Effect of Processed Kidney bean (*Phaseolus vulgaris - pinto group)* seed meal on Proximate Composition, Growth Performance and Survival of the *Cyprinus carpio* (Linnaeus, 1758) Fingerlings

साइप्रिनस कार्पियो (लिनिअस, 1758) अंगुलिकाओं के अनुमानिक संगठन, विकास और उत्तरजीविता पर प्रसंस्कृत किडनी *बीन (फेसीओलस वल्गोरिस - पिंटो समूह)* बीज भोजन का प्रभाव

ARUSHI ARYA

Thesis

Master of Fisheries Science

(Aquaculture)

2023

DEPARTMENT OF AQUACULTURE

COLLEGE OF FISHERIES

MAHARANA PRATAP UNIVERSITY OF AGRICULTURE AND TECHNOLOGY, UDAIPUR – 313001 (RAJASTHAN)

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Thesis

Submitted to The

Maharana Pratap University of Agriculture & Technology,

Udaipur

In partial fulfillment of the requirements for

The degree of

Master of Fisheries Science

(Aquaculture)

By

ARUSHI ARYA

2023

MAHARANA PRATAP UNIVERSITY OF AGRICULTURE AND TECHNOLOGY, UDAIPUR

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CERTIFICATE-I

CERTIFICATE OF ORIGINALITY

The research work embodied in this thesis titled **"Effect of Processed kidney bean (*Phaseolus vulgaris - pinto group)* seed meal on Proximate composition, Growth performance and Survival of the *Cyprinus carpio* (Linnaeus, 1758) fingerlings"** submitted for the award of degree of **Master of Fisheries Science** in the subject of **Aquaculture** to Maharana Pratap University of Agriculture and Technology, Udaipur (Raj.), is original and bonafide record of research work carried out by me under the supervision of **Dr. M.L. Ojha**, Associate Professor, Department of F.R.M and A.A.H.M, College of Fisheries, Udaipur. The contents of the thesis, either partially or fully, have not been submitted or will not be submitted to any other Institute or University for the award of any degree or diploma.

The work embodied in the thesis represents my ideas in my own words and where others' ideas or words have been included, I have adequately cited and referenced the original source. I also declare that I have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/ source in my submission. I understand that any violation of the above will be cause for disciplinary action by the University and can also evoke penal action from the sources which have thus not been properly cited off from whom proper permission has not been taken when needed.

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CERTIFICATE – II

Dated: ..../...../2023

This is to certify that this thesis entitled **"Effect of Processed kidney bean *(Phaseolus vulgaris - pinto group)* seed meal on Proximate composition, Growth performance and Survival of the *Cyprinus carpio* (Linnaeus, 1758) fingerlings"** submitted for the degree of **Master of Fisheries Science** in the subject of **Aquaculture**, embodies bonafide research work carried out by **Ms. Arushi Arya** under my guidance and supervision and that no part of this thesis has been submitted for any degree. The assistance and help received during the course of research have been fully acknowledged. The draft of the thesis was also approved by the advisory committee on......./........../2023.

The manuscript has been subjected to plagiarism check by software Urkund software. It is certified that as per the check, the similarity index of content is …… and is within permissible limit as per the MPUAT guidelines on checking plagiarism.

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This is to certify that this thesis entitled **"Effect of Processed kidney bean *(Phaseolus vulgaris - pinto group)* Seed meal on Proximate composition, Growth performance and Survival of the *Cyprinus carpio* (Linnaeus, 1758) fingerlings"** submitted by **Ms. Arushi Arya** to the Maharana Pratap University of Agriculture and Technology, Udaipur in partial fulfilment of the requirements for the degree of **Master of Fisheries Science** in the subject of **Aquaculture**, after recommendation by the external examiner was defended by the candidate before the following members of the examination committee. The performance of the candidate in the oral examination on his thesis has been found satisfactory; we therefore, recommend that the thesis be approved.

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This is to certify that **Ms. Arushi Arya** student of **Department of Aquaculture**, College of Fisheries, Udaipur has made all corrections / modifications in the thesis entitled **"Effect of Processed kidney bean *(Phaseolus vulgaris - pinto group)* seed meal on Proximate composition, Growth performance and Survival of the *Cyprinus carpio* (Linnaeus, 1758) fingerlings"** which were suggested by the external examiner and the advisory committee in the oral examination held on ....../...../2023. The final copies of the thesis duly bound and corrected were submitted on ...../......../2023 and are enclosed herewith for approval.

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Place: Udaipur **(Arushi Arya)**

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THIS THESIS IS DEDICATED TO MY MOTHER AND FATHER

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1. INTRODUCTION

Fisheries and aquaculture industries have gained more recognition in recent years for their critical role in ensuring global food security and nutrition. For millions of people, fisheries and aquaculture continue to be vital sources of food, nutrition, income and livelihood. Fish is a good and affordable source of animal protein, offering a solution to the nation's problems with hunger and malnutrition. Most significantly, it gives a significant portion of the economically underprivileged people of the nation a source of income. (Handbook on Fisheries Statistics, 2023).

The world's growing population has been fed and nurtured through aquaculture, which has the ability to raise socio-economic status of nations. 2020 saw a record-breaking 214 million tons of fisheries and aquaculture production, worth about USD 424 billion. The amount destined for human consumption (excluding algae) was 20.2 kg per capita, Aquatic food consumption is anticipated to rise by 15% by 2030, reaching an average of 21.4 kg per person, as a result of rising incomes, urbanisation, better post-harvest procedures, and dietary patterns. 58.5 million people are reportedly employed by this sector in primary production alone, with women making up around 21% of the workforce. A record 122.6 million tonnes of aquaculture production were produced worldwide in 2020, comprising 87.5 million tonnes of aquatic animals valued at USD 264.8 billion. The contribution of aquaculture to the global production of aquatic animals reached a record 49.2 percent in 2020. (SOFIA 2022).

Indian Fisheries sector evolved gradually over the years and became an important socio-economic attribute for the nation. After China, India is the third-largest fish and aquaculture producing country, accounts for about 16% of total inland and 5% of total global marine fish production respectively and India’s overall share to World fish production was approximately 8%. India’s fish production was 162.48 lakh tonnes overall in the year 2021–2022, 121.21 lakh tonnes from the inland sector and 41.27 lakh tonnes from the marine sector, respectively. Fisheries sector plays a crucial role in the national economy and is one of the key contributors to the country's foreign exchange earnings. The Fish Production in India has raised from 56.56 lakh tonnes in 2000-01 to 162.48 lakh tonnes in 2021-22. Andhra Pradesh state tops in the inland fish production, followed by West Bengal, Uttar-Pradesh, Odisha, Bihar and other states. (Handbook on Fisheries Statistics, 2023).

As a key source of animal protein, particularly in developing nations as India, aquaculture and fisheries have significantly benefited the poor and the global economy, with an Annual Growth Rate in Fish Production is 10.34 %, aquaculture is the fastest-growing sector of the food production industry. India's fisheries sector contribution in the agriculture economy was 6.72% and 1.1% to the country's overall economy. Rs.2,32,620 crore Contribution of Fisheries sector in Indian Economy (GVA):2020-21. (Handbook on Fisheries Statistics, 2023)

Around 2.45 million ha of tanks & ponds area exist in India, where culture-based fisheries predominates and accounts for the largest portion of all fish production. Presently about 8.5 million MT are produced from tanks and ponds. (Fisheries Statistics current report, 2021-22).

