2012 2nd International Conference on Biomedical Engineering and Technology
IPCBEE vol. 34 (2012) © (2012) IACSIT Press, Singapore

Used of Some Plant Wastes for Fish Feeding with Reference on its Impact

Mahmoom Metwally[1] and Abdulbaset Elgellal[2]

[1] Department of Reproductive Physiology, Central Lab for Aquaculture Agriculture Research Centre
[2] Department of Chemistry, Faculty of Science, Misurata, 7 October University

Abstract. This study monitored changes in growth rate, various blood constituents (Blood glucose, total protein, cholesterol, Triglycerides ALT, AST, ALP and Gper) and glycogen content of Nile tilapia *(Oreochromis niloticus)* fed on diets containing different remaining plant materials. A total number of 120 Nile tilapias with an average body weight of 14 g/fish were divided into 4 equal groups. The 1st group fed on diets containing wheat bran, the 2nd group fed diet containing barley bran, the 3rd group fed diet containing olive mill olive mill waste) and the 4th group fed diet containing dat ston (dat ston mill waste). The results showed that the highest body gain for fish fed on diet No. 1 and 2, but the Food conversion ratio was low. Blood glucose level decrease in groups3 groups4 compared to group 1,2. Total plasma protein showed no significant difference among groups, but the lowest value was recorded in fish fed on diet No.4. Cholesterol, triglycerides, AST and ALT concentrations showed obvious increase in fish fed on olive mill than the other groups. Glycogen content in liver and muscles increased in groups1 and groups2 than other groups. In conclusion, it can be suggested that adding waste material of plant origin to fish diet can promote growth rate, decrease mortality rate and increase the antioxidant activity in fish.

Keywords: Olive mill, Dat ston, Barley bran growth performance, Body composition, Blood

1. Introduction

Traditionally, fish meal is the preferred dietary protein source for many farmed fish species and is appreciated for its amino acid balance, vitamin content, palatability and un-identified growth factors [1]. However, increasing cost of fish meal has restricted it to use as a protein source for fish diets. Therefore, plant proteins appear to be the most suitable alternatives for fish meal in fish diets. The efficiency of the various alternative protein sources as a partial or complete replacement for fish meal has been individually evaluated in fish diets, e.g. sunflower meal [2, 3], Soybean [4, 5], linseed meal [6, 7], canola [8] and cottonseed meal [9]. Individually, these plant by-product meals are rich in protein and essential amino acid. In rainbow trout, turbot, sea bass and sea bream, it was recommend to complete a substitute of fish meal by a mixture of plant protein. All diets contained L-amino acids to meet the amino acid requirements estimated for rainbow trout [10]. Other studies have also found that adding a mixture of plant protein source is more appropriate to obtain adequate amino acid compared to the incorporation of a single plant protein source [11, 12]. Replacing of fish meal by a plant protein mixture did not significantly affected feed intake, feed conversion ratio, protein efficiency ratio and the apparent digestibility coefficient of dry matter, crude protein and ether extract [13]. Increasing plant protein in the diets significantly reduced haemoglobin, hematocrite, ALT and AST values [13]. Replacement of fish meal in fish diet with yeast protein *Saccharomyces cerevisiae* supplemented with biogenic L-carintine (methionine plus lysine mixture) can totally replace of fish meal in tilapia diet without any adverse effect on growth performance [14]. Yeasts are a rich source of protein and B-complex vitamins. They have been used successfully as a complementary protein source in fish diet [14]. In addition, they have been used as a supplement in animals feed to compensate for the amino acid and vitamin deficiencies of cereals and are recommended as a substitute for soybean oil in diets for fowl [15]. Yeast and soybean have almost the same essential amino acid composition [16]. Carp fed two different isoprotein diets, either with increased fat

level (Group I) or increased carbohydrate level (Group II), showed significant differences regarding, cortisol, total protein and protein fraction contents, AST and ALT activities and body composition and weight increments between the two experimental groups [17]. Replacing fishmeal with soybean meal in practical feeds for Cuneate drum, induced no significant differences in feed intake between fish fed the control feed and feeds in which soybean meal replaced 20 to 80% of the fishmeal [18]. Substitution of fishmeal by a mixture of plant protein sources exerted an anti-oxidative effect, compromised growth performance only at the 100% level and decreased one of the immune defense mechanisms at above 75% level [19]. The growth experienced by catfish fed the various protein sources indicates that *C. gariepinus* are able to utilise alternative protein sources successfully [20].The objective of the present work was to study the using of waste material of plants in fish diet (Wheat bran, Barley bran, olive mill remaining and dat ston mill remaining) with special reference to the effect of these materials on growth performance, blood constituents and body composition of Nile tilapia *Oreochromis niloticus*.

