I. Anthonyraj al. International Journal of Recent Research Aspects ISSN: 2349-7688, Special Issue: Conscientious Computing Technologies, April 2018, pp. 854-857

Effect of fermented seaweeds in growth and biochemical composition of edible fish, Catla catla

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Abstract: - Seaweeds with good protein level are receiving considerable attention as novel feeds with potential nutritional benefits. However the presence of high crude fiber and low protein content are issues for low inclusion of seaweeds in aqua feeds. Fermentation is a simple and cheap method which might considerably decrease crude fiber content and increase protein value. Fermentation of seaweeds with lactic acid bacteria and yeast enhance the nutritive value by enriching protein, vitamin, mineral, essential amino acids, essential fatty acids and also improves the digestibility of seaweed based feeds. In this experiment, feed formulation was performed using fermented seaweed, Padina sp and Turbinari sp separately. Fermentation of seaweeds was done with beneficial bacteria like lactic acid bacteria and yeast, which is known to act as growth promoter, immune enhancer and probiotics in cultivable organisms. The effect of formulated feed was studied in edible fish, Catla catla. It is one of the most important aquacultured freshwater species in South Asia. Different proportions of fermented seaweed, such us 10%, 20% and 30% were chosen with control feed. The culture experiment was conducted for a period of 56 days. The formulated feed has increased the biochemical composition of the fish positively. The considerable increase in the nutrient level of fermented seaweeds due to microbial synthesis during fermentation process envisages that fermented seaweeds are the possible alternative protein ingredients in aqua feeds. In this experiment, the main technology is microbial fermentation. Therefore, it can also provide a reference for further development and application in aquaculture feed.

Keywords: seaweed, catla sp, fermentation, growth and biochemical.

INTRODUCTION

Several studies are directed to an efficient and cost-effective supplementary fish feed because of the importance of fish as a protein source for human and animal's diet. Fish meal is one of the major ingredients in making fish feed, considering its high importance as a source of protein. Nowadays, various types of seaweeds have become the centre of attention due to the possibility of these aquatic plants as an alternative source of protein for cultured fish.

MATERIALS AND METHODS

Experimental fish

The edible fish Catla catla, were collected from the "Sabari Fish Form", Vellanguli, Tirunelveli District, and TamilNadu and acclimatized to laboratory conditions for two weeks and fed with commercial diet.

SCIENTIFIC CLASSIFICATION

Kingdom: Animalia
Phylum: Chordata
Class: Actinopterygii
Order: Cypriniformes
Family: Cyprinidae
Genus: Catla
Species: Catla

Catla fish is the one of the popular fresh water fishes grown throughout india and identified as a indian carp. The commercial farming of catla fish is very high due to its fast growth and market demand.

Local names of catla fish in India:

Bhakur, Boassa, Chepti, Katla, Tambra(Hindi, Marathi), Botcha(Telugu), Katla, Thoppu meen (Tamil), Katla(kannada),Karakatla, Katla(malayalam), Katla, Pla kra Ho(Bemgali), Thambra(Gujarathi).

Biological Features

Body short and deep, somewhat laterally compressed, its depth more than head length; head very large, its depth exceeding half the head length; body with conspicuously large cycloid scales, head devoid of scales; snout bluntly rounded; eyes large and visible from underside of the head; mouth wide and upturned with prominent protruding lower jaw; upper lip absent, lower lip very thick; no barbels; lower jaw with a movable articulation at symphysis, without a prominent process; gill rakers long and fine; pharyngeal

teeth in three row, 5.3.2/2.3.5 pattern; dorsal fin inserted slightly in advance of pelvic fins, with 14 to 16 branched rays, the simple rays non-osseous; anal fin short; pectoral fins long extending to pelvic fins; caudal fin forked; lateral line with 40 to 43 scales. Greyish on back and flanks, silvery-white below; fins dusky.

The experiment seaweed Padina gymnospora and Turbinaria ornata was collected from Hare Island, Thoothukudi. Very commoly found in mid intertidal to at least 30 m deep. Grows in a variety of habitats including rocky intertidal, tide pools, intertidal benches, reef flats and deeper water.

Preparation of feed

Padina gymnospora was used as the substrate in the production of high nutritional fish feed. The collected seaweed was washed thoroughly and was dried in an air forced oven at 60 °C for 24 hours. Then, the dried seaweed was grounded to the size of 2 mm and was kept in an airtight container at 4 °C for further use. The other substrate that was used in this study is groundnut cake, soyabean meal, cotten milk extract, fish oil, vitamin tablets, wheat bran, multi grain otta. The dried seaweeds were grounded well in laboratory pulverizer sieved through a 0.3 mm mesh and used as raw seaweed powder and raw material for fermentation. Microbial fermentation of the seaweed was carried out in the fermenter vessel. The dried seaweed powder to seawater in the ratio of 1:9 (seaweed: seawater) was taken in the fermenter vessel. Each 10 ml of Lactobacillus spp. and Saccharomyces cerevisiae was inoculated at a concentration of 3.10 x 104. The sugar substrate, dextrose was added at the rate of 5 % w/v of base material. The fermentation was carried out till the pH reached at 4.00. A pH between 4 and 5 is desired for fermentation of feed ingredients because when the pH is below 4.00 the feed intake decreases and above 5.00, microbial spoilage is likely to occur. The fermented seaweed silage was collected from the fermenter and dried in a hot air oven at 60 0C for 2 days. The fermented seaweed powder is then used for feed preparation.

