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Study on the Growth Performance and Survival Rate of Two Important Indian Major Carps (*L. rohita and C. mrigal*) with Reference to Wastage of Vegetables as a Feed.

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Abstract
The present study has been conducted to observe the growth performance (with reference to length, weight, girth and depth) of two important Indian Major Carps, rohu (*Labeo rohita*) and mrigal (*Cirrhinus mrigal*). The experimental fishes were fed on pellets prepared from the combination of different vegetable waste for 60 days. The pelleted feed was given to the Indian Major Carps as a replacement of costly feeds. It was observed that the survival rate of experimental fishes was 100% during the experiment. The growth rate of fishes fed on the different feed (commercial feed(F-1), control feed(F-2) and the experimental feed(F-3)) was observed fortnightly. And the growth of length, weight, girth and depth was calculated with reference to SGR%. The SGR% for 60 days of experiment was 0.163%, 0.704%, 0.377% and 0.403% respectively in case of experimental fishes which was higher than the fishes fed on control feed as it was 0.085%, 0.219%, 0.173% and 0.107% respectively. It was also higher than the fishes fed on commercial feed as the SGR% of fishes with reference to length, weight, girth and depth was 0.064%, 0.184%, 0.187% and 0.129% respectively. This result shows the good impact of vegetable waste pellets on the growth of fishes.

Keywords: Vegetable waste, alternative nutritional source, Indian Major Carps, Specific Growth rate.

1. Introduction
In the aquaculture 60% cost occupied by the fish feed [8]; in which the wide range of expenditure is occupied by the fish meal due to its high protein content. Hence, there is need to search for the alternatives of fish meal. India generates approximately 30% vegetable waste of its total agricultural production per year [5]. And it's generally discarded into the landfills or the rivers, which may cause the environmental pollution. The utilization of such waste as an ingredient for fish feed can decrease the cost of feed and by utilizing it as a feed can also help to decrease the environmental pollution. Some vegetables are available at any season and the wastes of these vegetables are also shows the high nutritional values. The present study shows the effect of these wastes of vegetables on the growth and survival of two important Indian Major Carps (*Labeo rohita* and *Cirrhinus mrigal*).

2. Materials and methods
2.1 Procurement of the experimental fishes
The fingerlings of the Indian Major Carps were procured from the Fish farm and rearing center, Kosmada and brought to the Department of Aquatic Biology, VNSGU, Surat. The fingerlings were well acclimatized and maintained as a stock.

2.2 Experimental setup
experimental setup was made at the Aquarium Room of the Department of Aquatic Biology, VNSGU, Surat. Two aquaria with the capacity of 100 L were filled with the water and fishes were introduced in it @ 4 fingerlings of IMC. The fishes were adjusted for a week by giving the experimental feed. The aquaria were covered with a net to avoid the jumping out of the fishes and to eliminate the entry of insects in the tank. Netting was done at regular basis to

avoid the development of primary productivity. Temperature was maintained between 25-30^{0}C which is the optimum temperature required by the IMC and the pH was maintained between 7-8.

2.3 Preparation of experimental feed

For the preparation of experimental feed (F-3), the wastage of vegetables was collected from the different vegetable markets. After washing and cleaning, the waste vegetables were dried by sun-drying and the powder was made from it. The powder along with other ingredients (Wheat flour, Rice bran and Groundnut Oil Cake) was used to make a pellet. The control (F-2) feed was prepared by avoiding the vegetable waste in the feed and the common polyculture feed for IMC was taken as commercial feed (F-1).

2.4 Feed trials

Experimental feed was given to the fishes @ 5% of the body weight once a day at evening 5 p.m for the initial 15 days and then the feeding rate was increased up to 10% of their body weight till the end of the experiment. Left over feed was collected (if any) and weighing of it was done after sun-drying.

2.5 Analysis of proximate composition of pellets and the ingredients

Analysis for the proximate composition of feed ingredients and prepared feed was done for the crude protein by the micro-kjeldhal method IS: 7219 (2015), lipid by Folch *et al* (1957) method; sugar by the Method of sampling and analysis for sugar confectionery IS:6287 (2015), ash and moisture were estimated by gravimetric method AOAC (2000). List of ingredients and the proximate composition of ingredients and the experimental feed is described in table 1.