2. Material and Method

2.1. Fishes

A total number of 120 Nile tilapias with average body weight of 14 g/fish were used in the present study. The used fish were apparently healthy and free from any abrasions or external parasites. They were acclimatized in glass aquaria for two weeks and put in optimum conditions.

2.2. Preparation of Experimental Diets

Four diets were prepared as shown in Table 1. The diet was pelleted trough fodder machine. The pellets were dried in a drying oven for 48 hours at 45°C, then cooled and saved in plastic bags and stored in refrigerator at 2°C during the experimental duration to avoid the nutrients deterioration.

2.3. Experimental Design

This experiment was conducted in aquatic Lab. of faculty of science Marghib University Libya. Fish were divided into 4 equal groups (each group has 10 fish) with three replicates. Group 1 fed on diet containing wheat bran. Group2 fed on diet with adding of barley bran group3 fed on diet with adding olive mill waste and group4 fed on diet with dat ston mill waste as indicated in Table1.

Table 1: Formulation of the experimental diets (% as dry weight basis)

Ingredients %	1st diet	2nd die	3rd die	Th 4 diet
Fish meal	30	30	30	30
Wheat flour	30	30	30	30
Wheat bran	30	-	-	-
Barley bran	-	30	-	-
Olive mill	-	-	30	-
Date stone mill	-	-	-	30
Cod liver Oil	3	3	3	3
Corn oil	2	2	2	2
Mineral premix	2	2	2	2
Vitamin premix	3	3	3	3
Total	100	100	100	100
Crud protein %	35.9	34.7	34.9	33.2
Crud fat %	8.09	8.37	10.47	9.58
Total carbohydrates %	36.88	39.95	30.65	31.27
Ash %	20.51	12.41	18.81	22.05

2.4. Growth Performance

Fish were weighed every 2 weeks in all experimental groups and live weight gain was recorded as the difference between final weight and initial weight.

2.5. Sample Collection

At the end of experiment, heparinzed blood samples were collected, from the caudal vein of fish after three months. The blood divided into 2 parts, the part1 for blood picture examination and part2 centrifuged at 3000 r.p.m for 15 minutes and blood plasma samples were stored at-20°C for biochemical analysis. In addition, samples from liver and muscles were taken and stored at-20°C for determination of glycogen.

2.6. Growth Measurements

Specific growth rate (S.G.R.), Feed conversion ratio (F.C.R.), Survival rate %, were calculated according to Jobling [21].

2.7. Biochemical Analysis

Fish body composition, moisture content was determined by oven drying at 105°C for 10 hrs (constant weight). Crude protein was indirectly measured by analysis of total nitrogen (CP = N X 6.25) using the Kjeldahl method [22]. Crude lipid was determined by using Soxhlet apparatus and ash was detected by weighting samples in a porcelain crucible placed in a furnace at 550°C for 4h. Crude fibre was estimated according to Goering and Van Soest [23]. Total plasma protein was determined by the Biuret method described by Wootton [24]. Plasma cholesterol was determined according to Pearson *et.al.* [25], Triglycerides [26], Glucose concentration in plasma was measured according to Trinder [27]. Liver and muscle glycogen were determined according to Johann and Lentini [28].

2.8. Statistical Analysis

Data were analyzed by analysis of variance using the SAS program [29]. Duncan's multiple-range test [30] was used to verify significance of the mean differences among treatments.