Table – 1 Ingredients in feed preparation

Feed Ingredients	control	10%	20%	30%
Multigrain Atta	100	100	100	100
Meal Maker	50	50	50	50
Fish Meal	80	70	60	50
Wheat Bran	20	20	20	20
Fish Liver Oil	5	5	5	5
Vitamin B12	2	2	2	2
Cotton Seed Extr	250(ml)	250(ml)	250(ml)	250(ml)
Seaweed Powder	_	10	20	30

Experimental design

Growth experiment was conducted with control and fermented seaweed P .gymnospora incorporated feeds at three different conc. viz., 10%, 20% and 30% (Table-1) . The fed was feeds twice daily at 10.00 am and 6.00 pm. The experiment was conducted for 56 days. The fishes were weighed every fourteenth day and the amount of feed adjusted accordingly. Fishes were reared in cement tanks. Each aquarium was equipped with a biological filter containing a high porosity filter sponge which was washed thoroughly every three days. Dissolved oxygen was added with diffused air at the top of the filter. After every 14th day two fishes were sacrificed for biochemical analysis of protein, lipid and carbohydrate.

Results

Fish growth performance and feed conversion were determined in terms of weight gain (WG), percentage of weight gain (WG%), daily growth rate (DGR), specific growth rate (SGR) (Table- 2& 3)

Table-2. Growth performance of C. catla for the fermented P. gymnospora feed.

Parameters	Control	10%	20%	30%
IW(g)	3.04±0.03	1.055±0.002	1.51±0.026	3.57±0.025
FW(g)	6.05±0.03	2.56±0.036	4.02±0.02	7.35±0.045
WG(g)	3.01±0.038	1.505±0.004	2.51±0.015	3.78±0.038
WG%	99.01±0.01	142.7±0.306	166.2±0.265	105.9±0.49
DGR(g/day)	0.054±0.001	0.027±0.0025	0.045±0.0021	0.068±0.0025
SGR(%/day)	1.23±0.03	1.58±0.03	1.75±0.035	1.29±0.032

Table-3. Growth performance of C. catla for the fermented seaweed Turbinaria ornate feed

Biochemical composition

P. gymnospora

In the Initial day of the experiment, the level of protein in the control, 10%, 20% and 30% were 1.06, 1.49, 1.06 and 1.28 mg.g-1 wet tissues respectively. At the end of the experiment period the level of protein was 28.22, 22.34, 22.74 and 24.48 mg.g-1 respectively. In the Initial day of the experiment, the level of carbohydrate in the control, 10%, 20% and 30% fermented seaweed were 2.43, 2.33, 2.22 and 2.39 mg.g-1 wet tissue respectively. At the end of the experiment period the level of carbohydrate was 28.44, 28.44, 30.12 and 31.58 mg.g-1 respectively. In the Initial day of the experiment the level of lipid in the control, 10%, 20% and 30% were 0.28, 0.31, 0.27 and 0.25 mg.g-1 wet tissues respectively. At the end of the experiment period, the level of lipid was 6.54, 4.12, 4.86 and 5.22 mg.g-1 respectively (Fig.1).

Parameters	control	10%	20%	30%
IW	1.35±0.03	1.73±0.02	1.68±0.02	1.97±0.01
FW	4.05±0.03	1.92±0.03	2.44±0.02	2.89±0.02
WG (g)	2.7±0.15	0.19±0.02	0.76±0.02	0.92±0.03
WG %	200±2.51	10.98±0.02	45.23±0.02	46.70±0.01
DGR(g/day)	3.57±0.02	0.20±0.02	0.81±0.03	0.83±0.01
SGR(%/day)	1.15±0.02S	0.56±0.03	1.17±0.01	1.42±0.02

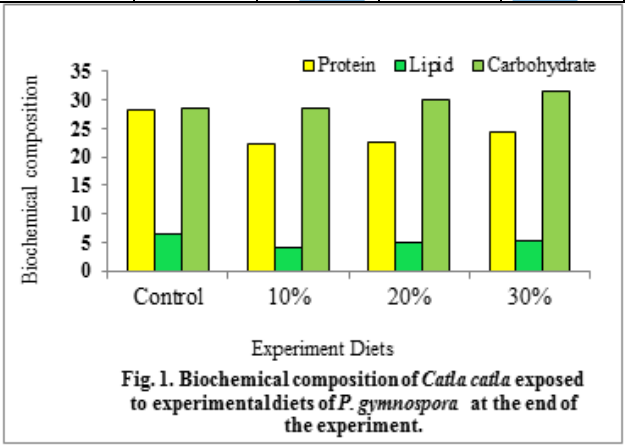

Fig. 1. Biochemical composition of *Catla catla* exposed to experimental diets of *P. gymnospora* at the end of the experiment.