Rajasthan state fish production was 0.66 lakh tonnes in the year 2021-22, Indian Major Carp and exotic carp contribute to around 0.42 and 0.11 lakh tonnes to Rajasthan inland fisheries. Fish seed production in Rajasthan is 55105.9 lakh fry. Rajasthan annual fish consumption (per capita /kg) is as low as 0.01. Indirect and direct fisheries-related activities employ around 57,260 farmers/fishermen. Total fund released for development of fisheries sector in Rajasthan was around 206.22 lakhs in the year 20-2021. Rajasthan state has enormous potential to raise aquaculture and fisheries production due to availability of sufficient numbers of water resources. (Fisheries Statistics current report, 2023)

One of the first fish species to be domesticated for aquaculture purpose is the common carp *(Cyprinus carpio)* Linnaeus, (1758). The third most frequently introduced species globally is the common carp. Carp is omnivorous fish with a strong preference for eating benthic invertebrates including worms, molluscs, zooplankton, and water insects. The stalks, leaves, and seeds of aquatic and terrestrial plants are all consumed by the carp. In addition to silver and grass carp, the common carp is an important species for cultivation among the cyprinids and its output has increased by double in the past ten years. It was largely influenced by the cultures of Asian nations like China, India, etc. According to Ogino and Chen (1973) and Ogino (1980), the daily protein requirement of common carp is about 1g kg^{-1} body weight for maintenance and 12g kg^{-1} body weight for maximum protein retention. If sufficient digestible energy is contained in the diet, the optimum protein level can be effectively kept at 30-35% (Watanabe,1982)

C. carpio introduced about sixty years ago for aquaculture has now been found to invade into the Ganga, the largest river of the country contributing significantly to the fishery. Common carp is the third most widely cultivated and commercially important freshwater fish species in the world (FAO, 2013). It is being considered as a potential candidate for commercial aquaculture in Asia and some European countries as it has a very high adaptive capability to both environment and food (Soltani *et al.* 2010; Manjappa *et al.* 2011; Rahman 2015). It is being developed as a species under composite fish culture via the All India Coordinated Research Project. The country's fish production has increased due to the common carp, which is raised under various agro climatic conditions (Jena *et al.*,2002). *Cyprinus carpio*, the common carp, is a widely dispersed fish throughout the world, Sivakumaran *et al.* (2003). The common carp, which contributes to overall inland fish production, was introduced to India between 1939 and 1957 for aquaculture purposes as per Froese *et al.* (2004), Singh *et al.* (2006). The utilization of *C. carpio* gradually expanded for enhancing reservoir fishery production (Suguan,1995), (Sugunan, 2000) and it was then introduced into reservoirs and lakes. Due to their early sexual maturity, quick colonization, and wide range of environmental tolerances, common carps (*C. carpio*), thrive in any culture system. In 2010, making over 9% of the world's total finfish aquaculture production, Asia accounted for more than 90% of common carp's aquaculture production. It also includes the second-highest farm fish production in the world, primarily from Asia (Milstein 1992).

Feed accounts for more than 60% of the production's input costs in aquaculture. In both semi-intensive and intensive fish farming, feed is the most expensive cost factor. In fact, the variable cost of a carp culture operation accounted for by just feed expenses in two-thirds of cases (Jauncey *et al*. 1982). According to Lim *et al*. (1997), the high cost of feeds is mostly due to an overreliance on protein sources like fish meal and shrimp meal. Therefore, fish meal must be replaced in order to satisfy the growing demand for protein-rich feed ingredients in the aqua feed manufacturing industry. To overcome the high cost input of feed, it would be economical to take advantage of Plant-based protein sources which will amplify fish production. Plant-based protein sources may hold the key solution because they are cheap, readily available and high in protein, claim Chakraborty *et al*. (2019). To accomplish the ultimate aim of high profit from carp culture, it is, therefore, essential to include some alternative less expensive plant based ingredients into feed, from which feed quality will be improved without compromising the growth of fish.

Proper nutrition is one of the most important factors influencing the ability of cultured organism in sexual maturity, growth and longitivity. The main objective of feed formulation is to utilize the knowledge of nutrient requirements, locally available feed ingredients and digestive capacity of fish for the development of a nutritionally balanced mixture of feed stuff. The largest consumers of commercial aquaculture feeds were the herbivorous and omnivorous carp species. 57% of total carp production rely on feeds. Feed production has been growing at an average annual rate of 8.0% per year since 2000 and expected to grow to 58.85 million tons by 2020 and 73.15 million tons by 2025. Aquafeed Market by Species, Ingredient, Lifecycle, Form, Additive and Region-Global Forecast to 2025 (researchandmarkets.com)

In the diet formulation generally several agro-based ingredients have been used. The ingredients that contain less than 20% protein and 18% fibres are classified as energy supplements. The bottom dwelling species appear to take maximum advantage of energy supplements added in practical diets that spare protein for their growth because benthic fish food organisms are inadequately available that do not support their growth and survival. Whereas, the ingredients that contain 20% or more protein are grouped as protein supplements. (Handbook of fisheries and aquaculture 2019)

Therefore, Kidney bean *(Phaseolus vulgaris)* is one of the possible substitute ingredient used in the supplementary feed. As per Rehman & Shah (2004), Yin *et al*. (2008) Kidney beans *(Phaseolus vulgaris L.)* are excellent providers of nutrients, including proteins, carbohydrate, minerals and vitamins. Kidney bean / common bean, because of its high protein, fiber, prebiotic, vitamin B and chemically varied micronutrient content have been supported in nearly ideal diet. Easy access and the cheap price of Kidney beans plants are also encouraging factors for their use in large scale in aquaculture to provide better growth and performance at the same time. Specifically, the omega fatty acids (linoleic acid (n-6) (LA) and alpha linoleic acid (n-3) constitute another significant lipid class of compounds contained in dry beans, according to Câmara *et al*. (2013). Red kidney beans have a great amino acid profile with lysine, leucine, aspartic acid, glutamic acid and arginine being particularly abundant, according to Shehzad *et al*. (2015). This is an indication that it may be feasible to replace more expensive conventional feedstuffs with cheaper alternatives in order to reduce the cost of aquaculture production.

Kidney bean seeds have a comparatively high nutritional content, claim Thani *et al.* (2018). Therefore, they might act as a protein supplement in animal diet. The minerals in the seeds imply that they are suitable as viable animal feed ingredients.

Beans are essential food crops both economically and nutritionally and they are grown and consumed all over the world. Beans are a part of the Fabaceae family, which also includes legumes. On an area of 36,458,894 ha, the world produced 3,14,05,912 T of beans in 2017. In India, 63,90,000 T of beans were produced on an area of roughly 1,54,25,864 ha (Food and Agriculture Organization [FAO], 2017). Because of their high protein content (20–25%), complex carbohydrate (50–60%) and availability of vitamins, minerals and poly-unsaturated fatty acids, Kidney beans *(Phaseolus vulgaris)* rank among the most significant legume crops on a worldwide scale.