3. Results

Growth performances of fish after three months of feeding on different remaining materials are summarized in Table 2; fish groups fed on barley bran and wheat bran had a higher final body weight, weight gain and SGR than fish fed on olive mill and dat ston containing diets. There were no significant differences in the final body weight among fish groups fed on olive mill and dat ston containing diets. The highest amounts of dry feed intake (g/fish/day) were seen in fish groups fed on olive mill and dat ston, whereas, they expressed significant increase ($P<0.01$) than fish fed on wheat bran and barley bran containing diets, respectively as in Table 2. FCR decreased significantly ($P<0.01$) in *O. niloticus* fed on wheat bran and barley bran containing diets, compared to the groups fed on olive mill and dat ston containing diets. Mortality rate (%) increase in fish fed on olive mill and dat ston containing diets than other fish groups. Crude protein content in the body of fish showed no significant difference among all groups fed on diet containing of different remaining materials (Table 3). Crude lipids content in fish body increased ($P<0.01$) significantly (17.31 %) in fish groups fed on olive mill and dat ston containing diets compared to other groups. Ash content was showed significant ($P<0.01$) difference among fish fed on remaining materials. Also, dray matter content in fish body was significantly differ among all experimental groups. Total protein level in blood of all fish groups showed no significant differences among all groups. Blood glucose showed significant ($P<0.01$) decreases in fish fed on diets containing olive mill and dat ston diet compared to wheat or barley bran fed groups. Cholesterol level in blood was significantly ($P<0.01$)high in fish groups fed on olive mill and dat ston supplemented diets as compared to wheat or barley bran fed groups as illustrated in Table 4. Triglycerides in blood was significantly($P<0.01$) increased in fish groups fed on olive mill and dat ston supplemented diets as compared to wheat or barley bran fed groups. Blood ALT activity increased ($P<0.01$) significantly with adding of olive mill and dat ston to diets compared to wheat or barley bran fed groups. AST activity in blood after fed with olive mill and dat ston were significantly ($P<0.01$) increased compared to wheat or barley bran fed groups as in Table 4. ALP activity increased significantly($P<0.01$) with adding olive mill or dat ston mill to diets compared to wheat or barley bran fed groups. Glutathione peroxidase activity in blood was significantly ($P<0.01$) high in fish groups fed on diets contained olive mill or dat ston waste and as compared to wheat or barley bran fed group as illustrated in Table 4. Glycogen concentration in liver and muscles showed significant ($P<0.01$) decreases in fish fed on diets containing olive mill and dat ston diet compared to wheat or barley bran fed groups Table 5

Table 2: Growth performance and nutrient utilization of Nile Tilapia fed the experimental diets (Mean + SE)

Groups Growth	Group 1 Control	Group 2 Barley bran	Group 3 olive mill	Group4 Date Ston
Initial body weight (g)	14.54±0.25a	14.40±0.23 a	14.61±0.25 a	14.75±0.27 a
Final body weight (g)	78.75±0.64b	80.78±0.64a	71.36±0.62d	72.40±0.61c
Weight gain (g)	64.21±1.13a	66..38±0.77a	57..65±0.57b	58..67±0.34b
Specific growth rate	2.20±0.06a	2.01±0.05b	1 .94±0.04b	1 .90±0.08b
Total feed intake	47.02±0.98	46.58± 1.02	44.60±0.90	44.62±1.07
Feed conversion	1 .59±0.09d	1 .68±0.12c	1 .75±0.90b	1 .94±0.14a
Mortality rate (%)	1.2	1.5	2.1	2.0

Means with the different letters for each parameter is significantly different at $P < 0.01$.

Table 3: Whole body composition of Nile Tilapia fed the experimental diets (Mean + SE)

Groups	Group 1 Control	Group 2 Barley bran	Group 3 olive	Group4 Date
Crude protein(%)	21.03±0.43 a	21.83±0.37 a	20.56±0.51 a	20.56±0.36 a
Crude lipid (%)	4.88±0.15c	5.03±0.11b	5.68±0.43a	5.75±0.23a
Dry matter (%)	23 .46±0.06 c	24.79±0.08b	25.97±0.07a	24.52±0.02b
Ash (%)	5.49±0.03c	5.75±0.04b	5.71±0.02b	6.03±0.02a

Means with the different letters for each parameter is significantly different at $P < 0.01$.

Table 4: Blood constituents of Nile Tilapia fed on different remaining material (Mean + SE)

Groups	Group 1 Control	Group 2 Barley bran	Group 3 olive mill	Group4 Date Ston
Total protein	3.86±0.48a	3.84±0.27a	3.76±0.35a	3.66±0.20a
Glucose mg/dl	128.52±0.33a	129.71±1.14a	1 18.28±0.43b	1 14.16±0.70c
Cholesterol mg/dl	79.22±1 .47c	85.52±0.93b	89.70±0.15a	88.42±1.1 1a
Triglycerides	78.99±1.44b	79.56±1.91b	89.35±1.66a	90.72±1.33a
AST U/l	128.52±0.33a	129.71±1.14a	132.28±0.43c	134.16±0.70b
ALT U/l	120.22±1.47b	121 .52±0.93b	124.70±0.15a	125.42±1 .1 1a
ALP U/l	76.99±0.44c	79.56±0.91c	98.35±0.66a	92.72±1.33b
Gper U/l	68.52±1 .33a	66.71±1 .14a	96.28±1.43b	94.16±1.70b

Means with the different letters for each parameter is significantly different at $P < 0.01$.

