Eco. Env. & Cons. 28 (1) : 2022; pp. (464-468)
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ISSN 0971–765X

DOI No.: http://doi.org/10.53550/EEC.2022.v28i01.071

The effects of partial replacement of fish meal with *Roasted guar korma* meal on growth, feed utilization and survival of Tilapia (*Oreochromis niloticus*) advance Fry

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(Received 3 June, 2021; Accepted 5 July, 2021)

ABSTRACT

Present study was undertaken to study the effects of partial replacement of fish meal with *Roasted Guar Korma* on growth, feed utilization and survival of tilapia (*Oreochromis niloticus*). Advanced fry diet was examined. The experiments were conducted for 60 days in plastic tanks. Triplicates were maintained for each of the treatment. The five experimental diets were prepared which included a control diet (100% fish meal) and four treatment diets viz. fish meal replaced with *Roasted guar korma* at 25%, 50%, 75% and 100% of dietary protein levels respectively. The diets were formulated to provide 40% crude protein on a dry weight basis. Fish were fed with experimental dietsfor 60 days. The water quality parameters were found in the permissible range during entire experimental period. At the end of experiment it was found that the T2 treatment lead to higher weight gain (9.56 ± 0.49), SGR (1.57 ± 0.01) and PER (1.89 ± 0.02) and lowest FCR (1.65 ± 0.02) Thus, it can be concluded from the study that*Roasted guar korma* is a potential protein source and can be used to substitute fish meal in the diets of Tilapia *(O. niloticus)* advance fry.

Key words: *Roasted guar korma, Fish meal replacement, Tilapia, O. niloticus*

Introduction

One of the major points of discussion of the current era is the growing population and the need to meet their nutrition. The global aquaculture production is increasing at an annual rate of 6.6% which is more than agriculture and livestock. Feed dependent aquaculture has increased from 12.2 MMT to 50.7 MMT during this period (FAO, 2017).

Due to the high costs of fish meal and the dramatic decrease of fish catch, the demand for alternative protein sources is increasing day by day (Hardy, 2000; Kraugerud and Svihus, 2011). Siddhuraja and Becker, 2003 reported that major problems confronting the fish farming industry are the increasing cost and inadequate supply of fish meal and the competition of other livestock industries for fish meal.

Partial replacement of dietary fish meal protein with plant protein sources such as soyabean meal (SBM) (Oliva-Teles *et al*., 1994), winged bean (Fabgenro, 1999), has been successfully accomplished in a number of teleost fishes. However, only a few reports have appeared on the utilization of plant protein as the sole protein source in fish diets.

Guar (*Cyamopsis tetragonoloba*) which is also known as cluster bean is an annual herb growing up to 2m height with rose colored flowers. Guar has

excellent drought tolerance ability and is able to fix atmospheric nitrogen (El-sheikh and Ibrahim, 1999) India contributes 80% to the total guar production in the world. Guar meal has shown promising results in animal nutrition especially in cattle and poultry. In this regard, guar has a great potential to replace fish meal.

Raw guar meal contains anti-nutrients which limit its application in poultry diets. The main anti-nutrients are residual gum and protease inhibitors, known to increase the digest viscosity and reduce protein digestibility, respectively (Dersjant-Li *et al*., 2010). Although antinutritional factors such as trypsin inhibitor are present in the cluster bean, these are easily inactivated by heat (boiling) treatment, without adverse effect on its protein quality as described by Liener (1980). Results from these studies indicate that RGK is a promising sources of protein in aqua feeds.

Tilapia are known as "aquatic chicken" because of their fast growth, good quality flesh, disease resistance, adaptability to a wide range of environment conditions, ability to grow and reproduce in captivity and feed on low trophic levels. Therefore, they have become an excellent choice for aquaculture, especially in tropical and subtropical environment (El-Sayed 2006). Nile tilapia (*O. niloticus*) is one of the fastest growing, most valuable and economical freshwater fish.