Table 1: Mean proximate composition (%) of raw and processed pinto bean seed flours; (Audu *et al.* 2011)

Parameter	Raw	Boiled	Cooked	Roasted
Moisture	2.30 (0.35%)^{x}	5.8 (0.20)	7.9 (0.12)	7.1 (0.19)
Ash	2.5 (0.11)	4.0 (0.01)	3.6 (1.01)	3.4 (0.15)
Crude fat	14.4 (0.31)	10.4 (0.23)	10.0 (0.73)	8.9 (0.22)
Crude protein	18.0 (0.08)	20.1 (0.30)	19.9 (0.37)	21.8 (0.71)
Crude fibre	3.0 (0.02)	4.1 (0.16)	4.5 (0.32)	5.1(0.71)
Carbohydrate	59.7 (0.39)	55.6 (0.44)	54.8(1.34)	53.8(1.05)
Energy	1851.4	1429.6	1642.2	1612.9
Fatty acids	11.5	2.7	8.0	7.1

x**;** Number in parentheses are standard deviations of triplicate determinations

Examining the value and economics of several inexpensive agro-based protein supplemented ingredients used as fish nutrition sources. The kidney beans thus incorporated in the fish diet to examine its efficiency as feed that whether it is beneficial for the fishes or not. So, this research was under-taken. Looking at the nutritional quality, processing of kidney bean was necessary before incorporating them as diet supplement. Because, it contains ANF (Anti-nutritional factors) which affect nutrient uptake and growth in fishes and processing of kidney bean thus help to remove the residual effect of those ANF's in fish diet. The purpose of the suggested study was to investigate **"Effect of Processed Kidney bean (*Phaseolus vulgaris*-pinto group) seed Meal on Proximate composition, Growth Performance and Survival of the *Cyprinus carpio* (Linnaeus, 1758) Fingerings"** with the following objectives:

1. To study the effect of Processed Kidney bean *(Phaseolus vulgaris-pinto group)* seed meal supplementation on proximate composition of *Cyprinus carpio* fingerlings

2. To examine the effect of Processed Kidney bean *(Phaseolus vulgaris-pinto group)* seed meal on growth performance and survival of *Cyprinus carpio* fingerlings

3. To monitor water quality during experimental period

2. REVIEW OF LITERATURE

An important aim of research in fish production is to enhance cost effective aquaculture production while providing adequate animal protein and fish by-products for human consumption. The ever-increasing human population necessitates the need to source for alternative feeds and feedstuffs for fishes to attribute the best growth under different aquaculture conditions. Therefore, it would be economical to take advantage of Plant-based protein sources which will amplify fish production. Plant-based protein sources may hold the key solution because they are cheap, readily available and high in protein, claim Chakraborty *et al.* (2019). According to Thani *et al.* (2018) Kidney beans have a comparatively high nutritional content and is a rich source of protein. Therefore, Kidney bean *(Phaseolus vulgaris L.)* might be used as animal feed additives. The minerals in the seeds imply that they are suitable as viable animal feed ingredients. Thus, it was needful to work on kidney beans, used as fish feed ingredient against common carp *(Cyprinus carpio)*.

Balandran-Quintana *et al.* (1998) examined the effects of extrusion conditions (temperature, feed moisture content and screw speed) on some functional and nutritional properties of whole pinto bean meal. Pinto bean meals with 18, 20, and 22% moisture were extruded at 140, 160 and 180℃, using screw speeds of 150, 200 and 250 rpm in a single-screw laboratory extruded. In vitro protein digestibility, and trypsin inhibitor activity in extrudate were measured. Extrusion cooking has advantages, including versatility, high productivity, low operating costs, energy efficiency, and shorter cooking times (Harper, 1981). Results revealed that Pinto bean meal's protein digestibility was 72.7% when it was raw, but extrusion processing raised it to 81% under all test circumstances shows increasing in vitro digestibility of the protein. Trypsin inhibitors were inactivated completely for all conditions under extrusion. Best product was produced with 22% feed moisture at 160℃.

Absalom *et al.* (1999) carried out an experiment to assess the growth, feed consumption, and protein digestibility of Nile tilapia fingerlings, *Oreochromis niloticus* (mean weight: 1.36 ± 0.05 g) given diets containing different quantities of the kidney bean *(Phaseolus vulgaris)* under laboratory conditions. The kidney bean was included at various quantities of 60, 40, 20, and 0% (control). The feeding lasted upto 8 weeks. There was no mortality in any of the treatments. In general, fish given the control diet had the greatest growth and feed utilisation outcomes; however, results achieved with the 60% kidney bean diet were adequate. The weight gain of fish fed the control diet was 92.02%, 71.22% for those fed the 60% kidney bean diet, and the least weight gain value of 16.67% for those provided the 20% kidney bean diet. Protein digestibility was 85.04% in the control diet and 81.04% in the 60% kidney bean diet. In all of the experimental diets, Result revealed that the digestibility was greater than 65% thus kidney bean can be used by the Nile tilapia in adequate amounts in its diet. The result suggested that replacing more expensive traditional feedstuffs with less expensive substitutes may be possible in order to lower the cost of aquaculture operations.

Hossain *et al.* (2001) assessed the nutritional value of *Sesbania aculeata* seed meal as a potential source of protein in the diet of common carp, a 7-week feeding study was carried out in a recirculation system. Sesbania seed meal was added to the diets at different concentrations (12%, 24%, 36% and 48% for diets 2, 3, 4 and 5, respectively, which correspond to 10%, 20%, 30%, and 40% of the dietary crude protein) and the responses of the fish fed these diets were compared to those fed a fish meal-based control diet (40% crude protein).They created iso-nitrogenous and iso-energetic diets for all of them. There were two replicates of each treatment, with eight fish per replicate. Diet 1 (control) and diet 2 (including 12% Sesbania meal) were similar and considerably superior ($P<0.05$) than the other dietary groups based on the basis of observed growth rate, feed conversion ratio, protein efficiency ratio, apparent net protein utilisation and energy retention. When compared to fish given diets 1 and 2, those fed with diets 3,4 and 5 exhibited considerably worse growth performance due to the greater amounts of Sesbania meal (24%, 36%, and 48%, respectively). Fish given diets with greater concentrations (>12%) of Sesbania meal had considerably higher whole-body moisture, reduced lipid and gross energy contents. The presence of several antinutrients including tannins and saponins in Sesbania seeds is assumed to be the cause of the inferior growth performance of fish fed diets with greater amounts of Sesbania meal. The results showed that feeding common carp up to 12% of untreated Sesbania seed meal (10% of the diet's protein) did not have an adverse effect on common carp growth performance and nutrient utilization.

Siddhuraju *et al.* (2001) determined the potential nutritional value of mucuna seed meal as a dietary replacement for fish meal in practical diets for common carp, two feeding trials were carried out in a warmwater recirculating system. The performance of fish given these diets was compared to fish fed a fish meal-based reference diet that included 40% protein in experiments. In I and II experiments, raw and autoclaved mucuna seed meals, respectively, were employed in the diets to replace 10%, 20%, 30%, and 40% of the total dietary protein. All diets were formulated to be isoenergetic and isonitrogenous. Throughout phases I and II of the experiment, no fish died. In both experiments, diet 1 and 2 seemed to have similar and significantly greater growth rates, feed conversion ratios, apparent net protein utilisations and energy retentions than the other dietary groups. When compared to diets 1 and 2, the higher inclusion of raw and autoclaved mucuna meals in diets 3, 4, and 5 correspondingly, revealed a considerably lower growth performance. With the exception of fish fed diet 3, fish fed diets containing higher percentages (>13%) of raw mucuna meal had considerably higher carcass moisture, lower protein and higher fat contents. Even though fish were given autoclaved mucuna meal in experiment II, the growth parameters were dramatically lowered by the greater inclusion rate of mucuna seed meal. With the exception of the lipid content of fish given diet 5, no appreciable changes were found between fish fed the control and diets 2, 3, and 4 in terms of the whole body moisture, protein, ash, and lipid contents .Instead of the thermolabile antinutrients, it is possible that the inferior growth performance of fish given diets containing greater amounts of both raw and autoclaved mucuna meal is caused by the presence of larger levels of heat stable antinutrients combined with non-starch polysaccharide components.