Table 5: Glycogen concentration in liver and muscle tissues of Nile Tilapia fed the experimental diets (Mean + SE)

Groups	Group1 Control	Group2 Barley bran	Group3 olive mill	Group4 Dat Ston mill
Liver Glycogen g/gm Wet.Wt.	3.96±0.28a	4.15±0.27a	3.56±1.37b	3.35±1.41b
Muscles Glycogen g/gm Wet.Wt	1.76±0.48a	1.49±0.52a	0.95±0.35b	0.76±1.20b

Means with the different letters for each parameter is significantly different at $P < 0.01$.

4. Discussion

Fish groups fed on barley bran and wheat bran had a higher final body weight, weight gain and SGR than fish fed on olive mill and dat ston containing diets. There were no marked differences in the final body weight among fish groups fed on olive mill and dat ston containing diets. FCR decreased in *O.niloticus* fed on wheat bran and barley bran containing diets, compared to the groups fed on olive mill and dat ston containing diets. Mortality rate (%) increase in fish fed on olive mill and dat ston containing diets than other fish groups, these results are in agreement with those obtained by Liao [14], Mariola and Katarzyna [17], Yan Wang *et al.* [18] and Hoffman *et al. [20]*.Total protein level in blood of all fish groups showed no significant difference among all groups due to no difference in diet proteins [14, 17].Blood glucose showed significant decreases in fish fed on diets containing olive mill and dat ston diet compared to wheat or barley bran fed groups due to increase carbohydrate in their diets [16, 18, 20].Cholesterol and Triglycerides levels in blood was significantly high in fish groups fed on olive mill and dat ston supplemented diets as compared to wheat or barley bran fed groups due to their diets contains high fat than other groups, a significant and progressive decrease of plasma cholesterol and plasma protein levels was found with fish meal replacement [14, 18, 20].The ALT and AST activity in blood increased significantly with adding of olive mill and dat ston to diets compared to wheat or barley bran fed groups due to presence some oxidant material in olive mill waste [14, 18, 20].Glutathione peroxidase activity in blood was significantly high in fish groups fed on diets contained olive mill or dat ston waste as compared to wheat or barley bran fed group due to increase the metabolic activity,

these were in line to with increased glutathione reductase and gamma-glutainyl transferase after plant protein inclusion [18].Glycogen concentration in liver and muscles showed significant decreases in fish fed on diets containing olive mill and dat ston diet compared to wheat or barley bran fed groups due to increase of bloodglucose [18-20].In conclusion, remaining plant materials like olive mill waste and dat ston mill waste supplemented diets may be used in Nile tilapia fish feed without any effect on growth performance, body composition and biochemical constituents.

5. References

[1] A.G. Tacon. Feed ingredients for warm fish: fish meal and other feedstuffs. FAO Circm . 1993, 856: 64.

[2] D.M.S El-Saidy, and M.M.A. Gaber. Evaluation of dehulled sunflower meal as a partial complete replacement for fish meal in Nile tilapia, *Oreochromis niloticus* (L.), diets. In: Proceedings of the First Annual Scientific Conference on Animal and Fish Production, Fac. Agric., Al-Mansoura Univ., Egypt .September, 24-25. 2002a , 193-205.

[3] M.S. Ibrahim . Nutritional requirements tilapia fry during nursing period. M.Sc. Thesis, Fac. Agric. Benha University, Egypt, 2007.

[4] D.M.S. El-Saidy, and M.M.A. Gaber. Complete replacement of fish meal by soybean meal with dietary l-lysine supplement for Nile tilapia *Oreochromis niloticus,* fingerlings. J. the World Aquaculture Soc. 2002b, 33: 297-306.

[5] M.A. Soltan, M.K. Ibrahim, A. Fatma Hafez A.F. Fath El-Bab,. Effect of partial and total replacement of fish meal by soybean meal on growth and proximate analysis of Nile tilapia (*Oreochromis niloticus).* Egypt. J. Nutr. and Feeds .2001, 4: 799-812.

[6] D.M.S. El-Saidy, and M.M.A. Gaber. Linseed meal: its successful use as a partial and complete replacement for fish meal in practical diets for Nile tilapia *Oreochromis niloticus.* In: Proceedings of the Second International Conference on Animal Production and Health in Semi-Arid Areas. Fac. Envir. Agric. Sci., Suez Canal Univ., El-Arish-North Sinai, Egyp. 2001 ,pp: 63 5-643.