2.6 Observation of the survival rate and the growth performance of experimental fishes

The Survival Rate of the fishes during the experiment was calculated by using following formula.

(i) Survival rate = Number of fishes at the end stage of the experiment / Number of fishes at the initial stage of the experiment X 100

And the growth of experimental fishes was observed by measuring the total length, weight, girth and depth of the fishes.

The mean of the length, weight, girth and depth of all fishes was calculated and the growth performance was observed by calculating the Weight Gain and the SGR for total length, weight, girth and depth of fishes fed on F-1, F-2 and F-3 feed.

1. Weight Gain (WG) = final length of the fish (cm) – initial length of the fish (cm).
2. Weight Gain % (WG %) = gain of fish (gm) / Initial weight of fish (cm) X 100
3. Specific Growth Rate (SGR) % = 100 X [(ln W_2 - ln W_1)/ T]

Where $\mathbf{W_2}$ is the mean of final length or weight or girth or depth of fish, $\mathbf{W_1}$ is the mean of initial length or weight or girth or depth of the fish, **ln** is natural log and **T** is the time period of experiment.

3. Results and discussion

The results in table 2 shows the 100 % survival rate of all the fishes. The Weight Gain percentage was high in case of F-3 fishes as it was 52.63 % but it was low in case of F-1 and F-3 fishes as it was 28.57% and 14.04% respectively.

Specific Growth rate percentage for 60 days with reference to Weight of F-3 fishes was found more higher than the F-1 and F-2 as it was 0.704%, 0.184% and 0.219% respectively.

Figure 1 shows the SGR % calculated from the mean of the weight of fishes at the interval of 15, 30, 45 and 60 days. In that, the fishes for the F-1, F-2 and F-3 shows the similar growth for first 15 days as it was 0.038%, 0.269% and 0.341% respectively. But SGR% for last 15 days shows immense growth (1.124%) in case of fishes fed on experimental feed (F-3), while the fishes fed commercial (F-1) feed and control (F-2) feed shows the parallel growth. Hence it is proven that fishes showed the higher adaptability towards the vegetable waste fish feed.

Figure 2 shows the SGR % calculated from the mean of the length of fishes at the interval of 15, 30, 45 and 60 days. In that, SGR % of the length of the fishes from the F-1 shows the higher growth for first 15 days. But it shows the negative growth for 30 days and 45 days. On the other hand, the fishes fed on an experimental feed shows the positive and high growth.

Figure 3 shows the SGR % calculated from the mean of the depth of fishes at the interval of 15, 30, 45 and 60 days. In that, all the fishes from F-1, F-2 and F-3 feed treatment shows the high SGR % for the first 15 days. But after 15 days, all of the fishes showed the degraded growth and even negative SGR % was observe in case of fishes from the F-1 and F-2 feed treatment but the growth of fishes with F-3 feed treatment was still remained positive. The growth of fishes from F-2 and F-3 feed treatments were high during last 15 days.

Figure 4 shows the SGR % calculated from the mean of the girth of fishes at the interval of 15, 30, 45 and 60 days. In that, all the fishes from F-1, F-2 and F-3 feed treatments shows the similar growth during first 15 days but after that, the growth with reference to girth was higher in case of experimental fishes (F-3) than the other two groups as the SGR % for last 15 days was 0.381% for the fishes fed on control feed. The SGR% for the fishes with the F-1 feed treatment was 0.572 and the SGR% of for the fishes with the F-3 feed treatment was 0.588%.

4. Tables and Figures

Table 1: List of ingredients and the proximate composition of ingredients and the experimental feed.

Sr.no.	Ingredients	Protein (%)	Sugar (%)	Lipid (%)	Moisture (%)	Ash (%)
1	Rice bran (30%)	12.84%	1.59%	0.002 %	0.033%	0.01%
2	Groundnut Oil Cake (40%)	35.29%	3.49%	0.002 %	0.039%	0.008%
3	Wheat flour (10%)	12.09%	2.02%	0.001%	0.021%	0.001%
4	Veg. waste-1 (6.6%)	13.83%	4.02%	0.002%	0.039%	0.017%

5	Veg. waste-2 (6.6%)	15.93%	6.76%	0.003 %	0.031%	0.008%
6	Veg. waste-3 (6.6%)	3.68%	2.87%	0.003%	0.024%	0.007%
7	Commercial feed (F-1)	21%	0%	0.015%	0.575%	0.012%
8	Control feed (F-2)	22.08%	4.07%	0.013%	0.378%	0.011%
9	Experimental feed (F-3)	19.36%	4.39%	0.009%	1.561%	0.009%

Table 2: Survival rate and the Growth performance of fishes fed on F-1, F-2 and F-3 feeds for 60 days.

