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**Mahima Tamta**
Department of Fisheries Resource Management, College of Fisheries Science, G.B.P.U. Anand T Pantnagar, U.S. Nagar, Uttarakhand, India

**RN Ram**
Department of Fisheries Resource Management, College Of Fisheries Science, GB.P.U.A and T Pantnagar, U.S. Nagar, Uttarakhand, India

**JPN Rai**
Department of Environmental Science, College of Basic Science and Humanities, G.B.P.U.A and T Pantnagar, U.S. Nagar, Uttarakhand, India

**Munish Batra**
Department of Veterinary Pathology, College of Veterinary Science, G.B.P.U.A and T Pantnagar, U.S. Nagar, Uttarakhand, India

**Corresponding Author:**
**Mahima Tamta**
Department of Fisheries Resource Management, College of Fisheries Science, G.B.P.U. Anand T Pantnagar, U.S. Nagar, Uttarakhand, India

# Evaluation of growth performance of common carp and Amur carp with varying levels of macronutrients

**Mahima Tamta, RN Ram, JPN Rai and Munish Batra**

**Abstract**
The present study was conducted to evaluate the growth performance of common carp & Amur carp (both male and female) on the basis of protein, lipid and carbohydrate incorporated in feed. The study was conducted for 13 months. The observations of present study indicated that for achieving better growth the feed must be incorporated with macronutrients *viz* protein, lipid and carbohydrate in balance. The present study revealed that better growth parameters were attained by the fish group that was fed with high protein and lipid incorporated in feed, in comparison to control diet.

**Keywords:** Macronutrients, carps, growth

## Introduction
Proper nutrition is a key factor in promoting growth, generating good body composition and sustaining overall health of fish. Nutritious diets and appropriate feeding regimes play critical role in maintain good health of animal. The objective of feeding fish therefore, is to meet the nutritional requirements for good health, optimum growth, optimum yield and minimum waste (San and Chew, 2005) [13]. The six classes of nutrients (water, proteins and other nitrogenous compounds, lipids, carbohydrates, minerals and vitamins) are vital for growth, reproduction and maintenance of health of animal. The macronutrients (protein, lipids and carbohydrates) provide immense energy for metabolic system to be functional. They are also used to build and repair the tissues, to regulate body processes and are eventually they are converted and used for energy. The micronutrients (calcium, phosphorous, magnesium, chloride, sodium, potassium, sulphur), and the trace elements (cobalt, chromium, copper, iodine, iron, manganese, selenium, and zinc) are used to make avail the necessary cofactors for metabolism to be carried out. Both types of nutrients can be acquired from the environment, but in order to accelerate growth, these must be consciously supplemented in formulated diets.
Common carp (*Cyprinus carpio* L.) is one of the most economically vital freshwater species in the world, especially in Europe and Asia (Prchal *et al.*, 2018) [10]. Common carp accounts for approximately 40% of total global aquaculture product and 70% of total freshwater aquaculture product (Xu *et al.*, 2014) [17]. Being omnivorous, resistant and tolerant to wide variations of factors of the environment it is one of the most cultured fish in the world. The Amur carp is an original wild form, which spread from Asian carp centre to the Western Asian Rivers. This carp adapted to the local environmental conditions. In crossbreeding with all other strains Amur wild carp gave improved results. It has a good food conversion ratio and also good natural feed selection capacity.

## Materials and method
**Experimental Site and its Climate-** The experiment was conducted at College of Fisheries, Govind Ballabh Pant University of Agriculture and Technology, Pantnagar, Udham Singh Nagar, Uttarakhand, India, geographically located at 29° N latitude, 79.3° longitude and an altitude of 243.3 m above mean sea level (MSL), in Tarai belt of Shivalik range of Himalaya. The experimental site had humid sub-tropical climate characterized by very hot and dry summer and very cold winter. Experimental fish collection one of the experimental fish (Amur carp) was collected during the month of March 2019 from fish seed hatchery of College of Fisheries, Govind Ballabh Pant University of Agriculture and Technology, Pantnagar,

Udham Singh Nagar, Uttarakhand India and other (Common carp) was collected from a local fish farm. The experimental fish were kept in F.R.P tanks in re-circulatory aquaculture laboratory of College of Fisheries, with two replicates of each group.

**Statistical analysis:** The data obtained from various fish groups was statistically analyzed with design Two- Way ANOVA using Excel sheet.

## Result

### Proximate composition of formulated diets

**Table 1:** (Control diet)

| S. No. | Contents | Percentage % |
|---|---|---|
| 1 | Moisture | 17.58 |
| 2 | Ash | 11.96 |
| 3 | Crude protein | 29.20 |
| 4 | Crude fat | 7.89 |
| 5 | Carbohydrate | 33.37 |

**Table 2:** (Protein diet)

| S. No. | Contents | Percentage % |
|---|---|---|
| 1 | Moisture | 12.90 |
| 2 | Ash | 9.98 |
| 3 | Crude protein | 38.20 |
| 4 | Crude fat | 3.50 |
| 5 | Carbohydrate | 35.50 |

**Table 3:** (Lipid diet)

| S. No. | Contents | Percentage % |
|---|---|---|
| 1 | Moisture | 18.10 |
| 2 | Ash | 17.60 |
| 3 | Crude protein | 25.29 |
| 4 | Crude fat | 18.26 |
| 5 | Carbohydrate | 20.40 |

**Table 4:** (Carbohydrate diet)

| S. No. | Contents | Percentage % |
|---|---|---|
| 1 | Moisture | 21.26 |
| 2 | Ash | 12.69 |
| 3 | Crude protein | 28.2 |
| 4 | Crude fat | 5.63 |
| 5 | Carbohydrate | 31.92 |