[7] M.A., Soltan. Partial and total of soybean meal by raw and heat treated linseed meal in tilapia diets. Egypt. J. Nutr. and Feeds . 2005a, 8: 1091-1109.

[8] M.A. Soltan. Potential of using raw andprocessed canola seed meal as an alternative fish meal protein source in diets for Nile tilapia. (*Oreochromis niloticus).* Egypt Journal Nutrtion and Feeds. 2005b, 8: 1111-1128.

[9] A. Saudi. An experimental bromatological evaluation of feeding cottonseed meal and alpha-tocopherol to tilapia fish. Ph.D. Thesis, Fac. Agric. Benha University, Egypt. 2008.

[10] NRC,. National research Council. Requirements of Fish. National Academy Press.1993, Washington, DC, 114.

[11] T. H. Watanabe, V. Aoki, Viyakarn, M. Y. Yamagata, S. Satoh and T. Takeuchi, Combined use of alternative protein sources as a partial replacement for fish meal in a newly developed soft-dry pellet for yellowtail, Suisan Zoshoku. 1995, 43: 511-520.

[12] C. Regost, J. Arzel and S.J. Kaushik. Partial or total replacement of fish meal by corn gluten meal in diet for turbot, *Psetta maxim.* Aquaculture.1999, 180: 90-117.

[13] M.A .Soltan., M.A. Hanafy and M.I.A. Wafa. Effect of Replacing Fish Meal by a Mixture of Different Plant Protein Sources in Nile Tilapia (*Oreochromis niloticus* L.) Diets. Global Veterinaria 2(4): 157-164.

[14] I.C. Liao, J. of the Fish Soc. of Taiwan. 1977, 5:1-110.

[15] B.Go¨hl , Tropical Feeds.FAO/Oxford Computer Journals LTD,Version.1991, pp: 1-7.

[16] T.P., Yeh, J. Chinese Agric. Chem. Soc., 1963,1: 56.

[17] F. Mariola, And S. Katarzyna, 2000. Effects of intensive culture and feeding is protein diets with different fat and carbohydrate contents cortical, total protein and protein fraction contents, AST and ALT activates and on body composition and weight increments in Carp *(Cypryinus Carpio L.)* finger lings. Abbrev.: Acta Ichth. Piscat.1963, 30(1):100.

[18] Y. Wang , L.Jun Kong, Cui Li and P. Dominique Bureau . Effect of replacing fish meal with soybean meal on growth, feed utilization and carcass composition of cuneate drum (*Nibea miichthioides).* Aquaculture .2006, 261: 1307.1313

[19] B.A. Sttga, L.S. Pena, P.R. Gomez, F. Medale, S. Kaushik and S.J. Perez. Effect of fishmeal replacement by plant

protein sources on non-specific defence mechanisms and oxidative stress in gilthead sea bream *(Sparus aurata)*. Aquaculture .2005, 9: 387-400.

[20] L.C. Hoffman, J.F. Prinsloo and G. Rukan. Partial replacement of fish meal with either soybean meal, brewers yeast or tomato meal in the diets of African sharp tooth catfish *Clarias gariepinus* Water S.A. 1997, 23(2): 181-186.

[21] M. Jobling, A short review and critique of methodology used in fish in growth and nutrition studies. J. Fish Biol. 1983, 23: 685-703.

[22] Association of Official Analytical Chemists. 14.ed. Arlington: Association of Official Analytical Chemists . 1984, 1141.

[23] H.K Goering, and P.J. Van Soest. Forage fiber analysis: apparatus, reagents, procedures and some applications. Washington: USDA/ARS .1970, 20.

[24] L.D.P .Wotton, Microanalysis in medical biochemistry in micro mated. Churchill, London. Basel, Kargor, 4 th. 1964, 264-270.

[25] Pearson, S.S.S. and T.H. Mcgavack. Arapid procedure for the determination of serum cholesterol. J. Clinical Endocrinol. 1953, 25: 8-13.

[26] E.Rice, Triglycerides (neutral Fat) in serum. Standard Methods Clinical Chem. 1970 , 6: 215.

[27] Trinder, P., Determination of glucose in blood using glucose oxidase with an alternative oxygen acceptor. Annual Clinical Biochem .1969, 6: 24-27

[28] C. Johann, and E.A. Lentini. Simultaneous determination of glycogen and lipids from heart muscles. Analytical biochemistry. 1971, 43: 183-187

[29] SAS Institute. SAS/SAT User's guide-version6. Cary. 1989

[30] D.B.Duncan, Multiple range and multiple F tests. Biometrics. 1955. 1955, 11: 1-42