Sr.no.	Parameters	F-1	F-2	F-3
1	Mean initial weight (g)	19.25 gm	30.25 gm	19.25 gm
2	Mean final weight (g)	24.75 gm	34.5 gm	24.75 gm
3	Weight gain	5.5 gm	4.25gm	5 gm
4	Weight gain percent	28.57 %	14.04 %	52.63 %
5	SGR %	0.184 %	0.219 %	0.704 %
6	Survival Rate	100 %	100 %	100 %

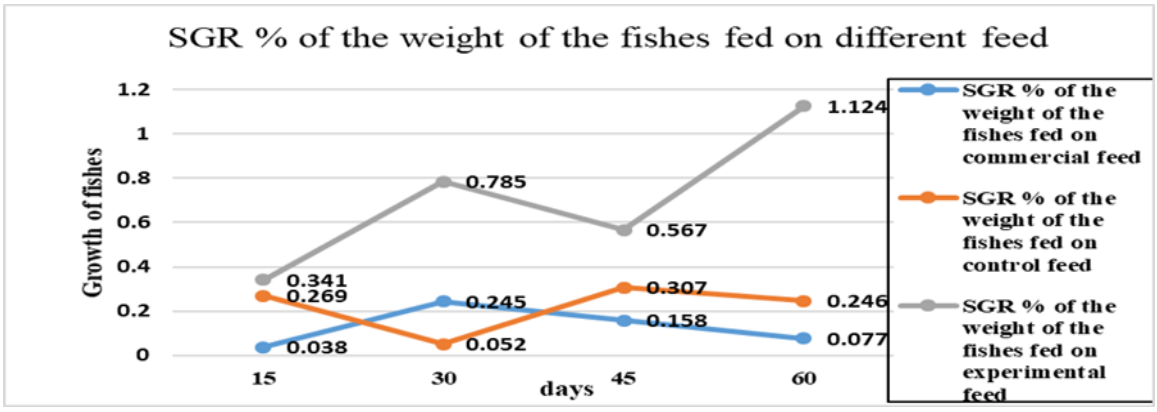

Fig 1: SGR % (at the interval of 15, 30, 45 and 60 days) of the weight of the fishes fed on commercial feed, control feed and an experimental feed.

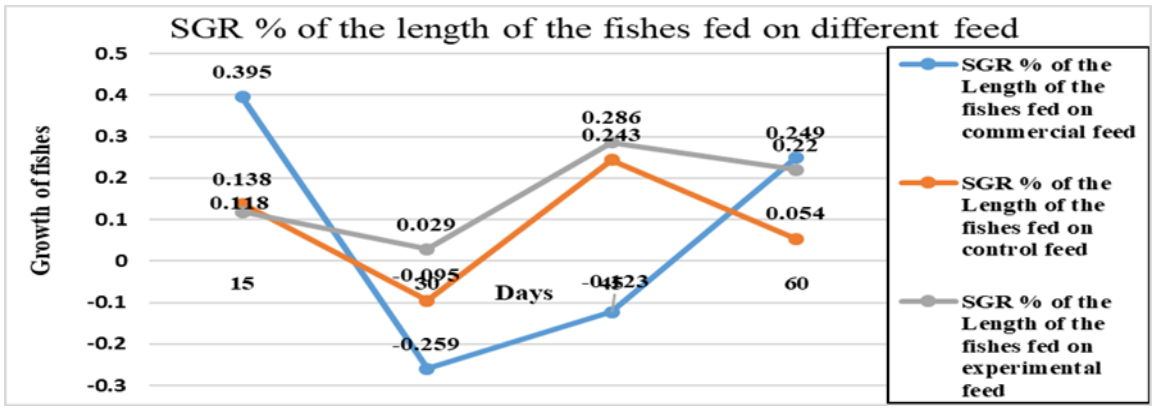

Fig 2: SGR % (at the interval of 15, 30, 45 and 60 days) of the length of the fishes fed on commercial feed, control feed and an experimental feed.