Arija *et al.* (2006) conducted an experiment to study the impact of several concentrations (0, 100, 200, and 300 g/kg) of raw kidney bean and extruded kidney bean in broiler chick (0 to 21 d of age) meals on performance, digestive organ sizes, protein and amino acid digestibility, intestinal viscosity, cecal pH, and blood parameters was studied. The data were examined using a three-by-two factorial design with three degrees of kidney bean with and without extrusion. A positive control with no kidney bean was employed. In Navarra (Spain), *Phaseolus vulgaris L.* var. Pinto seeds were produced and supplied to the diet either uncooked or extruded. The results showed that Extruded Kidney Bean had a greater Apparent Metabolizable Energy (calculated value) than Raw Kidney Bean ($P < 0.05$). Result also show that Extrusion improved weight gain ($P < 0.001$), feed consumption ($P < 0.01$) and feed efficiency ($P < 0.001$) compared to raw kidney bean. Weight increase and feed efficiency were found to interact significantly, suggested a greater response of extrusion at the highest kidney bean concentration. Extrusion massively improved the AID (apparent ideal digestibility) of CP ($P<0.001$) and all essential and non-essential amino acids, according to statistical analysis of the data. Increasing kidney bean in the diet did not affect blood parameters, except for total protein (*P*<0.05), which was increased. The extrusion considerably raised (*P*< 0.001) the concentrations of cholesterol, triglycerides, glucose, and testosterone. Thus result suggests that extruded kidney bean show better performance as feed in comparison to raw kidney beans. In conclusion, the addition of kidney bean in chicken diets caused a negative effect on performance as well as CP and amino acid digestibility. These effects may be attributed to the presence of ANF in the seed. The extrusion process counteracts this negative effect by removing the ANF and improving the nutrient availability of the seed.

Emiola *et al.* (2007) studied raw and various processed [aqueous heating, dehulled, and dry heating (toasted)] kidney bean meals affect on the performance, weights, and histology of broiler chicken internal organs. The feeding study lasted 56 days. 225, 1-day-old Anak strain broiler chicks were employed in the investigation. There were five treatment groups, each with three replicates and 15 birds. Raw and processed kidney bean meals were utilised to replace 50% of the protein in the control diet supplied by soybean. The information gathered was used to assess feed intake, weight increase, and feed utilisation efficiency. Dietary interventions altered average daily food intake, average daily gain, and feed utilisation efficiency. Kidney bean *(Phaseolus vulgaris)* was being explored as a potential component of pig and poultry diets. Many studies have shown that heat processing, such as wet and dry heating (toasting), promotes growth and increases the quantity of digestible nutrients available to young non ruminant animals, especially early chicks, resulting in better development. Average daily food intake and average daily gain in birds fed the control diet and heat-treated kidney bean meals were similar and significantly (P < 0.05) higher than those fed raw or dehulled meals. The feed conversion ratio in birds given raw or dehulled meals was considerably (P <0.05) greater than in birds fed the control diet. The results explained that Chicks fed heat-treated kidney bean represent similarly to the control diet. This recommended that heat-treated kidney beans can be utilised to replace 50% of the protein supplied by the soybean in the control diet.

Emiola *et al.* (2007) studied various processing of mucuna (*Mucuna pruriens var utilis*) and kidney bean *(Phaseolus vulgaris)* affected broiler chicken performance, nutritional utilisation and internal organ weight. The beans were treated in three ways: aqueous heating, toasting and dehulling. For the experiment, 315 as-hatched day-old broiler chicks (Anak strain) were employed.

There were seven food treatment groups, each with 45 birds, and three duplicates, each with 15 birds. In the control diet, processed mucuna and kidney bean meals were utilised to replace 50% of the protein provided by soybean meal. Although, average daily gain (ADG) was influenced by dietary treatments ($P<0.05$). ADG was substantially ($P<0.05$) greater in birds fed with aqueous heated kidney bean (AHKB) or mucuna bean meals (AHMM) than in birds fed toasted and dehulled meals. The trend in feed conversion efficiency (FCE) was similar to that of ADG. The structural changes were linked to the presence of high concentration of residual trypsin inhibitors in dehulled meals. The findings of this study clearly show that aqueous heat treatment is an effective method for processing legume seeds having high quantities of thermo-labile anti-nutrients. The result concluded that, AHKB and AHMM may be deployed to replace 50% protein supplied by soybean meal in broiler starter and finisher diets without affecting performance and intestinal organs.

Akande *et al.* (2010) described that to increase the nutritional quality of legumes and fully use their potential as a poultry feed ingredient, unwanted elements must be removed. It is commonly acknowledged that simple and low-cost processing procedures are effective means of generating desired modifications in seed composition. Soaking, heating, toasting, autoclaving, microwave cooking, pressure cooking, extrusion cooking, germination and chemical treatment have all been found to increase the quality of legumes by removing or inactivating various anti-nutritional factors. In many cases, using only one approach may not be sufficient to remove anti-nutritional compounds, and a combination of two or more ways may be needed.

Jader *et al.* (2012) an experiment was performed to evaluate the common carp nutritional influence on three conventional diets varies from its crude protein contains (25%, 30% and 35%). The Agriculture and Forestry College at Dohuk University in Summel city was conducting this experiment as part of a fish breeding effort. In cages of $1m^3$, common carp weighing 150±5.20 g were maintained and fed frequently for 90 days. Results show that the highest growth performance were obtained with 30% protein diet while the poorest one was obtained with 25% protein diet. FCR ranged from 2.27 to 3.01. Although the least Protein efficiency ratio was obtained when fish were fed on the diet protein having 35%cp.

Câmara *et al.* (2013) described that high protein, fibre, prebiotic, vitamin B are present in high levels and chemically varied micronutrient content, dry beans *(Phaseolus vulgaris L.)* or common beans have been described as a nearly ideal diet. Dry beans can also be cultivated in a range of eco-agricultural settings and sold in a number of ways, including whole unprocessed seeds, as part of mixes, canned goods or as a gluten-free wheat flour alternative. Dry beans are grown/consumed in nearly every country. Brazil is now the leading producer (3.2 MMT), followed by India, Myanmar, and China. Dry beans contain iron and calcium at adequate levels. Polyunsaturated fatty acids (PUFAs) are another major lipid class found in dry beans, notably the omega fatty acids (linoleic acid (n-6) (LA) and alpha linoleic acid (n-3) (ALA). Additionally, dry beans contain a variety of prebiotics. This nutrient serves as a cofactor in several reactions and helps a number of biological processes, including DNA synthesis and repair. According to Xu and Chang, among the 13 legumes included in the study, black soybean, black bean and pinto bean exerted the highest antioxidant capacity.

Kumar *et al*. (2013) determined that kidney beans are popular owing to their richness and high protein content, as well as the presence of antioxidants, minerals and polyphenols. Kidney beans are grown as a primary food source for humans and other animals in tropical and subtropical locations across the world. China, Indonesia, Turkey, India, Thailand, United States and other nations have claimed kidney bean production. Additionally, compared to soybeans, peanuts and other legumes, kidney beans offer greater quality antioxidants and availability of micronutrients like zinc and calcium.

