Xi'an Shiyou Daxue Xuebao (Ziran Kexue Ban)/
Journal of Xi'an Shiyou University, Natural Sciences Edition
ISSN: 1673-064X
E-Publication: Online Open Access
Vol: 66 Issue 03 | 2023
DOI 10.17605/OSF.IO/Y689H

IMPACT OF DIFFERENT PERCENTAGES OF ANIMAL AND PLANT BASED DIETARY LIPIDS ON THE WEIGHT GAIN, TOTAL LENGTH, FORK LENGTH AND SERUM METABOLITES OF CIRRHINUS MRIGALA

AMARA AKHTAR
Department of Zoology, Wildlife and Fisheries, University of Agriculture, Faisalabad.

SAJID ABDULLAH*
Department of Zoology, Wildlife and Fisheries, University of Agriculture, Faisalabad.
*Corresponding Author Email: uaf_sajidabdullah@yahoo.com

ABDUL MATEEN
Department of Zoology, Wildlife and Fisheries, University of Agriculture, Faisalabad.

MUHAMMAD ANJUM ZIA
Department of Biochemistry, University of Agriculture Faisalabad.

Abstract

Present examination work was directed to comprehend the impacts of nutrients supplementation on minerals edibility in Cirrhinus mrigala fingerlings benefited from plant based (monounsaturated and immersed)and animal based origin and unsaturated) dinner based eating regimens enhanced with reviewed levels (3% 6% and 9%) of dietary lipid. The greatest body weight was seen in T19 (53.2 16.99) with 9% creature based fats and 3% plant-based fats and least body weight was seen in T13 (49.58 15.68) with 3% creature based fats and 3% plant-based fats. The absolute proteins were greatest in T11 (6%PBPU) and least in T10 (3%PBPU). Fatty substances were greatest in T9 (9%PBMU) and least in T0. Cholesterol was most noteworthy in T0 and least in T9 (9%PBMU) Level of glucose was most noteworthy in T0. 21 trial slims down were utilized including reference diet and twenty test counts calories. Reference diet was taken care of to the fingerlings of Cirrhinus mrigala to give suitable supplements to ordinary development. Test abstains from food were comprised of 70% reference diet and 30% test fixing i.e., sunflower oil Soybean oil, fish oil, and cold liver oil. Ascorbic Acid was included the feed at 1% fixation as toxic marker for assurance of supplement edibility. Most elevated edibility esteems (%) of lipid were seen in T20 of dietary lipid supplementation and least development saw in T10, these qualities varied fundamentally ($p<0.05$) from the reference diet and other test eats less carbs. Accordingly, in light of the current outcomes, it very well may be presumed that a counterfeit feed with 9% enhanced fish oil is adequate with practically no unfriendly impacts on development execution and muscle quality.

Keywords: Cirrhinus Mrigala, Fish Growth, Lipid Requirement, serum metabolites, Weight gain

INTRODUCTION

Freshwater fishes are not merely a major source of protein but they also contain nutritionally valuable lipids and fatty acids (FA). Labeo rohita (Danbro), Cirrhinus mrigala (Morakhi), Catla catla (Thalli) are economically important to human nutrition of Pakistan because of their high nutritional quality. Aquaculture is the fastest growing source of animal protein. Aquaculture currently provides about half of all the fish consumed globally (Bostock et al., 2010). Feed primarily accounts for 50 to 60% of total cost in fish culture (Essa et al., 2010). Fish meal (FM) is a major protein source in aqua feeds for different

ISSN: 1673-064X
E-Publication: Online Open Access
Vol: 66 Issue 03 | 2023
DOI 10.17605/OSF.IO/Y689H

fish species because it is an excellent source of essential nutrients such as indispensable amino acids, essential fatty acids and a number of attractants (Dawood et al., 2015).