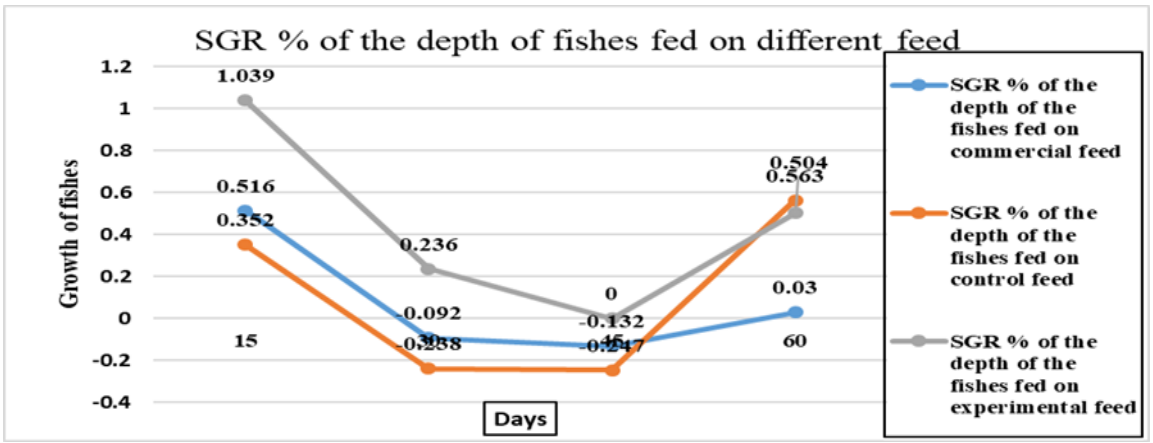

Fig3: SGR % (at the interval of 15, 30, 45 and 60 days) of the depth of the fishes fed on commercial feed, control feed and an experimental feed.

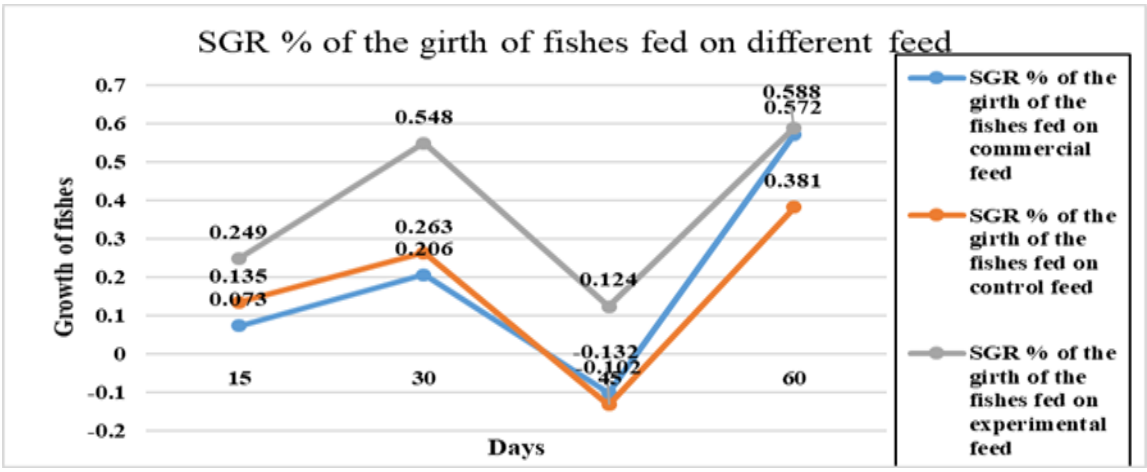

Fig 4: SGR % (at the interval of 15, 30, 45 and 60 days) of the girth of the fishes fed on commercial feed, control feed and an experimental feed.

Conclusions

Protein value of experimental feed was lower than the commercial feed and the control feed but the results obtained from the different parameters shows the higher growth of fishes fed on experimental feed than the other two feed as the protein value of experimental feed was 19.36 %, protein value of control feed was 22.08% and the protein value of commercial feed was 21%. It seems that nutritional values of different vegetable waste work very well for the growth enhancement of Indian Major Carps. Costly ingredients like fish meal can be replaced by vegetable waste ingredients as the results shows the higher growth of experimental fish than the fishes fed on commercial feed which is made up of high amount of fish meal.

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