Fikru *et al.* (2014) studied the effects of substituting processed kidney bean meal (PKBM) with soybean meal (SBM) on feed intake, body weight gain, profitability and egg production of white leghorn (WL) chicken were investigated. A total of 225 chickens (165 layers and 30 cocks) with uniform body weight (BW) and age were randomly dispersed into 15 pens and five treatments. SBM replacement by PKBM was used at 0, 25, 50, 75 and 100% levels for T1, T2, T3, T4 and T5, respectively. Feed costs dropped as the level of PKBM in the ration increased due to the lower purchase price of raw kidney bean. As a result, it is possible to infer that using 100% (at a rate of 100g/kg concentrate diet) PKBM as a replacement for SBM in the diet of layers had no effect on egg production, but egg was produced economically in groups where PKBM replaced SBM.

Hussein *et al.* (2015) conducted an experiment on the effect of replacing Soybean meal (SBM) by processed kidney bean (PKB) on egg production, feed intake and economic benefit for white leghorn layers. Hundred eighty white leghorn layers of similar initial body weight of 1121.17 g ± 24.92 and age of 6.5 months and 30 cocks were randomly distributed into five treatments using complete randomized design (CRD). PKB replaced SBM at a rate of 0 (control), 25, 50, 75 and 100% for T_1, T_2, T_3, T_4 and T_5, respectively. The recommended level of SBM (26%) in the ration was used as a base of replacement. Feed intake (FI), Hen Day Egg Production (HDEP), egg weight and egg mass were recorded daily. Economic replacement was assessed at the end of the experiment. The result of chemical analysis showed that Crude Protein (CP) and Metabolizable Energy (ME) content of PKB was 28% and 32182.2 Kcal respectively, which was lower than SBM but higher than noug seed cake (NSC). This indicates that the substitution capacity of PKB for SBM was better than NSC. Average daily feed intake (FI) was showed significant difference ($P<0.05$) among the treatments. The higher mean daily FI per bird was recorded in T_4 and T_5 as compared to the rest treatments. The percent hen day egg- production, egg weight and egg mass for layers fed 100% PKB was significantly ($P<0.05$) lower than those fed PKB up to 50%. Whereas Feed Conversion Ratio (FCR) is significantly lower in T_5 as compared to the rest treatments. Results revealed that PKB replaced for SBM, profit generated in the order of $T_3>T_2>T_1>T_4>T_5$ and Marginal Rate of Return (MRR) indicated profitability of PKB replacement upto 75% and beyond this replacement a decrease in economy of production by 1.83 units.

Shehzad *et al.* (2015) investigated that beans have a high nutritional profile, with 22.7% protein, 3.5% mineral, 1% fat, and 57.7% carbs, 38.6% starch, and 18.8% dietary fibre (60% insoluble and 40% soluble). In red kidney beans, proteins are typically regarded as the key macronutrient. Beans have shown to be important leguminous crops in terms of nitrogen fixing from the atmosphere. Legumes are regarded as a significant source of protein in developing and vegetarian countries due to their high protein content and vital amino acids profile which is rich in lysine, leucine, aspartic acid, glutamic acid and arginine. Common bean, snap dragon, navy bean, pinto bean, rajma, and surkh lobia are all names for this plant. Brazil, the United States, India, China, Turkey and Ethiopia are the top producers (Sahadevan *et al*., 2012).The flour and protein content of these red kidney beans demonstrated important functional characteristics (Tang, 2008).Red kidney beans are an excellent source of vitamin B, as well as vital minerals such as K, Ca, Mg, P and iron (Souci *et al.*, 2000). Thus the result revealed that Red kidney bean can be a potential ingredient to be utilized in a nutraceutical and functional foods. These are notable sources of plant-based dietary protein.

Olanipekun *et al.* (2015) performed the research work to addresses the nutrient and anti-nutrient constitution of processed and raw seed flours of the white variety of kidney bean (Phaseolus vulgaris) seeds. Because of its high protein content, kidney bean is considered as one of the rich source of nutrients. The raw seeds served as the control, while the kidney bean seeds were either boiled or roasted. The seeds were ground into flour and their vitamins and minerals were examined. Additionally, antinutrients was also determined. Protein content in kidney beans considerably ($p<0.05$) increased with processing, going from 20.92% in raw samples to 25.24% in roasted samples. The amount of antinutrients in the kidney bean was considerably ($p<0.05$) decreased during processing. Tannin was decreased by roasting by 52% and phytohaemaglutinin by 45%. Kidney bean seeds flour serve as a good sources of micro and macronutrients.

Ojha *et al.* (2016) investigated how a herb-supplemented diet affected the growth, metabolism, and haemato-immunological parameters on fingerlings of the *Labeo rohita* . Fish were fed a diet containing a herbal combination of *Mucuna pruriens* and *Pedalium murex* (1:1) at four different graded levels (0.0, 0.06, 0.08 and 0.1 g/100g diet). In comparison to the control, the supplemented meal significantly ($p<0.05$) enhanced growth, specific growth rate (SGR) and food conversion ratio (FCR). Still the maximum weight gain and specific growth rate (SGR) were recorded with 0.06g per 100g herbal supplemented diet The study's result demonstrated the importance of the herbal combination of *Mucuna pruriens* and *Pedalium murex* for *Labeo rohita* fingerling's growth, metabolism and immunological defence.

Azevedo *et al.* (2017) described that due to the broad range in the cost and accessibility of some traditional protein items, the search for substitute protein sources for fish diets is essential. Phaseolus vulgaris bean by product meal was used in a 45 day experiment on juvenile Nile tilapia (initial weight: 16.2 ± 0.1 g) in a water recirculation system to determine the impact on productivity indices and body composition. Three iso nitrogenous (35% crude protein) and isocaloric (3,100 kcal/kg of digestible energy) diets were created using a totally random design (n=4), substituting 0%, 6.2%, and 12.4% bean by product meal for 0%, 10%, and 20% soybean meal crude protein.

Fish given the experimental diets did not vary in terms of final weight, weight increase, specific growth rate, feed intake, protein efficiency ratio, or survival ($P>0.05$). Body crude protein, ash, or ether extract content did not differ ($P>0.05$) across groups. Result proved that the inclusion of bean by-product meal up to 6.2% as a substitute of soybean meal does not reduce the productive performance or body composition of fish.

Gangadhar *et al*. (2017) performed an experiment to determine the digestibility of dry matter and nutritional value of a diet consisting of three ingredients: soybean meal, azolla and silkworm pupa were used in an experiment by Fringed-lipped Peninsula Carp and Common carp. The outcome shows that azolla-incorporated diets for *Cyprinus carpio* were less digestible for dry matter and protein than diets for L. fimbriatus. The greatest digestibility values in *Labeo fimbriatus* were reached at 30% in graded levels of soybean meal diets, whereas the highest values in common carp were found at 40% inclusion level. There is no difference in digestibility between the two species when silkworm pupae are added up to 40%.

Murthy *et al*. (2017) assessed the impact of dietary supplementation of carrageenan for the Common Carp *(Cyprinus carpio)* to estimate growth, feed utilization and survival. Carrageenan was added to experimental diets at two graded levels: 0.5 (T_1) and 1% (T_2). They discovered that, as compared to T_0 and T_1, common carp fed a diet containing 1% (T_2) carrageenan experienced the maximum growth in terms of specific growth rate. However, T_1 treatment had the best survival (76.5%) and PER (0.06) whereas T_0 treatment had the lowest FCR (2.5).