Cirrhinus mrigala is the third most important Indian major carp. Cirrhinus mrigala is bottom feeder fish species, feed on decaying organic matter and vegetable debris (Britz et al., 1997; Azeredo et al., 1998). It is commercially cultured in the Indian sub-continent and is commonly known as "Mrigal" or "Nain" due to presence of golden eyes. Cirrhinus mirgala in aquaculture industry has been developing more efficiently than any other fish (Yildirım et al., 2014). Artificial feed is being used by cirrhinus mirgala as a potential source of basic nutrients such as amino acids, fatty acids, vitamins, minerals and growth factors (Zhou et al., 2004; Rahim et al., 2017). However, increasing demand, limited supply and high cost of fish meal with the expansion of aquaculture made it necessary to search for alternative protein sources (Pham et al., 2008; Lim et al., 2011). Dietry lipids are considered as best alternative protein and energy sources for fish growth (Gatlin et al., 2007; Hussain et al., 2011a, b, 2015).). Dietry lipids are essential for growth and development as it provides the body with energy and is needed for the production of hormones, antibodies, enzymes and tissues. Dietary lipids are easily available at low cost. Dietary lipid constitutes the primary nutrient cost of feed in culture systems. Consequently, optimization of dietary lipids along with increasing growth, reproduction and development at low costs (Thoman, Davis & Arnold 1999). The major objective of our study was to evaluate the role of dietry lipids in C. mrigala fingerlings and to formulate cost effective and environment friendly feed for the indigenous culturable fish species.

MATERIALS AND METHODS

The research work was conducted to determine the effect of dietary lipid levels on the feed utilization, growth performance, body composition and serum metabolites of major carp fingerlings. The trial was performed at Fish research farms, Department of Zoology, Wildlife and fisheries, University of Agriculture, Faisalabad.

EXPERIMANTAL CONDITIONS

Fingerlings of major carps were taken from the Government Fish Hatchery, Faisalabad. Fingerlings of *Cirrhinus mrigala* were put in tanks where they were acclimatized to new experimental conditions. Fishes were fed once a day on basal diets. By using digital meter dissolved oxygen of water medium was checked and maintained (HANNA, model HI 9147). Water quality parameter i.e., temperature of water and pH was monitored by AMPROBE pH meter.

Experimental Diets and Ingredients

Ingredients of experimental diets were chemically analyzed according to rules of AOAC (1995). The diets were formulated on the basis of plant origin (monounsaturated and polyunsaturated), animal origin (saturated and unsaturated) and combination of plant and animal origin dietary lipids. Each experimental diet formulated was made by supplementing different levels of lipids viz. 0%, 3%, 6% and 9% (El- Kasheif *et al.,* 2011).

ISSN: 1673-064X
E-Publication: Online Open Access
Vol: 66 Issue 03 | 2023
DOI 10.17605/OSF.IO/Y689H

Feeding Protocol

The fingerling was fed according to 2% of their wet body weight. 17 fingerlings were stocked in each experimental tanks and duplicate tanks was given for each experimental diet. The un-consumed diet was dried in oven and was used in FCR determination.

Growth performance and Feed utilization

Growth performance was determined by having weekly gross weights of fishes from each treatment. Feed utilization was determined by collecting uneaten feed from the tanks of the fishes. Growth performance and feed utilization can be determined in terms of absolute weight gain (WG), weight gain (%), specific growth rate (SGR), survival rate (%) and feed conversion ratio (FCR).

Moisture

Sample of fish muscle (1 gram) was taken in petri dish (W1). This petri dish was placed in the oven at 105^{o} C for 12 hours. This dried sample was then shifted to desiccator for 5 minutes and weight again. This sample was shifted again to the oven for 1-2 hours until constant weight was observed (W2). The difference in weight was determined as moisture. Following formula was used for calculation of dry matter percentage.

$$\text{Moisture (\%)} = \frac{\text{W1} - \text{W2}}{\text{Weight of sample}}$$

Where,

W1= Weight of petri dish + sample before drying

W2= Weight of petri dish + sample after drying

Dry matter (%) = 100 – moisture %

Weight gain (%)

Weight gain was determined by following formula:

$$\text{Weight gain \%} = \frac{\text{Final weight} - \text{Initial weight}}{\text{Initial weight}} \text{X100}$$

Absolute weight gain (AWG)

Absolute weight gain was determined by subtracting the final weight from initial weight of fish. Absolute weight gain (g) = Final weight (g) – Initial weight (g)

Feed conversion ratio (FCR)

Feed utilization was determined by calculating FCR.

$$\text{FCR} = \frac{\text{Total dry feed intake (g)}}{\text{Wet weight gain (g)}}$$

ISSN: 1673-064X
E-Publication: Online Open Access
Vol: 66 Issue 03 | 2023
DOI 10.17605/OSF.IO/Y689H

Statistical analysis

Statistical analysis of data was done by applying ANOVA (One-way analysis of variance). Student Newman-Keuls test was used for comparing means of data and probability was taken as $p < 0.05$ (Snedecor and Cochran, 1991).