### Results of observed parameters-Length

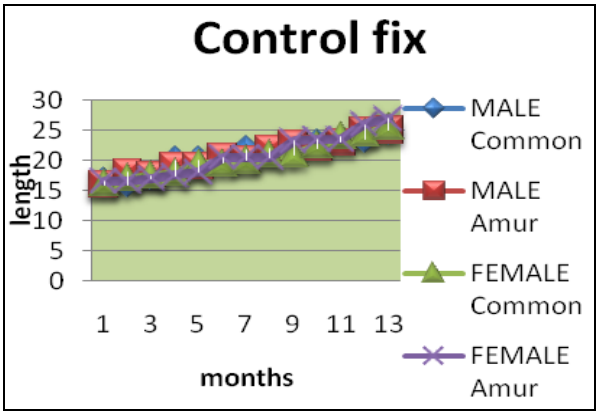


**Fig 1:** Length of male and female of common carp and Amur carp with Control diet (Fed two times a day)

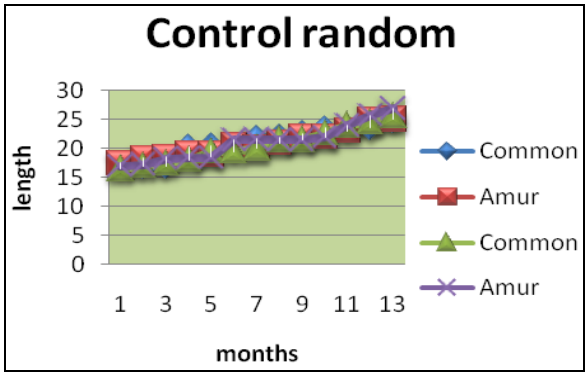


**Fig 2:** Length of male and female of common carp and Amur carp with Control diet (Fed once in a day)

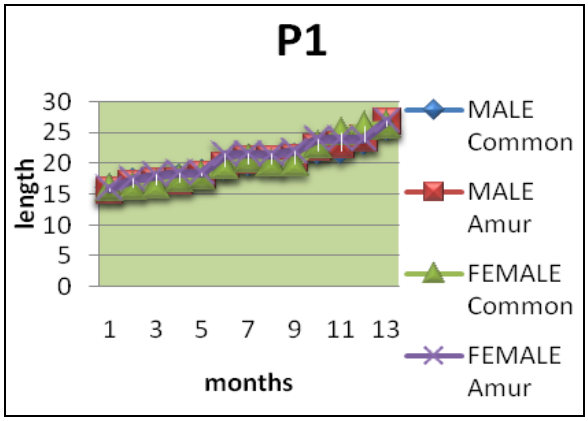


**Fig 3:** Length of male and female of common carp and Amur carp with Protein diet

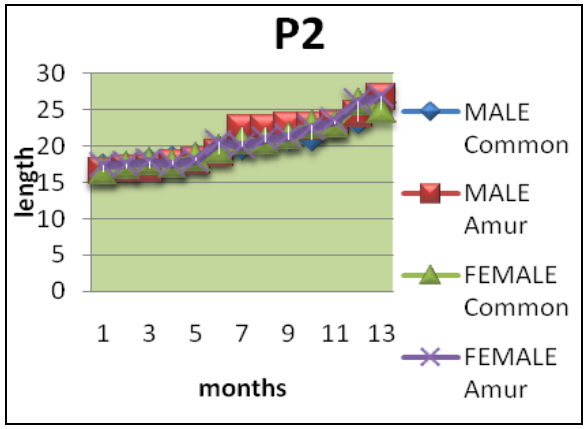


**Fig 4:** Length of male and female of common carp and Amur carp with Protein diet

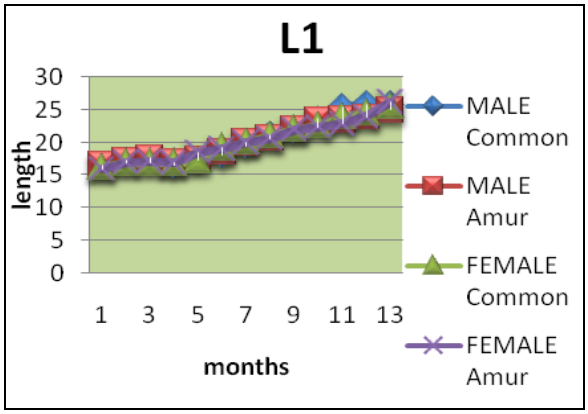


**Fig 5:** Length of male and female of common carp and Amur carp with Lipid diet

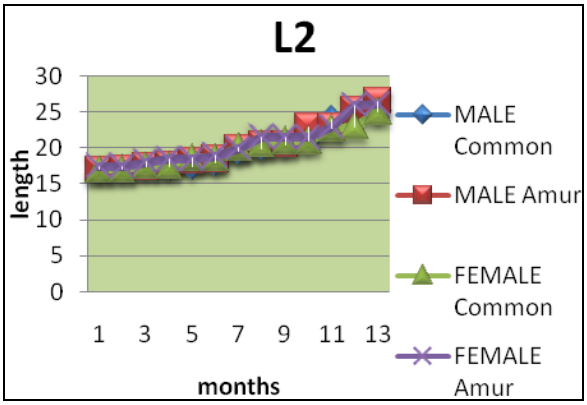


**Fig 6:** Length of male and female of common carp and Amur carp with Lipid diet

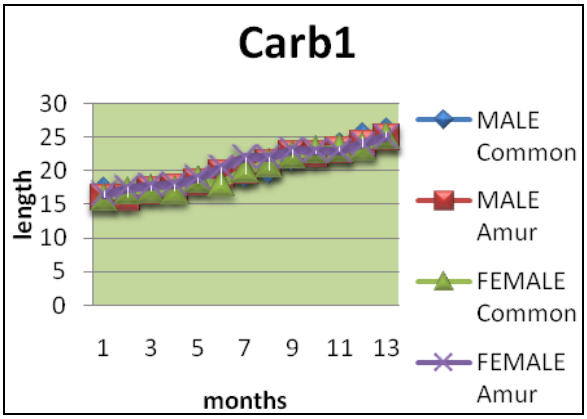


**Fig 7:** Length of male and female of common carp and Amur carp with Carbohydrate diet

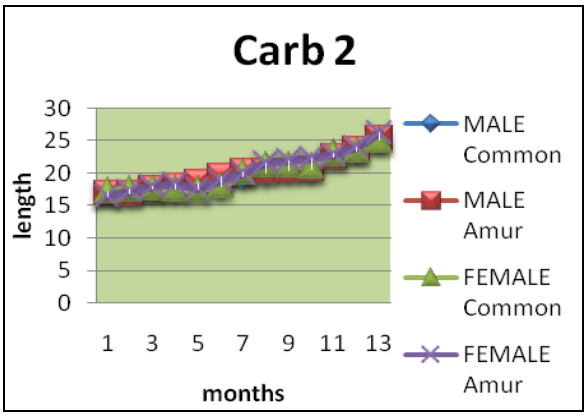


**Fig 8:** Length of male and female of common carp and Amur carp with Carbohydrate diet

**Weight**

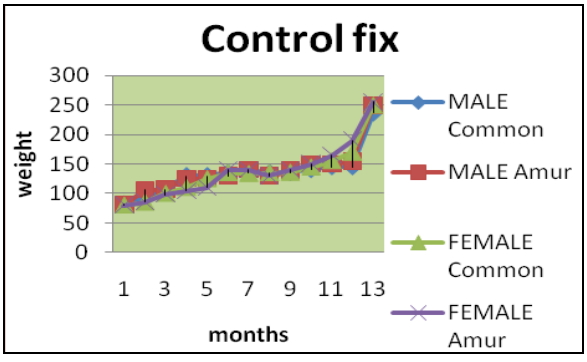


