4	0.6	0.7	0.7
24:1	1.6	2.1	2.1	1.4
Tot.MUFA	25.9	25.4	26.9	26.8
Dien				
16:02	1.1	00	1.3	1.4
18:2n6	5.9	4.8	4.5	4.7
20:02	00	00	00	2.3
Tot. DUFA	7.0	4.8	6.1	5.3
Poly				
18:3n6	1.2	1.4	1.1	1.3
18:3n3	2.0	3.0	3.4	2.9
20:3ω6	1.2	1.1	0.8	1.1
20:3ω3	0.06	0.03	0.03	0.1
20:4ω6	0.98	0.9	0.5	1.8
20:5ω3	1.7	1.9	1.4	1.1
21:5ω3	0.6	0.1	0.1	1.3
22:5ω6	0.3	0.1	0.3	1.1
22:5ω3	2.7	2.0	1.9	2.3
22:6n3	5.5	4.8	4.9	4.9
Σ PUFA	15.06	15.40	13.43	14.8
Total ω3	11.22	13.80	11.62	14.6
Total ω6	9.5	7.1	7.4	7.5
ω3/ω6	1.20	1.94	1.43	1.54

CONCLUSION

The findings of the present study has shown that generally aquatic weeds create different severe problems in water bodies. By using these non-conventional sources, the rapid growth of those unwanted weeds must be controlled to some extent. It created local employment generation and reduced the cost of fish feed. The feed prepared from aquatic weeds particularly Lemna (*Lemna minor*) enhanced yield as well as production.Feeds prepared by using aquatic weeds by magnifying ω-3PUFA in carcass get better value of fish

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Data Availability Statement: The database generated and /or analysed during the current study are not publicly available due to privacy, but are available from the corresponding author on reasonable request.

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