Table 1: Composition of experimental diets with unsaturated and saturated animal-based and plant-based lipid levels

Ingredients	Control	% Animal-based unsaturated lipids in diet			% Animal-based saturated lipids in diet		
		3%	**6%**	**9%**	**3%**	**6%**	**9%**
Fish Meal	45.0g	45.0g	45.0g	45.0g	45.0g	45.0g	45.0g
Fish oil	0.0g	1.5g	3.0g	4.5g	1.5g	3.0g	4.5g
Cod liver oil	0.0g	1.5g	3.0g	4.5g	1.5g	3.0g	4.5g
Wheat bran	29.0g	26.0g	23.0g	20.0g	26.0g	23.0g	20.0g
Vitamins and mineral mix	1.0g	1.0g	1.0g	1.0g	1.0g	1.0g	1.0g
Rice bran	24.0g	24.0g	24.0g	24.0g	24.0g	24.0g	24.0g
Ascorbic Acid (Antioxidant)	1g	1g	1g	1g	1g	1g	1g
Total	100g	100g	100g	100g	100g	100g	100g

Table 2: Composition of experimental diets with monounsaturated and polyunsaturated plant-based lipid levels

Ingredients	Control	% Plant-based monounsaturated lipids in diet			% Plant-based polyunsaturated lipids in diet		
		3%	**6%**	**9%**	**3%**	**6%**	**9%**
Fish Meal	45.0g	45.0g	45.0g	45.0g	45.0g	45.0g	45.0g
Canola oil	0.0g	1.5g	3.0g	4.5g	1.5g	3.0g	4.5g
Olive oil	0.0g	1.5g	3.0g	4.5g	1.5g	3.0g	4.5g
Wheat bran	29.0g	26.0g	23.0g	20.0g	26.0g	23.0g	20.0g
Vitamins and mineral mix	1.0g	1.0g	1.0g	1.0g	1.0g	1.0g	1.0g
Rice bran	24.0g	24.0g	24.0g	24.0g	24.0g	24.0g	24.0g
Ascorbic Acid (Antioxidant)	1g	1g	1g	1g	1g	1g	1g
Total	100g	100g	100g	100g	100g	100g	100g

ISSN: 1673-064X
E-Publication: Online Open Access
Vol: 66 Issue 03 | 2023
DOI 10.17605/OSF.IO/Y689H

Table 3: Composition of experimental diets with combination of (3%, 6% and 9%) plant and 3%, 6% and 9% animal-based lipid levels

Plant Based lipids	Control	3% canola oil + soybean oil	6% canola oil + soybean oil	9% canola oil + soybean oil	3% canola oil + soybean oil	6% canola oil + soybean oil	9% canola oil + soybean oil	3% canola oil + soybean oil	6% canola oil + s soybean oil	9% % canola oil + soybean oil
		3%	6%	9%	3%	6%	9%	3%	6%	9%
(%) of diet	0.0g	1.5 + 1.5 = 3	3 + 3 = 6	4.5 + 4.5 = 9	1.5 + 1.5 = 3	3 + 3 = 6	4.5 + 4.5 = 9	1.5 + 1.5 = 3	3 + 3 = 6	4.5 + 4.5 = 9
Animal Based Fat (3%)	0.0g	3.0g	3.0g	3.0g	6.0g	6.0g	6.0g	9.0g	9.0g	9.0g
Fish oil	0.0g	1.5g	1.5g	1.5g	3.0g	3.0g	3.0g	4.5g	4.5g	4.5g
Poultry lipids	0.0g	-	-	-	-	-	-	-	-	-
Fish meal	27.0g	26.0g	26.0g	26.0g	26.0g	26.0g	26.0g	24.0g	24.0g	24.0g
Rice bran	30.0g	27.5g	27.5g	27.5g	24.0g	24.0g	24.0g	-	-	-
Wheat Flour	40.0g	39.0g	39.0g	39.0g	38.0g	38.0g	38.0g	40.0g	40.0g	40.0g
Ascorbic-acid (antioxidant)	1.0g	1.0g	1.0g	1.0g	1.0g	1.0g	1.0g	1.0g	1.0g	1.0g
Vitamin Mineral complex	2g	2.0g	2.0g	2.0g	2.0g	2.0g	2.0g	2.0g	2.0g	2.0g
Total	100g	100g	100g	100g	100g	100g	100g	100g	100g	100g