**Fig 1:** Weight of male and female of common carp and Amur carp with Control diet (Fed two times a day)

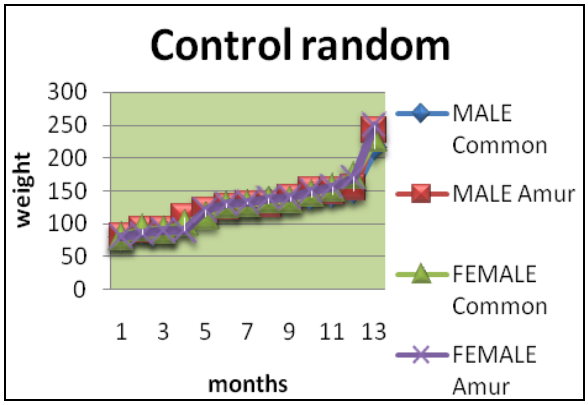


**Fig 10:** Weight of male and female of common carp and Amur carp with Control diet (Fed once in a day)

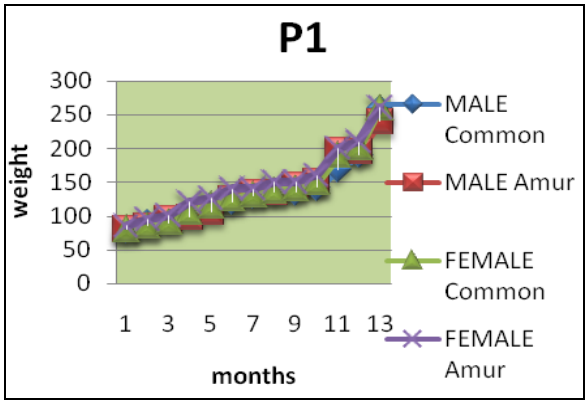


**Fig 11:** Weight of male and female of common carp and Amur carp with Protein diet

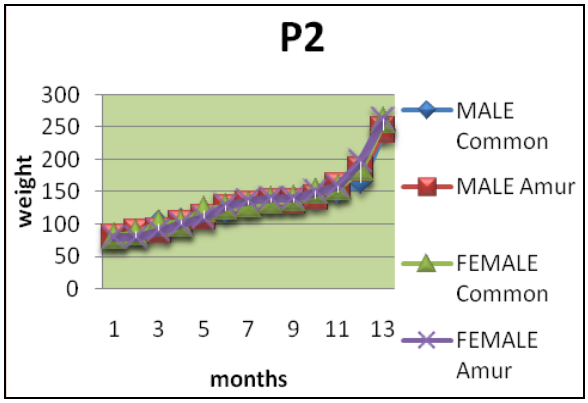


**Fig 12:** Weight of male and female of common carp and Amur carp with Protein diet

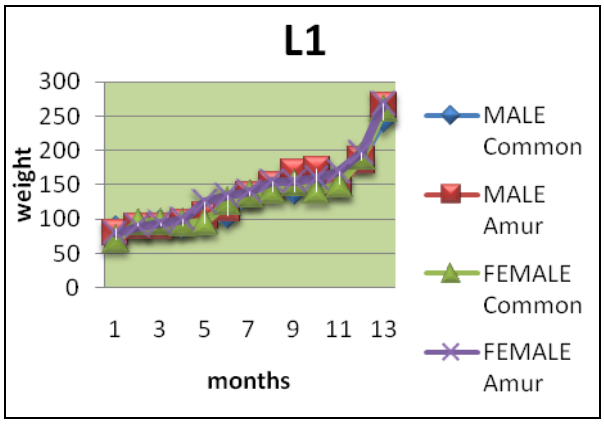


**Fig 13:** Weight of male and female of common carp and Amur carp with Lipid diet

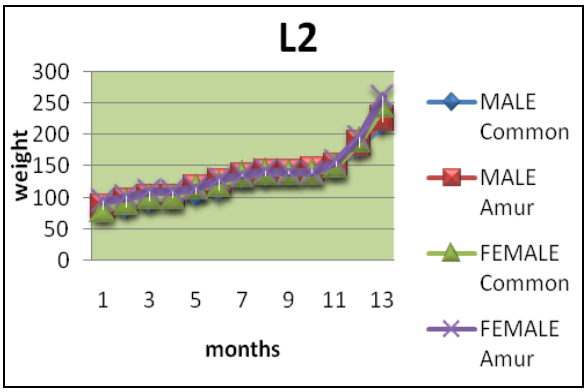


**Fig 14:** Weight of male and female of common carp and Amur carp with Lipid diet

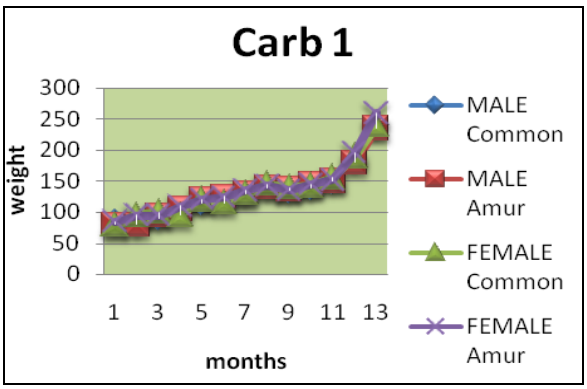


**Fig 15:** Weight of male and female of common carp and Amur carp with Carbohydrate diet

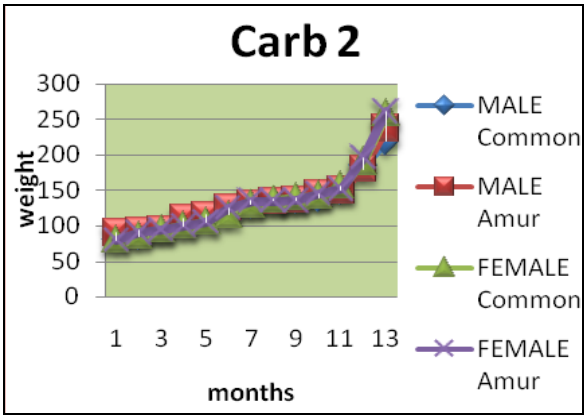


**Fig 16;** Weight of male and female of common carp and Amur carp with Carbohydrate diet

**Condition factor-**

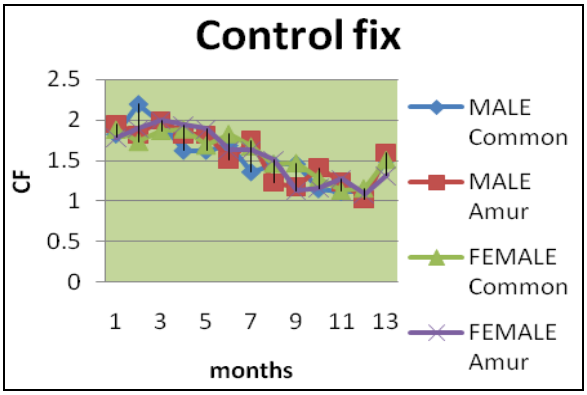


**Fig 17:** Condition Factor of male and female of common carp and Amur carp with Control diet (Fed two times a day)

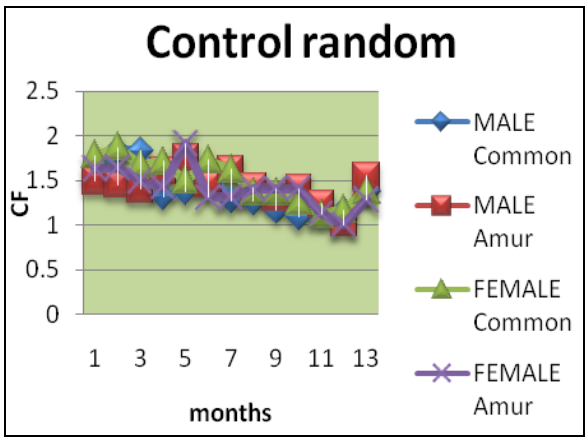