T. ornata

In the Initial day of the experiment the level of protein in the control, 10%, 20% and 30% were 1.06, 1.49, 1.06 and 1.28 mg.g-1 wet tissues respectively. At the end of the experiment period the level of protein was 28.22, 19.23, 19.75 and 22.36 mg.g-1 respectively. In the Initial day of the experiment the level of protein in the control, 10%, 20% and 30% were 0.28, 0.31, 0.27 and 0.25 mg.g-1 wet tissues respectively. At the end of the experiment period the level of lipid was 6.54, 6.32, 6.12 and 7.46 mg.g-1 respectively. In the Initial day of the experiment the level of carbohydrate in the control, 10%, 20% and 30% were 2.43, 2.33, 2.22 and 2.39 mg.g-1 wet tissues respectively. At the end of the experiment period the level of carbohydrate was 28.44, 28.76, 31.44 and 31.67 mg.g-1 respectively (Fig.2).

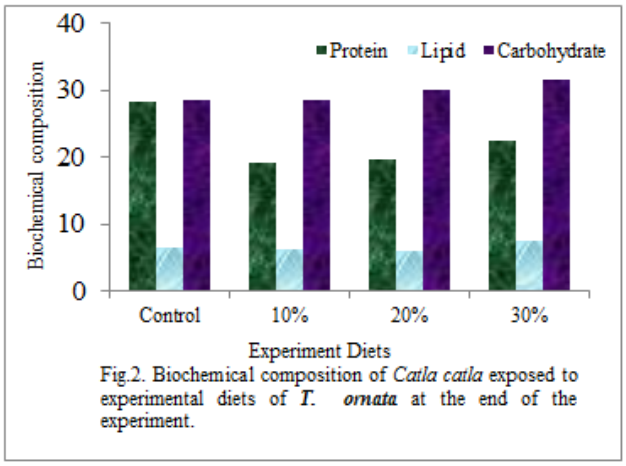

Fig.2. Biochemical composition of *Catla catla* exposed to experimental diets of *T. ornata* at the end of the experiment.

DISCUSSION

In the present study, the biochemical composition of Catla catla exposed to experimental diets at the end of the experiments was given in the Fig. The protein value was higher in the control, when compared to seaweed treated fish. In 30% fermented feed diet, the protein level was high compared to 10% and 20% fermented seaweed. The lipid level was higher in control when compared to fermented seaweed diet. The carbohydrate level was higher in the 30% fermented seaweed diet. The growth level was nearly equal to the control feed. Similar results were observed in other research papers also. The results were in good accordance with other paper.

One of the major growth promoting factors in fish feed is protein. Protein including enzymes, hormones and immunoglobins are needed by normal bodily functions and the deficiency of this nutrient can affect the protein synthesis and lead to the reduction in weight and other symptoms to the fish [1] Gatlin, D.M. (2010). The protein requirement of the fish was influenced by several factors, including fish size, water temperature and water quality, rearing environment, the genetic compositions and also feeding rates of the fish. Soluble carbohydrate in fish feed is important not only as a source of energy, but also because of its ability to increase the pellet integrity and stability, which is a crucial characteristic for fish feed [1] Gatlin, D.M. (2010).. In this study, the maximum amount of

carbohydrate was observed after the fermentation of using green seaweed (C.lentillifera). Contradict results were observed from the study done by [2] Murugaiyan et al. [2012] which found that Sargassum sp. has the maximum carbohydrate content (25.5±1.37%) followed by the other types of brown seaweed which is Stoechospermum marginatum (15.8±0.8%). Green seaweed, Caulerpa taxifolia and Caulerpa racemosa on the other hand showed a minimum carbohydrate content which are (9.7±0.47%) and (8.5±0.84%) respectively. Nutrition status of the cells has contributed to the variations of lipids and carbohydrate contents in the seaweed. The growth performance and feed utilization in the present study were also in agreement with other previous studies that have used algal species as diet ingredients in fish feed. [3] Davies et al. (1997) concluded that the use of the red algae, Porphyra purpurea,as a diet ingredient for mullet (Chelon labrosus) at high inclusion levels (16% and 33%), inhibited growth performance and feed utilization efficiency. Also, [4] Yousif et al. (2004) used Enteromorpha sp. as a dietary ingredient for Siganus canaliculatus with inclusion levels of 10%, 20%, 30% and noticed a decrease in the growth performance and feed utilization efficiency as the algae inclusion level increased. Our results, and the results of the previous studies, indicated that the maximum suitable algae inclusion levels in fish diets may depend on the feeding habits of the fish, and the species of Algae. The considerable increase in the nutrient level of fermented seaweeds due to microbial synthesis during fermentation process envisages that fermented seaweeds are the possible alternative protein ingredients in aqua feeds. In this experiment, the main technology is microbial fermentation. Therefore, it can also provide a reference for further development and application in aquaculture feed.

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