RESULTS

Growth Catalogs

The effects of source of dietary lipid levels in prepared diets on growth and serum metabolites are given in Table 2.Growth performance of *Cirrhinus mrigala* fed with animal origin saturated and un-saturated dietary lipids was observed during the trial. The maximum weight gain was observed in T9 (51.10 ±18.45) with 9% plant based monounsaturated fatty acids the minimum total weight was observed in To treatment (31.79 ±8.99) fed with 0% lipids. Results shows the maximum body weight was observed in T19 (53.2 ±16.99) with 9% animal-based fats and 3% plant-based fats and minimum body weight was observed in T13 (49.58 ±15.68) with 3% animal-based fats and 3% plant-based fats as compared to all combine ratio of animal and plant-based fats. With 9% animal-based fats and 3% plant-based fats, the maximum total length was observed in T19 (11.45 ±3.94) and minimum was observed in T0 group (6.96 ±1.69) in case of animal based unsaturated fatty acids. The maximum fork length was observed in T20 (11.35 ±4.67) with 9% animal-based fats and 6% plant based fats and minimum was observed in T0 group (6.58 ±1.71) whereas in case of animal based unsaturated fatty acids.

Serum metabolites

Analysis if variance of serum metabolites i.e., total protein, triglycerides, cholesterol and total glucose was shown in the table 2. .The total proteins were maximum in T11 (6%PBPU) and minimum in T10 (3%PBPU). Triglycerides were maximum in T9 (9%PBMU) and minimum in T0. Cholesterol was highest in T0and lowest in T9 (9%PBMU) Level of glucose was highest in T0.

Results clearly presented examples that were fed with plant based PUFAs has positive effects on the growth factor s and has considerable difference from other actions. Minimum growth was observed in control group T0. The restrict group was given protein

Xi'an Shiyou Daxue Xuebao (Ziran Kexue Ban)/
Journal of Xi'an Shiyou University, Natural Sciences Edition
ISSN: 1673-064X
E-Publication: Online Open Access
Vol: 66 Issue 03 | 2023
DOI 10.17605/OSF.IO/Y689H

diet devoid of lipids and so the proteins might have been used for energy production and not for growth

Table 4: Under treatments (T) receiving different dietary lipids levels, growth indices of *Cirrhinus marigala* cultured

Parameter	Maximum	Minimum
Average weight gain (g)	51.10±18.45	31.79 ±8.99
Average body weight (g)	53.2±16.99	49.58±15.68
Average final total length (cm)	11.45±3.94	6.96±1.69
Average final fork length (cm)	11.35±4.67	6.58±1.71

Table 5: Analysis of serum metabolites of different origin dietary lipids of *Cirrhinus Mrigala*

Parameters	Maximum value	Minimum value
Total protein (g/dl)	3.15±0.16	2.59±0.05
Triglycerides (mg/dl)	327.73±2.05	242.30±1.20
Cholesterol (mg/dl)	227.14±5.13	209.14±5.08
Glucose (mg/dl)	27.02±1.85	18.02±1.73