**Fig 18:** Condition Factor of male and female of common carp and Amur carp with Control diet (Fed once in a day)

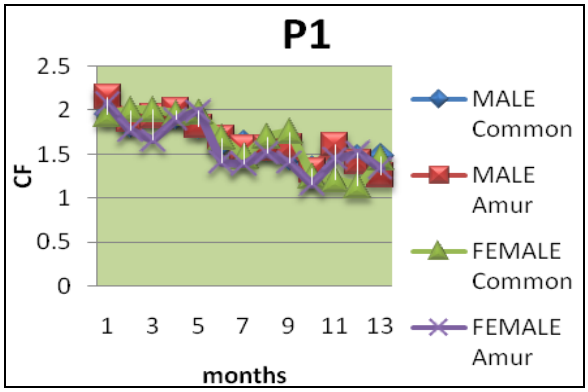


**Fig 19:** Condition Factor of male and female of common carp and Amur carp with Protein diet

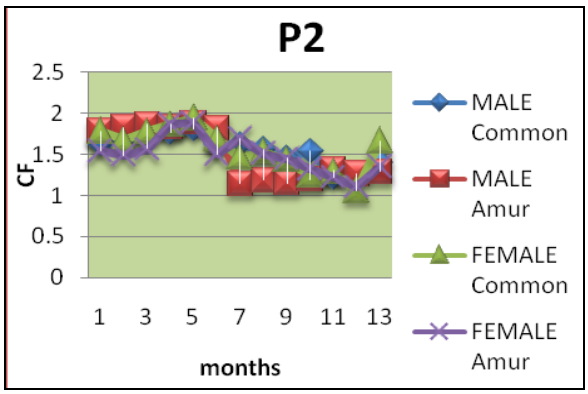


**Fig 20:** Condition Factor of male and female of common carp and Amur carp with Protein diet

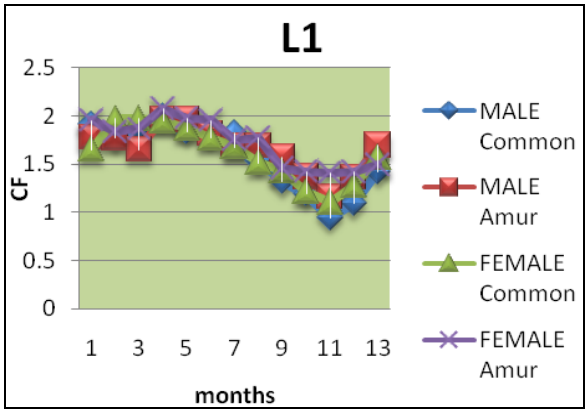


**Fig 21:** Condition Factor of male and female of common carp and Amur carp with Lipid diet

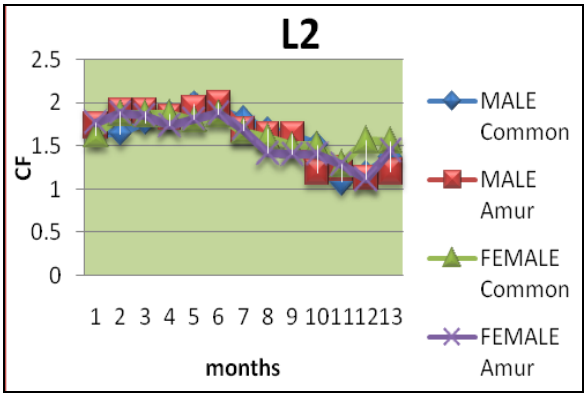


**Fig 22:** Condition Factor of male and female of common carp and Amur carp with Lipid diet

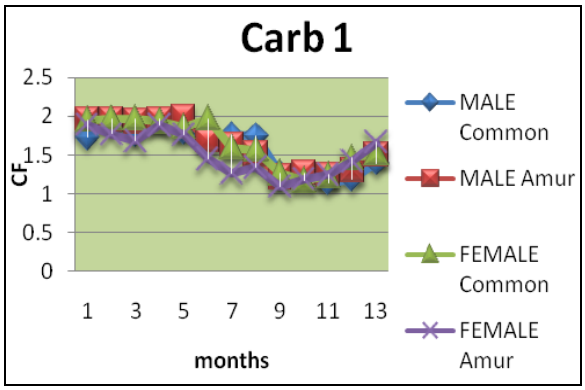


**Fig 23:** Condition Factor of male and female of common carp and Amur carp with Carbohydrate diet

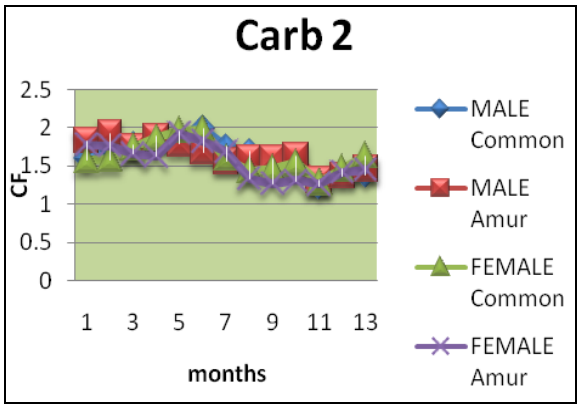


**Fig 24:** Condition Factor of male and female of common carp and Amur carp with Carbohydrate diet

**Gonado-somatic index-**

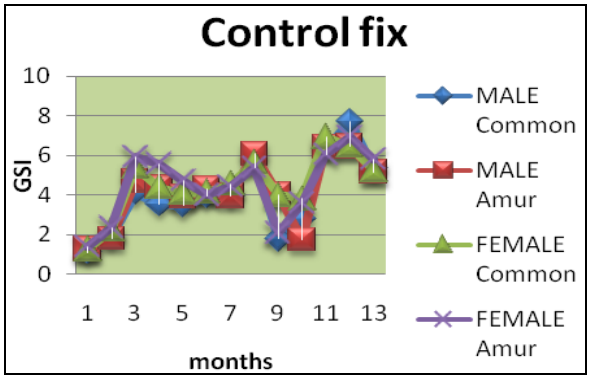


**Fig 25:** Gonadosomatic index of male and female of common carp and Amur carp with Control diet (Fed two times a day)

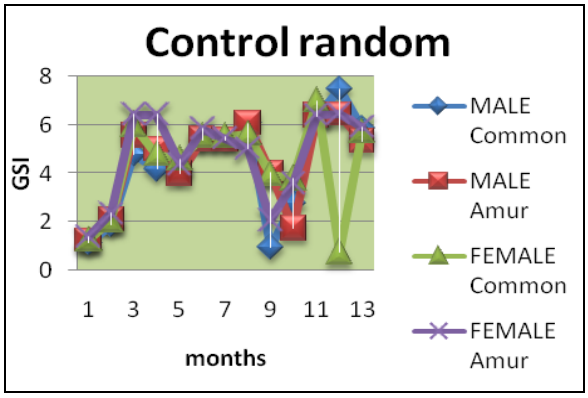