Al- Thobaiti *et al*. (2017) investigated several plant protein sources by substituting fish meal for plant protein sources in Nile tilapia diets. Three iso-proteinous diets were prepared using a variety of feed ingredients, including maize gluten meal, wheat gluten meal, bagasse kenna meal and fish meal. The Research results show that various plant protein sources may substitute fish meal up to 20% without adversely influencing the health of the fish.

Thani *et al*. (2018) determined the influence of cooking time and toasting on the proximate composition, vitamins, minerals, amino acid, and phytochemical content of kidney bean seed. The seeds were obtained from Akwanga market in Akwanga L.G.A. of Nasarawa State, Nigeria, cooking for 1, 2, 3, and 4 hours; another portion was toasted. The cooked ones were labelled T_2, T_3, T_4 and T_5 for 1, 2, 3, and 4 hours of cooking time, while the raw and toasted ones were labelled

T_1 and T_6, respectively. Nutrient and anti-nutrient compositions were determined in samples from each treatment. It can be concluded that cooking durations showed significant ($P<0.05$) increase in nutrients and decrease in anti-nutrient compositions compared to the unprocessed seeds. Similarly, toasting resulted in variations in all nutrients and anti-nutrients evaluated. The cooked and toasted seeds were considered acceptable for human and animal consumption. Results claim that the toasted kidney bean seed (T_6) had the maximum crude protein (19.02%), ether extract (3.87%), ash (2.69%), and energy (3319.77 kcal/100kg) as compared to the raw, the study shows that kidney bean is a rich source of protein and compares favourably to values found for other legumes such as cowpea. The vitamin and mineral compositions of raw and toasted kidney bean seed indicate that toasting considerably ($p<0.05$) raised the vitamin A and B2 contents of the kidney bean seed, Toasting increases the availability of amino acids and show increased mineral availability of the sample as they might be used as animal feed additives. The tannin concentration of roasted kidney bean seed has no deleterious impact on monogastric animals. Results revealed that the greatest protein concentration was discovered in toasted kidney bean seeds. The effect of cooking time on processed kidney bean seeds may be attributable to enhanced nutritional bioavailability. By inactivating natural toxic components, the beans may improve tenderization, boosting nutritional value and palatability. Kidney bean seeds contain a high concentration of nutrients. As a result, they used as a protein supplement in livestock feed.

Alu *et al.* (2018) study was conducted to determine the time period of soaking has an impact on the nutritional value of kidney beans *(Phaseolus vulgaris)*. *P. vulgaris*, a kind of kidney bean, had its nutritional value examined in a study to ascertain the effects of soaking time. A total of 500 grammes of whole seeds were soaked in distilled water at room temperature in a bean-to-water ratio of 1:30 for 12, 24, 36, 48, 60, and 72 hours before being marked as T1, T2, T3, T4 and T5, respectively. After being soaked, the seeds were drained, washed, and dried at 105 °C for around 18 hours to obtain consistent weight. To prepare the dried seeds for further study, they were ground in an attrition mill and stored in plastic bags. After the procedure was complete, samples were obtained for examination and each treatment was replicated twice. Nevertheless, soaking for 60 hours yielded the highest results for vitamins A and C (581.35 and 32.15 mg/100g), whereas soaking for 72 hours produced the best result for vitamin B (3.16 mg/100g). The impact of soaking time on the amino acid content of KB is demonstrated by a gradual increase in the values of the acids with increasing soaking time. Monogastric animal farmers can adopt the 60-hour soaking of KB bean seeds before feeding them to animals as it yields the greatest results that are acceptable for feeding monogastric animals, including fish.

Syeed *et al.* (2018) performed a study to determine the possible impacts of *Trigonella foenum graecum* (fenugreek), used as a feed additive, on the growth efficiency, immune-haematological responses and defence against the bacterial pathogen *Aeromonas hydrophilla* in *Cyprinus carpio* fingerlings. Fish were given daily dietary doses of fenugreek seed at 0.5%, 1% and 1.5% during an 8-week period. The results demonstrated that adding fenugreek seed to the diet significantly increased weight gain, decreased mortality and enhanced survival, feed conversion ratio in the treated groups when compared to the control group. The treated group of fishes showed a greater protein content as well. Results concluded that the addition of fenugreek based diets is mostly responsible for the improvement in the growth and immunity of *Cyprinus carpio* against *A. hydrophilla* infection.

Chakraborty *et al.* (2019) conducted research on replacement of fishmeal, used plant based protein ingredients. In recent centuries, the globe has experienced a tremendous increase in human population, which has given rise to nutritional problems, particularly those connected to food security. Fish supply, which is the most affordable high-protein food, has to be expanded in order to provide food security and a continuous flow of nutrient-rich food. Researchers and feed makers looked for an alternative source of protein for sustainable aqua feed production as a result of the fish meal's gradual price increase and limited availability. Fishmeal has traditionally been regarded as a major dietary source of protein for the manufacturing of aqua feed. Fish meal's price has recently increased due to a lack of supply and strong demand. However, it is not wise to only rely on fish meal (Kaushik *et al*., 1995; Fournier *et al*., 2004). Results concluded that Plant-based feed ingredients are high in protein and since they are readily available fetch a lower market price than fish meal, plant-based protein sources could be the answer. But high in anti-nutritional factors, which limit their use in fish diets. To remove anti-nutritional factors found in plant-based feed components, fermentation, solvent extraction, heat treatment, and protein separation procedures are commonly employed to improve the digestibility and nutritional quality of the item.

Okonkwo *et al*. (2019) conducted a four-week feeding trial to evaluate the effect of sun dried (raw) (SD), dehulled (D) and boiled kidney beans (BKB) on the haematological and blood biochemistry of broiler birds. The study employed one hundred and twenty unsexed broiler birds. In a fully randomised design (CRD), the birds were randomly allocated to four dietary regimens that were replicated three times with twelve (12) birds per replicate. T1, T2, T3, and T4 were the treatment groups: control diet (CD), sun dried kidney bean (SDKB), dehulled kidney bean (DKB) and boiled kidney bean (BKB). The feeding experiment lasted four weeks. Used kidney beans proximate composition was also determined. The proximate composition revealed that kidney beans (crude protein level of 20.98%) are an adequate protein source for birds. Blood samples were obtained at the end of the feeding trial, and the haematological and serum biochemical parameters of the birds were assessed using established procedures. Although all of the haematological and biochemical values obtained in the study fall within the referral range, indicating that the processing method had no negative effect on the haematological and serum biochemical parameters of the birds, the diet without kidney bean (Control) and diet containing sun dried kidney bean generated the best results. Based on the findings, it was suggested that kidney bean is an excellent source of plant protein in animal diets and does not need to be processed before being used in animal feed. In conclusion Results show that sun drying the kidney bean is the best processing method followed by dehulling the beans.