DISCUSSION

Cirrhinus mrigala is quite possibly the main hydroponics specie in India and refined alongside two other major carps catla and Labeo rohita in poly culture systems. It is a detrivorous and normally acquainted with eating tiny fishes or plant fixings. By and large, worldwide normal of 5% fish supper is utilized for carp species (Tacon and Metian, 2008). The current investigation was intended to really take a look at the total supplanting of FM with Plant and creature fixing combination in the eating routine of C. mrigala. It was confirmed from accessible writings that FM supplanted diet with plant and creature fixings affected development, feed proficiency, supplement edibility, and serum metabolites (Aksnes, Hope, Høstmark, and Albrektsen, 2006; Fontaínhas-Fernandes, Gomes, Reis-Henriques, et al., 1999). In this review, regardless of the dietary fixings arrangement, credited comparative development and weight gain for C. mrigala. This could be because of a similar degree of dietary energy (DE) and dietary lipid (DL) in both the eating regimens. Going before examines (Dias et al., 2009; Kaushik, &cove's, D., Dutto, G.,, and Blanc, D., 2004). Proposed that the supplement cosmetics of the feed is a higher priority than the fixings in the feed for the development execution of fish. Satisfactory equilibrium of key lipid in the feed can be accomplished through a reasonable mix of various plant protein sources (Dias et al., 2009; Silva, Espe, Conceição, Dias, and Valente, 2009). In the current review, the test feed, containing distinctive plant fixing combination, was presumably adequate to meet the supplement prerequisite of the fish species. The particular development rate and protein productivity proportion of C. mrigala took care of these two weight control plans in the current trial didn't shift recommending the protein usage from these to take care of sources were likewise comparative. Edibility is significant in deciding the supplements accessibility to look for development. Notwithstanding, there are many post-absorptive elements that impact supplement usage and development.

Xi'an Shiyou Daxue Xuebao (Ziran Kexue Ban)/
Journal of Xi'an Shiyou University, Natural Sciences Edition
ISSN: 1673-064X
E-Publication: Online Open Access
Vol: 66 Issue 03 | 2023
DOI 10.17605/OSF.IO/Y689H

Likewise, the supplement edibility is a lot of ward on the structure of fixings utilized in the feed. In this review, the dry matter and protein absorbability of C. mrigala took care of the test feed was comparative in contrast with FM-based control feed (Hossain, Nahar, and Kamal, 1997). It is affirmed from the current review that the carp species can effectively use over 80% supplement edibility from plant fixings present in their eating routine. The ADC of lipid in both the feeds were around 90%, which is like the announced qualities in different fishes like Sahu , silver point (93.6-94.8%) , (Mohanta , Mohanty, Jena, and, rohu (90.42-94.05%) (Hossain et al., 1997), and mrigala (92.1-98.1%) (Singh, 1991) took care of various plant protein-based functional eating regimens. The ADC of energy was around 90% in C. mrigala and comparative in both the feeds, which were likewise higher than the announced qualities in like manner carp (66.5-81.1%) (Hossain and Jauncy, 1989) took care of various plant protein-based eating regimens.

The ADCs of protein, lipid, and energy around 90% found in every one of the weight control plans in our review demonstrated that the supplements present in the eating regimens are genuinely edible .Digestion is the bio elements of catalysts. The information on stomach related compound exercises helps in choosing the right element for feed detailing for an animal types. The carbohydrase action in fish stomach is likewise to a great extent impacted by the dietary carb level and source (Kamalam, Medale, and P, S., 2017). In the current review, both the feeds contain an equivalent measure of carb, which could be the justification for equivalent amylase exercises in C. mrigala took care of both the feeds. Stomach related chemicals are a lot of dependent on feed creation and age/or phase of advancement (Chaudhuri, Mukherjee, and Homechaudhuri, 2012; Cousin, Laurencin, and Gabaudan, 1987).

lized for the current trial was something very similar and the equivalent exercises of the stomach related proteins in C. mrigala took care of both the weight control plans recommended that C. mrigala used the supplements regardless of the source. In the current review, entire body general creations of C. mrigala didn't vary fundamentally among the dietary medicines. Comparable perceptions were made in the entire body protein content of Nile tilapia (El-Saidy& Gaber, 2003) and carp (Pongmaneerat, Watanabe, Takeuchi, and Satoh, 1993). At the point when taken care of plant protein combination takes care of against fish supper containing takes care of. The entire body lipid content of C. mrigala in the both the medicines were likewise something very similar. The presence of fish oil from the fishmeal source was obvious with the presence of EPA and DHA in the unsaturated fat arrangement of feed (Table 1), nonetheless, that didn't impact the entire body lipid sythesis of C. mrigala. The unsaturated fat profiles of C. mrigala were not altogether impacted by the dietary medicines aside from the ALA content. The fish took care of with linseed oil enhanced feed saved an altogether higher measure of ALA in their tissue. This unmistakably shown the higher measure of ALA in the test feed brought about higher tissue ALA content.