**Fig 26:** Gonadosomatic index of male and female of common carp and Amur carp with Control diet (Fed once in a day)

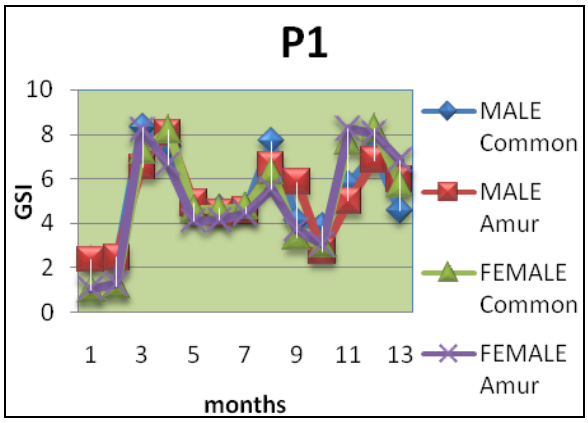


**Fig 27:** Gonadosomatic index of male and female of common carp and Amur carp with Protein diet

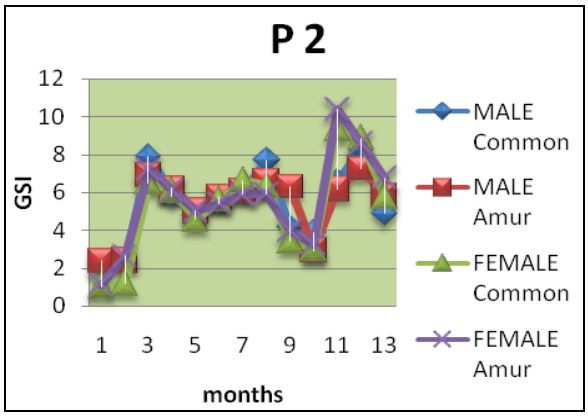


**Fig 28:** Gonadosomatic index of male and female of common carp and Amur carp with Protein diet

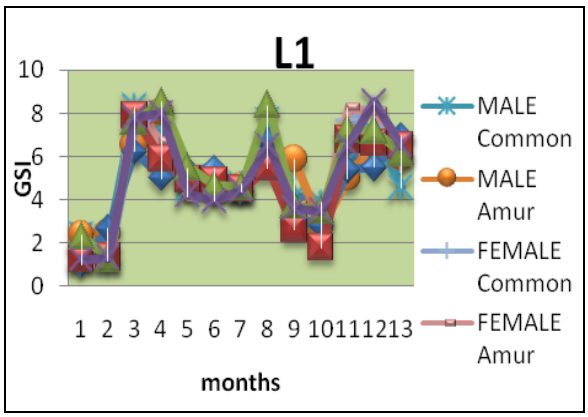


**Fig 29:** Gonadosomatic index of male and female of common carp and Amur carp with Lipid diet

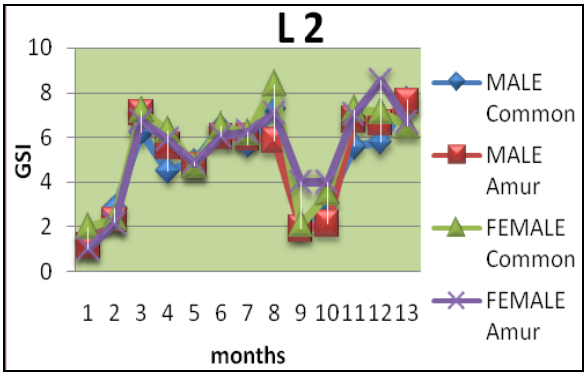


**Fig 30:** Gonadosomatic index of male and female of common carp and Amur carp with Lipid diet

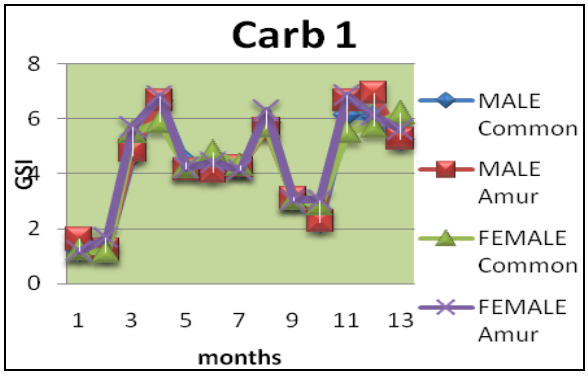


**Fig 31:** Gonadosomatic index of male and female of common carp and Amur carp with Carbohydrate diet

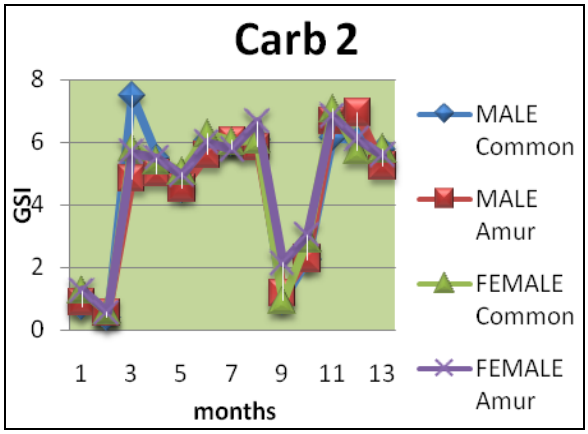


**Fig 32:** Gonadosomatic index of male and female of common carp and Amur carp with Carbohydrate diet

**Tables of growth parameters of common carp and amur carp are listed below**

**Table 5:** Growth parameters of common carp

| Parameters | Control | | | | Protein | | | | LIPID | | | | Carbohydrate | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | control fix ( fed twice in a day) | | control random (fed once in a day) | | P1 | | P2 | | L1 | | L2 | | Carb 1 | | Carb2 | |
| | M | F | M | F | M | F | M | F | M | F | M | F | M | F | M | F |
| L(cm) | 20.6 ±2.7 | 20.4 ±2.8 | 19.8 ±2.5 | 20.5 ±2.8 | 20.4 ±2.7 | 20.3 ±3.5 | 20.2 ±2.5 | 20.5 ±2.9 | 20.4 ±3.5 | 20.2 ±3.1 | 19.9 ±2.8 | 19.9 ±2.4 | 20.2 ±3.0 | 20.1 ±2.9 | 20.7 ±3.1 | 20.4 ±2.8 |
| W(gm) | 134.3 ±36.7 | 135.5 ±43.2 | 128.2 ±34.4 | 130.9 ±40.0 | 135.9 ±48.3 | 138.8 ±51.4 | 131.3 ±42.2 | 135.8 ±47.5 | 132.8 ±46.7 | 133.9 ±49.8 | 129.9 ±39.4 | 134.5 ±44.3 | 131.8 ±43.5 | 134.3 ±43.3 | 129.5 ±39.3 | 133.3 ±48.5 |
| CF | 1.5 ±0.3 | 1.5 ±0.2 | 1.3 ±1.3 | 1.3±1.5 | 1.6 ±0.2 | 1.6 ±0.3 | 1.3 ±1.5 | 1.6 ±1.5 | 1.5 ±0.3 | 1.6 ±0.2 | 1.3 ±1.6 | 1.5 ±1.6 | 1.5 ±0.3 | 1.6 ±0.3 | 1.3 ±1.6 | 1.6 ±1.6 |

(M: Male, F: Female, P: Protein, Carb: Carbohydrate, CF: Condition Factor, L: Length, W: Weight, L1 & L2: replicates of lipid group, P1 & P2: replicates of protein group, CARB 1& CARB 2: replicates of carbohydrate group.)