Materials and Method

The experiment was conducted at the Wet Laboratory of Post-graduate Institute of Fisheries Education and Research, Kamdhenu University, Rajpur (nava), Himmatnagar, Gujarat. Over a period of 60 days from 4th February, 2019 to 3rd April, 2019. Advance fry of *Oreochromis niloticus* (Tilapia) with total length of 3.56 ± 0.09 cm (mean ± SE) and weighing 0.62 ± 0.04 g were selected for the experiment from Aqua fish farm, Ranagadh Village, Limbadi, District- Surendranagar, Gujarat (22°48'53.8''N 71°59'02.2''E). The fish were brought to Post-graduate Institute of Fisheries Education and Research, Kamdhenu University, Rajpur (Nava), Himmatnagar and were allowed to remain in plastic pools (500 l) with continuous aeration for 30 days.

Advance fry of tilapia (*O. niloticus*) were randomly selected and distributed in five distinct experimental groups in triplicate, following a completely randomized design

The experimental setup consisted of 15 plastic tanks (50 L capacity). The tanks were washed with potassium permanganate solution (4 mgl^{-1}) thoroughly and cleaned with fresh water. Three hundred sixty (450) fishes were randomly distributed in five distinct experimental groups. Each group was having three replicates following completely randomized design. Each plastic tank containing 50 L chlorine free water was stocked with 30 fishes. Water used for the entire experiment was sourced from bore-well (ground water source). Round the clock aeration was provided through the air-blower. The aeration pipe in each tank was provided with an air stone and a plastic regulator to control the air pressure uniformly in the entire tank.

The fishes were fed with a control diet for 30 days before the commencement of experiment. No attempts were made to stimulate or control the environmental condition. The experimental conditions were kept same throughout the experiment. The length and weight was measured at interval of 15 days to assess the growth. The fishes were starved overnight before taking bodyweight.

The experimental tanks siphoning was done every day in order to remove excess feed pellets and the remaining faecal matter. An equal volume of clean water replaced the siphoned water. This was carried out throughout the experimental period of 60 days.

Ingredients such as fish oil, vitamin and mineral mixture (Agrimin, Virbac Animal Health India Pvt. Ltd.) and were used for feed formulation. Five treatment diets with 40% protein were prepared *viz.*T0 = control (100% fish meal as primary protein source; 0% roasted guar korma), T1 = (75% of fish meal and 25% roasted guar korma), T2 = (50% of fish meal and 50% roasted guar korma), T3 = (25% of fish meal and 75% roasted guar korma) and T4 = (0% of fish meal and 100% roasted guar korma)

Moisture

The moisture content of the diet and carcass tissue were determined by taking a known weight of sample in Petri-dish and drying in hot air oven at 100-105°C until no change in weight. The moisture content was calculated using following formula:

$$\text{Moisture}(\%) = \frac{\text{Wet weight of sample} - \text{Dried weight of sample}}{\text{Wet weight of sample}} \times 100$$

Crude protein (CP)

The nitrogen content of the experimental diet, biofloc and carcass tissue was estimated quantitatively by Kjeldhal method. The crude protein percentage was obtained by multiplying nitrogen percentage by a factor of 6.25.

Crude protein (%) = N_2 (%) X 6.25

Where, N_2 is total nitrogen.

3.7.2.3 Ether extract

The ether extract was estimated by Soxhlet apparatus using petroleum ether (Boiling point 40-60 °C) as the solvent. The calculation was made as follows

$$EE(\%) = \frac{\text{Weight of ether extract (g)}}{\text{Weight of the sample (g)}} \times 100$$

Ash

Ash content was estimated by taking a known weight of sample in silica crucible and placing it in a muffle furnace at 600 °C for 6 hours. The calculation was done as follows:

$$Ash(\%) = \frac{\text{Weight of ash (g)}}{\text{Weight of sample (g)}} \times 100$$

Percentage weight gain

The percentage weight gain was calculated using the following formula:

$$\text{weight gain } (\%) = \frac{\text{Final weight} - \text{Initial weight}}{\text{Initial weight}} \times 100$$