In this association, preceding contemplates (Glencross, 2009; Tocher, 2003; Turchini and Francis, 2009) depicted that change of tissue unsaturated fat in balance fish were

ISSN: 1673-064X
E-Publication: Online Open Access
Vol: 66 Issue 03 | 2023
DOI 10.17605/OSF.IO/Y689H

conceivable with the replacement of fish oil with other dietary lipid. Nonetheless, the chance of unsaturated fats go through changes through metabolic cycles, including usage for energy creation (b-oxidation), bio-transformation (chain extension and desaturation), and anew unsaturated fat creation (lipo beginning) cannot be disregarded (Tocher, 2003). Linseed oil was utilized in this review due to the wealth of n-3 PUFA, ALA in linseed oil, forerunner of longer, more unsaturated and wellbeing advancing n-3 long-chain-PUFA, EPA, and DHA (Turchini et al., 2009). In the current trial, the entire body EPA and DHA substance were comparable in both the medicines, demonstrating bioconversion of ALA into LC-PUFAs. There was additionally no prevalence in tissue unsaturated fat saw in fish took care of with control feed which had leftover fish oil. Substitution of FM and FO by plant fixings didn't impact the blood biochemical constituents in C.mrigala in the current examination which consents to the previous perceptions in C. carpio (Stepanowska &Sawicka, 2006) took care of with fishmeal supplanted diet with plant fixings.

References

1. Ali, M.Z. and Jauncey, K., 2005. Approaches to optimizing dietary protein to energy ratio for African catfish Clarias gariepinus (Burchell, 1822). *Aquaculture Nutrition*, **11:**95-101.
2. Bostock, J., McAndrew, B., Richards, R., Jauncey, K., Telfer, T., Lorenzen, K., Little, D., Ross, L., Handisyde, N., Gatward, I. and Corner, R., 2010. Aquaculture: global status and trends. *Philosophical Transactions of the Royal Society B: Biological Sciences*, **365:**2897-2912.
3. Chanda, S., Paul, B.N., Ghosh, K. and Giri, S.S., 2015. Dietary essentiality of trace minerals in aquaculture-A Review. *Agricultural Reviews*, **36:**100-112.
4. Chung, Y.G., Camp, J., Haranczyk, M., Sikora, B.J., Bury, W., Krungleviciute, V., Yildirim, T., Farha, O.K., Sholl, D.S. and Snurr, R.Q., 2014. Computation-ready, experimental metal–organic frameworks: A tool to enable high-throughput screening of nanoporous crystals. *Chemistry of Materials*, **26:**6185-6192.
5. Cutini, A., Matteucci, G. and Mugnozza, G.S., 1998. Estimation of leaf area index with the Li-Cor LAI 2000 in deciduous forests. *Forest Ecology and Management*, **105:**55-65.
6. Dalbir, S.P., Roopma, G., Ritu, K., Vaini, G. and Shivalika, R., 2015. Effect of fish oil substitution with sunflower oil in diet of juvenile Catla catla (Ham) on growth performance and feed utilization. *Journal of Fisheries & Livestock Production*, 1-3.
7. Dawood, M.A., Koshio, S., Ishikawa, M. and Yokoyama, S., 2015. Interaction effects of dietary supplementation of heat-killed Lactobacillus plantarum and β-glucan on growth performance, digestibility and immune response of juvenile red sea bream, Pagrus major. *Fish & shellfish immunology*, **45:**.33-42.
8. El–Kasheif, M., Saad, A. and Ibrahim, S., 2011. Effects of varying levels of fish oil on growth performance, body composition and haematological characteristics of Nile tilapia Oreochromis niloticus (L). *Egyptian Journal of Aquatic Biology and Fisheries*, **15:**125-141.
9. El-Safi, S.H., Bucheton, B., Kheir, M.M., Musa, H.A.A., Moawia, E.O., Hammad, A. and Dessein, A., 2002. Epidemiology of visceral leishmaniasis in Atbara River area, eastern Sudan: the outbreak of Barbar El Fugara village (1996–1997). *Microbes and infection*, **4:**1439-1447.
10. Grundmann, M., Kwatra, V., Han, M. and Essa, I., 2010, June. Efficient hierarchical graph-based video segmentation. In *2010 ieee computer society conference on computer vision and pattern*

ISSN: 1673-064X
E-Publication: Online Open Access
Vol: 66 Issue 03 | 2023
DOI 10.17605/OSF.IO/Y689H

recognition pp. 2141-2148.