**Table 6:** Growth parameters of Amur carp

| Parameters | Control | | | | Protein | | | | Lipid | | | | Carbohydrate | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | control fix ( fed twice in a day) | | control random (fed once in a day) | | P1 | | P2 | | L1 | | L2 | | Carb 1 | | Carb2 | |
| | M | F | M | F | M | F | M | F | M | F | M | F | M | F | M | F |
| L(cm) | 20.7 ±2.6 | 20.7 ±3.4 | 20.8 ±2.3 | 21.0 ±3.0 | 20.1 ±3.1 | 21.0 ±3.0 | 20.7 ±3.2 | 21.0 ±2.7 | 20.2 ±2.9 | 20.2 ±3.0 | 20.3 ±3.0 | 20.6 ±2.8 | 20.1 ±2.9 | 20.8 ±2.7 | 20.0 ±2.4 | 20.4 ±2.8 |
| W(gm) | 137.4 ±39.7 | 137.4 ±47.4 | 131.7 ±41.0 | 133.3 ±45.5 | 137.9 ±48.3 | 148.9 ±49.8 | 132.3 ±44.9 | 136.5 ±50.8 | 138.5 ±51.8 | 143.6 ±50.8 | 134.2 ±38.9 | 140.8 ±44.6 | 132.4 ±42.0 | 138.2 ±46.8 | 133.0 ±40.0 | 134.9 ±44.0 |
| CF | 1.5 ±0.3 | 1.5 ±0.3 | 1.5 ±1.4 | 1.2 ±1.4 | 1.6 ±0.2 | 1.5 ±0.2 | 1.2 ±1.5 | 1.3 ±1.5 | 1.6 ±0.2 | 1.7 ±0.2 | 1.2 ±1.6 | 1.4 ±1.5 | 1.6 ±0.3 | 1.5 ±0.2 | 1.4 ±1.6 | 1.4 ±1.5 |

(M: Male, F: Female, P: Protein, Carb: Carbohydrate, CF: Condition Factor, L: Length, W: Weight, L1 & L2: replicates of lipid group, P1 & P2: replicates of protein group, CARB 1& CARB 2: replicates of carbohydrate group.)