Specific Growth Rate (SGR)

SGR (specific growth rate) as percentage was calculated according to El- Sayed (1998) using the formula given below.

$$SGR = \frac{\text{Log}_e(\text{Final Weight}) - \text{Log}_e(\text{Initial Weight})}{\text{Number of Days}} \times 100$$

Food Conversion Ratio (FCR)

FCR is the mass of the food eaten divided by the body mass gain, all over a specified period of time. The FCR (Food Conversation Ratio) was calculated according to El- Sayed (1998) using following formula:

$$FCR = \frac{\text{Amount of feed given (g)}}{\text{Body weight gain (Wet weight) (g)}} \times 100$$

Protein Efficiency Ratio (PER)

Protein efficiency ratio is a measure of utilization of dietary protein. PER was calculated using the below given formula as per El- Sayed (1998).

$$PER = \frac{\text{Body weight gain (g)}}{\text{Protein fed (g)}}$$

Table 1. Proximate composition of ingredients used in the study

Ingredients	Moisture	Dry matter	Ash	Protein	Fat
Fish meal	3.85	96.15	26.75	56.00	5.56
Roasted guar 7.10 *korma*	92.90	35.35	56.00	3.45	
Wheat flour	9.15	90.85	1.70	12.41	1.01
Rice flour	10.50	89.50	6.15	8.02	1.05
Wheat bran	10.85	89.15	4.65	12.00	2.99

1 Star fish meal plant, Veraval, Gujarat India. 2 Local market, Veraval, Gujarat India

Table 2. Composition and proximate analyses (on as-fed basis) of the test diets

Ingredients	Diets				
	T0 (Control)	T1	T2	T3	T4
Roasted guar Korma (56 CP)	0.00	17.25	34.55	1.75	69.00
Fish meal (56 CP)	69.00	51.75	34.51	7.25	0.00
Wheat bran (12CP)	11.00	11.00	11.00	11.00	11.00
Tapioca	2.00	2.00	2.00	2.00	2.00
Fish oil	8.00	8.00	8.00	8.00	8.00
Vitamin mixture	1.00	1.00	1.00	1.00	1.00

Survival rate

At the end of the experiment all the culture tanks were dewatered and the number of experimental animals in each tank was counted and the survival rate (%) was calculated by the following formula

$$\text{Survival (\%)} = \frac{\text{No. of fish survived after rearing}}{\text{No. of fish stocked}} \times 100$$

Results

The control diets produced excellent growth ratesthroughout the study. Table 4 shows effect of different protein sources on fish performance. Highest SGR was found in T2 diet treatment (1.57 ± 0.01) Similarly, the FCR was significantly low in the fish fed with diet T2 ($p<0.05$), where the PER value was found significantly high in the fish fed with diet T2 ($p<0.05$). The rate of fish survival ranged 100% in T0 treatment groups. Water quality parameters such as temperature, pH, dissolved oxygen, salinity, nitrate, nitrite and alkalinity were found to be within the optimum range during the experimental period. The fish carcass proximate composition in the present study showed that dry matter and crude protein content of O. niloticuswas not influenced by dietary protein source.

Discussion

Ahmad *et al.,* (2018) reported that the highest growth rate in tilapia achieved in feed having 40% dietary protein level during the research period. Thus, The level of protein was kept at 40% among all treatment diets tomaximize the growth of *O. niloticus* advancedfry.

Table 3. Proximate analysis of all treatment diets (determined on dry matter basis)

	Diets				
	T0	T1	T2	T3	T4
Crude protein	39.96	40.00	40.15	40.19	40.34
Ether extract 10.40	8.81	0.35	9.18	9.20	
Ash1	3.15	16.15	16.70	16.00	14.05
Moisture	10.83	10.90	11.04	11.07	11.09

1 Gemini sunflower oil
2 seven sea cods
3 Vitamin and mineral mixture/Kg premix: Vitamin A-7,00,000IU, VitaminD3-70,000IU, Vitamin E-250 mg, Nicotinamide-1000 mg, Cobalt-150 mg, Copper-1200 mg, Iodine-25g, Iron-1500 mg, Magnesium-6000 mg, Manganese-1500 mg, Potassium-100 mg, Sodium- 5.9 mg, Sulphur-0.72%, Zinc-9600 mg, Calcium-25.5%, Phosphorus-12.75%.