Ferreira *et al*. (2020) conducted the study to assess *Phaseolus vulgaris* bean residue meal, a heat-treated form of bean residue, as a potential replacement for other sources of protein in Nile tilapia fish diets. A completely randomized design was used, totalling four (n = 4) dietary treatments: diet without BRM (CON), raw BRM (RBRM) and heat-treated BRM at 100 °C for 15 min (BRM15), and 30 min (BRM30) before inclusion in diets. The experimental diets were hand-fed to Nile tilapia fingerlings (1.3 g initial weight) for 66 days, split evenly into three meals each day. Performance metrics, body composition, retention of nutrients, and the physical basis of diets were assessed. The results revealed that 30 min heat treatment of BRM enhanced ($P<0.05$) protein retention in fish. In comparison to fish fed CON diet, fish fed with BRM30 showed higher body protein content ($P<0.05$) and reduced body lipid content ($P <0.05$). When compared to other dietary regimens, the physical properties (durability, dry matter leaching, waterproof time, and water stability time) of the BRM30 diet were notably better ($P<0.05$). Overall experiment survival was 99.7%, which was similar ($P>0.05$) among treatments. However, PPV (productive protein value) increased ($P<0.05$) proportionally to heat treatment time in fish fed BRM diets, although the values were lower ($P< 0.05$) than those observed in fish fed CON diet. When compared to other diets, the BRM30 diet exhibited a modest improvement ($P<0.05$) in pellet durability. In comparison to other treatments, dry matter leaching was 82% reduced ($P<0.05$) in the BRM30 diet. With BRM addition and heat treatment time, the WPT (water-proof time) and WST (water stability time) both improved linearly. However, result suggested that research on longer heat treatment time is needed due to the improvements observed in nutrient retention and physical characteristics of diets.

Hussain *et al.* (2020) determined the common carp *(Cyprinus carpio)* fingerling's growth performance, nutritional digestibility, and antioxidant activity, researchers assessed the effect of polyphenols supplemented canola meal-based diet. Seven experimental meals, designated T_0 to T_7 with graded amounts of polyphenols at 0, 100, 200, 300, 400, and 600 mg/kg each, were developed. In this study, results prove that the maximum antioxidant activity was seen in fish given a T_6 diet supplemented with 600 mg/kg of polyphenols. In this experiment, a rising trend in antioxidant activity was seen with increasing amounts of dietary polyphenols.

Zenhom and Ibrahim (2020) described the effects of fenugreek seed meal (FSM) supplementation on Common carp *(Cyprinus carpio)* growth performance, feed utilization, body composition and several physiological features. For a 12-week period, fish were given four different experimental diets that contained varying amounts of fenugreek seed meal: 0% (control diet), 10%, 20% and 30%. The results showed that adding more FSM to diets, up to 20% increased fish growth, survival rates, feed conversion ratios and PER. Fish diets that contained 10% FSM had substantial levels of protein and fat increase. The results inferred that the growth performance of Common carp improved and it grew significantly faster when 20% of fenugreek seeds were added to their diet.

Wahyudi *et al.* (2021) concluded from experiment that Oligosaccharides found in nuts have prebiotic properties. Prebiotics are fibres that the body is unable to digest but become food for probiotics. The study aimed to analyse the bacterial population, enzyme activity and feed conversion ratio of milkfish after being given various prebiotics from legumes in the feed. Milkfish measuring 4.13 ± 2.75 g are reared in a glass aquarium measuring 50 x 45 x 45 cm filled with water with a salinity of 15-20 ppt. Fish are maintained at a density of 15 individuals /aquarium for 60 days and are fed 5% body weight/day. Five prebiotic treatments of soybeans, peanuts, green beans, kidney beans, and control—were used in the trial, which had a totally randomised design. The outcomes revealed that the treatment had no impact on FCR but had a substantial impact ($p < 0.05$) on the bacterial population, as well as protease and amylase enzymes activity. The highest bacterial population was red bean prebiotics (2,082 × 103 CFU / mL), followed by green beans (2,001 × 103 CFU/mL), soybeans (972 × 103 CFU/mL). The highest activity (0.243 u/mL) and amylase enzyme (0.745 u/mL) was the prebiotic kidney beans, followed by soybeans (0.236 u/mL) amylase enzyme (0.506 u/mL) and other samples. The increase in bacterial population in the test fish's digestive system caused an increase in enzyme activity, and the prebiotic treatment of kidney beans induced the greatest rise. Prebiotics were added to feed in an effort to boost the microflora population in the host's digestive tract. This results in the production of exogenous enzymes that aid in digestion. At the conclusion of the research, enzyme activity increased. The FCR, meanwhile, varies within 1.43±.0.85 to 2.87±.1.70. It can be concluded that the best type of prebiotic is red beans.

Okonkwo *et al*. (2021) showed the effect of processing technique of kidney beans *(Phaseolus vulgaris)* on carcass quality, organ weight, and organoleptic qualities of broiler chicks (Arbo acre strain) was investigated using 120 day-old chicks. For treatments 2, 3, and 4, raw, dehulled, and boiling KB were utilised. The study used a totally randomised design with four treatments and three replications of ten birds each. Consequently, birds given BKD performed better in organoleptic characteristics, but those fed dehulled kidney bean meal performed better in organ weight and carcass yield. In conclusion, sensory features, organ weight and carcass yield indicate that kidney beans, particularly cooked and dehulled ones, may be used as a feed ingredient in broiler diets without any adverse effects.

Verma *et al*. (2021) performed an experiment to determine the impact of linseed oil cake (LOC) as a protein source on the digestibility and growth performance of the *Cyprinus carpio* yearlings. For 60 days, five levels of the experimental diets T_0, T_1, T_2, T_3 and T_4 were provided, each of which contained linseed oil cake at rates of 10%, 20%, 30%, 40% and 0%, respectively. By substituting an equivalent amount of the basal diet, linseed was added. The experimental fishes were fed at a rate of 3% body weight. Significantly difference ($P<0.05$) and the highest growth parameters, including weight gain (62.39±0.59g), percent weight gain (56.42±0.54), specific growth rate (0.799±0.007), gross conversion efficiency (GCE) (0.266±0.002) and apparent protein digestibility (APD) (74.415±0.014), were seen in the T_3 group, while the lowest value was found in the T_0 control group. In comparison to other treatments, the T_3 demonstrated enhanced feed utilisation with a low Food conversion ratio (FCR), i.e., 4.126±0.09. Throughout the course of the trial, the test fishes experienced a 100% survival rate. It was discovered that the survival rate of each treatment at various degrees of linseed oil cake inclusion remained unchanged. These results revealed enhanced food utilisation and protein digestibility on yearlings of Common carp, by showing that linseed oil cake at a rate of 30% in the fish diet had a positive influence on the growth of *Cyprinus carpio* yearlings.

Yadav *et al.* (2021) an experiment was performed to study the growth of *Cyprinus carpio* for 56 days to determine the impact of feeding *Moringa oleifera* pod meal. A total of 20 tanks with four replications, each contained 10 fishes with an average body weight of 12.0g. The feed was prepared using Moringa oleifera pod meal (MPM) at five different treatment levels, ranging from 0g (T0), 10g (T1), 15g (T2), 20g (T3) and 25g (T4) in g/100g. The fishes were fed at the rate of 3% of body weight per day. The fish growth performance exhibited a significant response in the results. T1 (5.80±0.0299g) had the highest body weight gain value while T4 (5.01±0.0299g) had the lowest value. T1 had the maximum percentage body weight gain (47.98±0.241%) while T4 had the lowest value (41.54±0.241%). SGR was highest in T1 therapy (0.732) and lowest in T4 treatment (0.620). The T4 (5.011) treatment had the best feed conversion ratio according to the trial. T1 (4.287) had the highest gross conversion ratio (0.228), while T4 (0.202) had the lowest. His investigation clarified that MPM at a rate of 10g (10%) obtained maximum fish growth and was advised for use as growth promoters in the diet of Common carp with no negative effects.