**Discussion**

The growth parameters observed showed the difference among the groups. Maximum length was attained by the female Amur carp fed with the protein rich diet i.e 21.0 cm in both replicates. The lowest length was attained by the male common carp that was fed with the control diet i.e. 19.8 cm. The maximum weight was possessed by the group of female Amur carp that was fed with the protein rich diet i.e.148.9

gm. The lowest weight was gained by the group of common carp that was fed with the control diet i.e 128.2 gm. When condition factor was calculated it showed slight fluctuation among the groups. The maximum condition factor was recorded for the group of female Amur carp for those the diet was enriched with lipid i.e. 1.72 and the lowest was recorded for the group of common carp that was fed with the control diet and the value was 1.38 and for rest of the groups it was remained between 1.4 to 1.6. The above results are supported by the results of Phadate and Srikar (1990) [9], they also formulated the diet with protein, lipid and carbohydrate with different percentage fed to three carp species *Catla catla*, *Cyprinus carpio,* and *Hypopthelmichthis molitrix* and found that the better growth was attained by the fish that were fed with the protein diet followed by lipid diet and carbohydrate diet. They also stated that protein rich diet ensured better growth in fishes. Khattab *et al.,* (2001) [5] also observed the growth performance of Nile tilapia with increasing protein level and found that the growth performance was positively affected by the protein levels. Salhi *et al*., (2004) [12] evaluated the growth, feed utilization of black catfish (*Rhamdia quelen*) on the basis of increasing level of protein and lipid incorporated in feed. They also found that the overall growth was significantly affected by both protein and lipid level, when compared to control diet. Tawwab *et al*., (2010) [1] were coincided with the same findings that the fishes having protein rich diet had better growth performance in comparison to control diet. The study of Labh *et al.,* (2014) [6] also revealed that the better growth was achieved by *Labeo rohita* fish by enhancing the protein in diet in comparison to control diet. The maximum average weight gain (%) was attained by the female group of Amur carp i.e. 9.58 % that was fed with the lipid rich diet, followed by female common carp i.e. 9.26 % fed with same diet, and followed by the female amur carp that was fed with protein diet i.e. 9.11%. The lowest value of average weight gain (%) was recorded for the fishes with control group i.e. 7.0%. The same results were observed by Zupan *et al.,* (2016) [19], in their experiment they found that the common carp with high lipid diet had significantly better growth performance compared to the fish fed with the lower percentage of lipid in the diet. The feed conversion ratio and feed conversion efficiency among the group was not significantly influenced by the treatments. The range of feed conversion ratio was between 5.5 & 6.2, and feed conversion efficiency ratio was ranged from 0.16 to 0.17 among all the groups. The aforesaid statement regarding the parameters was supported by the findings of Dias *et al.,* (2004) [4]. They investigated the effect of dietary carbohydrate and lipid on the growth performance of juvenile sole (*Solea senegalensis*). They also observed that there was no significant difference between the treatments. The same result was observed by Lee and Kim (2009) [7] that the feed conversion ratio and feed conversion efficiency were not significantly affected by the carbohydrate and lipid incorporated in feed that was fed to juvenile rock fish (*Sebastes schlegeli*). When the growth performance was evaluated between the control group (control fix feeding twice a day, and control random feeding once in a day) there was a slight difference in growth parameters. Maximum average length was attained by the group that had fix feeding (twice a day) i.e. 20.4 cm and minimum was attained by the control group that had random feeding with half ration i.e. 19.8 cm. Bascinar *et al.,* (2007) [3] also evaluated the growth performance of trout, they observed that the trout having feed once a day had lower growth performance compared to fish that were fed twice a day. The findings of Stankovic *et al.,* (2010) [14] also matched with the present study. They found that the growth performance of common carp influenced by the feeding frequencies, the group fed once in a day had lower growth performance in comparison to other groups having feed in split doses. The same study was conducted by Suloma *et al.,* (2017) [15]; they evaluated the effect of Feeding Schedules on the growth performance of Nile tilapia. The results from this study showed that, the within-day feeding schedule achieved better growth performance, rather than alternate feeding schedules between days for Nile tilapia. Thongprajukaew *et al.,* (2017) [16] also observed the effects of feeding frequency on growth performance of sex-reversed Nile tilapia, *Oreochromis niloticus*. These results suggested a superior growth capacity of tilapias fed twice daily. The highest average liver weight was recorded in the female common carp i.e. 2.0 gm, with protein diet followed by the female Amur carp with lipid diet i.e. 1.97 gm. The lowest liver weight was recorded in the males of common carp with the control diet i.e. 1.44 gm. The evaluation of gonad weight revealed that highest gonad weight was gained by the females of amur carp having protein diet i.e. 8.16 gm, followed by the females of Amur carp having lipid diet i.e. 8.10 gm. The average gonado-somatic index also followed the same trend that it is found maximum in the females of Amur carp with the protein diets i.e. 5.56 %, followed by the females of Amur carp and common carp that had lipid diet i.e. 5.41% followed by the fish with carbohydrate diet and the lowest gonado-somatic index was recorded by the males of common carp fed with control diet i.e. 4.00 %. The present study for the above parameter coincided with the study of Reidel *et al.,* (2010) [11]. Their observations on the GSI suggested that the highest value of GSI recorded with protein diet for *Rhamdia quelen*. The same study was conducted by Arathi and Jayprakas (2014) [2] they observed that the better GSI was recorded for the group of *Puntius vittatus* with high protein diet.

Conclusion- Protein is the major dietary nutrient affecting performance of fish (Lovell, 1989) [8]. It provides the essential and nonessential amino acids which are necessary for muscle formation and enzymatic function and in part provides energy for maintenance (Yang *et al.,* 2002) [18]. It is also important to minimize the amount of protein used for energy, because protein usually the most expensive major constituents in a diet. Insufficient as well as excess level of protein in feed is also not desirable. After carefully investigating all the parameters related to growth, and biochemical parameters, it was found that feed with good amount of protein & lipid performed better than rest of the experimental diets. It can be also concluded that Amur carp showed better somatic growth, so if Amur carp is cultured in large scale, it can fetch good profit, thus augmenting fish production, and food security can be ensured globally. So the present study concluded that the incorporation of protein ~38.00%, lipid ~18.00%, and carbohydrate ~31.92% in feed can help to enhance the growth.

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