Table 4. Growth, food conversion ratio and protein efficiency ratio of *O. niloticus*fed the test diets for 60 days.

Parameters	Treatments				
	T0 (Control)	T1	T2	T3	T4
L1	4.26±0.25	4.16±0.49	4.30±00	4.13±0.12	4.23±0.68
L2	8.30±0.12	8.47±0.35	8.57±0.09	8.43±0.19	7.73±0.28
W1	1.51±0.01	1.52±0.38	1.55±0.12	1.57±0.66	1.52±0.19
W2	8.61±0.71	8.99±0.40	9.56±0.49	6.80±0.48	5.53±0.66
SGR	1.50 ± 03	1.53 ± .013	1.57±0.13	1.35±.02	1.24±.03
FCR	1.89±0.01	1.77±0.01	1.65±0.02	1.97±0.01	2.13±0.01
PER	1.65±0.01	1.76±0.01	1.89±0.02	1.58±0.00	1.46±0.00
SURVIVAL	98.88±1.11	100.00±0.00	98.88±1.11	97.77±1.11	96.66±0.00
Weight gain (%)	8.61±0.71	8.99±0.40	9.56±0.49	6.80±0.48	5.53±0.66

*L1- Initial length; L2- Final length; W1- Initial weight; W2- Final weight
SGR- Specific Growth Rate, SGR = Loge W2 – Loge W1 / T2-T1 x 100
FCR- Food Conversion Ratio, FCR = Amount of feed intake (g) / Wet weight gain (g)
PER- Protein Efficiency Ratio, PER= Increment in body weight (g)/ Protein intake (g)
Survival – survival (%) = No. of fish survived after rearing / No. of fish stocked x 100
Weight gain (%) = Final weight – Initial weight / Initial weight x 100

It was clearly demonstrated that there was significantly higher growth obtained in fish fed with the diet containing 50% fish meal and 50% guar korma, as compared to the other treatment diet. The highest percentage of body weight gain was found in treatment T2 (%), whereas the lowest was found in T4 diet (%).

Highest SGR was found in T2 diet treatment (1.57 ± 0.01) followed by T1 (1.53 ± 0.01) T0 (1.50 ± 0.03), T3 (1.35 ± 0.02) and T4 (1.24 ± 0.03).it significantly differ from other treatments and as compare to Al-Hafedh and Siddiqui's (1998) result which was 1. 94 ± 0.1b in diet 1 (75 % guar) reported for Nile tilapia.

In this present study FCR was significantly differed from all treatment than each other and this result obtained in T2 which was lowest 1.65± 0.02309 compare to FCR reported for *O. niloticus* (1.53-2.06) fed 30 % protein diets containing 13-50% green gram legume (De Silva and Gunaskera, 1989). Viola and Arieli (1983) found that the soyabean meal can be used to replace half of the fish meal in tilapia feeds containing 25% protein.

The highest PER was found in T2 diets (1.89 ± 0.02). The lowest PER was observed in T4 diet (1.46± 0.08) treatment. It appears that the replacement of fishmeal protein by guar protein up to level of 50% in tilapia diets and it was higher than the 1.64 ± 0.1[a] which was 50% plant protein (Al-Hafedh and Siddiqui, 1998) and also De Silva and Gunasekera (1989) did not report any significant variation in PER (1.65-2.06) in green gram diets (13-50%) substituted at 30% protein level in Nile tilapia fry diets.

The average survival rate of 100, 98.88±1.11, 98.88±1.11, 97.77 ± 1.11 and 96.66 ± 00% was observed in T1, T0, T2, T3, T4 treatments respectively. However, there was found no significant difference (p>0.05,) among the treatments.

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