11. Hemre, G.I. and Sandnes, K., 1999. Effect of dietary lipid level on muscle composition in Atlantic salmon Salmo salar.
12. Hemre, G.I. and Sandnes, K., 1999. Effect of dietary lipid level on muscle composition in Atlantic salmon Salmo salar.
13. Iqbal, S.Z., Mustafa, H.G., Asi, M.R. and Jinap, S., 2014. Variation in vitamin E level and aflatoxins contamination in different rice varieties. *Journal of Cereal Science*, **60:**352-355.
14. Kaushik, S.J. and de Oliva Teles, A., 1985. Effect of digestible energy on nitrogen and energy balance in rainbow trout. *Aquaculture*, **50:**89-101.
15. Lytton, J., Westlin, M. and Hanley, M.R., 1991. Thapsigargin inhibits the sarcoplasmic or endoplasmic reticulum Ca-ATPase family of calcium pumps. *Journal of Biological Chemistry*, **266:**17067-17071.
16. Lytton, J., Westlin, M. and Hanley, M.R., 1991. Thapsigargin inhibits the sarcoplasmic or endoplasmic reticulum Ca-ATPase family of calcium pumps. *Journal of Biological Chemistry*, **266:**17067-17071.
17. Malet-Martino, M. and Martino, R., 2002. Clinical studies of three oral prodrugs of 5-fluorouracil (capecitabine, UFT, S-1): a review. *The oncologist*, **7:**288-323.
18. Menoyo, D., Lopez-Bote, C.J., Bautista, J.M. and Obach, A., 2003. Growth, digestibility and fatty acid utilization in large Atlantic salmon (Salmo salar) fed varying levels of n-3 and saturated fatty acids. *Aquaculture*, **225:**295-307.
19. Mishra, K. and Samantaray, K., 2004. Interacting effects of dietary lipid level and temperature on growth, body composition and fatty acid profile of rohu, Labeo rohita (Hamilton). *Aquaculture nutrition*, **10:**359-369.
20. Pandit, N.P. and Nakamura, M., 2010. Effect of high temperature on survival, growth and feed conversion ratio of Nile tilapia, Oreochromis niloticus. *Our Nature*, **8:**219-224.
21. PATEL, T., DERBASI, T. and HASSANEN, A., 1988. Thin aerofoil with multiple slotted flap. *Rozprawy Inzynierskie*, **36:**3-14.
22. Pham, T.A., Choi, B.C., Lim, K.T. and Jeong, Y.T., 2011. A simple approach for immobilization of gold nanoparticles on graphene oxide sheets by covalent bonding. *Applied Surface Science*, **257:**3350-3357.
23. Rahim, K., Saleha, S., Zhu, X., Huo, L., Basit, A. and Franco, O.L., 2017. Bacterial contribution in chronicity of wounds. *Microbial ecology*, **73:**710-721.
24. Riaz, D. and Shahzad, M.M., Effects of citric acid and phytase supplementation on nutrient digestibility and growth performance of Cirrhinus mrigala fingerlings fed on corn gluten (30%) meal based diets.
25. Shahian, D.M., Labib, S.B. and Chang, G., 1995. Cardiac papillary fibroelastoma. *The Annals of thoracic surgery*, **59:**538-541.
26. Sinha, V.R., Singla, A.K., Wadhawan, S., Kaushik, R., Kumria, R., Bansal, K. and Dhawan, S., 2004. Chitosan microspheres as a potential carrier for drugs. *International journal of pharmaceutics*, **274:**1-33.
27. Tacon, A.G.J. and Basurco, T.B., 1997. Fishmeal replacers: Review of ant nutrients within oilseeds and pulses-A limiting factor for the aqua feed Green Revolution.
28. Thoman, E.S., Davis, D.A. and Arnold, C.R., 1999. Evaluation of grow out diets with varying protein and energy levels for red drum (Sciaenops ocellatus). *Aquaculture*, **176:**343-353.