Sharma *et al.* (2021) examined the positive effects of germinated fenugreek seed meal (GFSM) on *Cyprinus carpio* fingerling's growth performance, survival and proximate composition. Fish were provided dietary supplements of GFSM at 3% body weight at inclusion rates of 0% (T_0), 5% (T_1), 10% (T_2), 15% (T_3), 20% (T_4), and 25% (T_5). For up to 60 days, an experimental investigation was done. Results revealed that at 25% inclusion level of GFSM in the fish diet, significantly ($p< 0,05$) higher growth performance was seen in the form of weight gain

(8.826±0.066 gm), percent weight gain (92.586±0.356%), specific growth rate (1.092±0.003), gross conversion efficiency (0.351±0.001) and protein efficiency ratio (1.181±0.024). The T_5 group had the lowest feed conversion ratio (2.844±0.007), indicating that fish utilized more feed than they did in the control diet. Throughout the course of the experiment, treated fish had a 100% survival rate. The experimental diet's proximate composition showed no appreciable differences ($p < 0.05$). A higher dosage of GFSM resulted in a higher amount of crude protein. In contrast to other treatments, the T_3 and T_5 group was found to have the highest quantities of crude fat and ash. The *Cyprinus carpio* carcass's moisture and carbohydrate contents showed no apparent variation. These results revealed that GFSM at a rate of 25% in fish diets had a positive impact on fish growth performance and that this level of GFSM may be employed in carp diets.

Shuaibu *et al*. (2022) conducted experiment to assess the effects of different inclusion levels of cooked kidney bean meal as non - conventional feedstuff on the growth performance of broilers chicks. The test diets were formulated such that, diet T_1 (control diet) contained no kidney bean meal, diet T_2 contained 20% cooked kidney bean meal, diet T_3 contained 40% cooked kidney bean meal and diet T_4 contained 60 %cooked kidney bean meal. The trial lasted for eight weeks and the following parameters were measured weekly during the experiment. Feed intake, body weight, weight gain, feed conversion ratio, nutrient digestibility, length of body parts and carcass proportion. The result showed that there were significant differences ($p<0.05$) in the Final body weights and average mean body weights. The birds fed 20% cooked kidney bean meal diets had the highest mean body weight (1220g) while birds fed 60% cooked kidney bean meal had the lowest mean body weight (941.20g). It was however concluded that the addition of cooked kidney bean meal had a positive effect on the performance as well as CP digestibility of the birds when their inclusion in the diet is within the range of 20-40% replacement of conventional plant protein sources of feed (Soyabean meal and Groundnut cake). Result also recommend that other processing method of kidney bean could be employed in order to adequately remove the anti-nutritional factors to the barest minimum.

Ibrahim *et al*. (2023) studied On Nile tilapia, *(O. niloticus)*, a feeding study lasting 70 days was planned. 200 fish (34.38 ± 0.05 g) were divided into five groups with four replicates in each (10 fish /replica; 40 fish/group) and given five isonitrogenous and isocaloric diets with five replacement levels of fishmeal (FM) with kidney bean *(Phaseolus vulgaris L)* protein hydrolysate

(KBH) (0, 25, 50, 75, 100%). The results showed a significant improvement in the feed conversion ratio across all replacement levels, with the highest value obtained in the KBH75 and KBH100 groups. The performance metrics (total weight gain, final body weight, , protein efficiency ratio, average daily weight gain and specific growth rate) also showed a significant increase. According to the broken line regression analysis, 76% was the ideal level of FM substitution with KBH. Growth hormone and digesting enzymes (amylase and protease) levels were substantially raised by switching FM to KBH. FM substitution with KBH led to an improvement in immunological functioning (phagocytic %, lysozyme, nitric oxide, phagocytic index and complement 3). From an economic perspective, the KBH75 and KBH100 diets had lower feed costs and feed cost/kg growth. According to the research studies, KBH may completely replace FM by enhancing the expression of genes associated to growth, digestion, immune/antioxidant parameters, and their encoding gene expression. The ideal replacement level was 76%. The substitution of KBH for FM proved economically effective.

3. MATERIAL AND METHODS

The purpose of the present study was to investigate the effect of processed Kidney bean *(Phaseolus vulgaris- pinto group)* seed meal on proximate composition, growth performance and survival of the *Cyprinus carpio* (Linnaeus, 1758) Fingerlings. The materials and methods utilized in the research are mentioned below.

3.1 EXPERIMENTAL DESIGN

This study was performed for 60 days, from 4 April 2023 to 4 may 2023, at the wet lab of the Department of Aquaculture, College of Fisheries, Udaipur (Rajasthan). The Aquaculture Research and Seed Production Unit, Directorate of Research, MPUAT, Udaipur, provided 200 common carp fingerlings. In the experiment European common carp (*Cyprinus carpio carpio*) species variety was used. The fishes were placed in the FRP plastic tanks (500 litres capacity) and fed with a control diet (Groundnut oil cake and rice bran 1:1) for a week, prior to the commencement of the experiment to acclimatize them to the experiment diet and environment.

In the experiment, 18 FRP tanks with a volume of 225 litres were utilized. After a week, the healthy fingerlings of common carp having unvarying size were randomly allocated in five experiment treatments groups and one control group, with each of the three replicates following a completely randomized design. Each tank was to be stocked with 10 common carp fingerlings. All 18 tanks were thoroughly cleaned before fishes were placed within and filled with 200 litres of filtered subterranean water.

Feed was given twice a day, in the morning hrs. at 10 AM and in the evening hrs. at 5 PM. In the form of spaghetti, fingerlings were fed at the rate 3% of their body weight. The growth parameters of experimental fish, Common carp *(Cyprinus carpio)* were analyzed at fortnight interval. In Every 15 days during the trial, the water quality was evaluated. During experiment period fishes were carefully handled with the help of hand net, in the tank. To maintain the desired water quality, Siphoning was done in every 12-14 days and water was replaced and refilled as needed. The samples of fishes were examined for growth performance and proximate composition after 60 days of the experiment whereas, the proximate composition of experimental diet was evaluated during the initial days of research.

3.2 PREPRATION OF BASAL DIET

Feed ingredients

The basal/control diet was prepared by blending different ingredients such as groundnut oil cake (30%), rice bran (30%), Soybean meal (25%), wheat flour (11%), Vegetable Oil (2%) and Vitamin-mineral mixture (2%). The details are listed in (Table 3.1).

3.3 PREPARATION OF EXPERIMENTAL DIET

The experimental diet was prepared by mixing the graded levels of processed kidney bean seed meal in basal diet at five distinct rates: T_1 (5%), T_2 (15%), T_3 (25%), T_4 (35%) and T_5 (45%) including T_0 as (control), replacing an equivalent quantity of the basal diet. The Kidney bean *(Phaseolus vulgaris - pinto group)* was brought from the local market, Udaipur. The kidney bean was subjected to the following processing methods:

The beans were cleaned and washed before being processed, the dry seeds were soaked in water for about 8-12 hrs., after around 8 hrs of soaking, these beans were steam cooked for about 10-15 min at 60-100°C. Then beans undergo the process of dry heating generally referred as toasting, this step involved spreading the seeds thinly in a pan over a burner at (60-80°C) and stirring occasionally to maintain even heating. Dry heating proved adequate when the beans changed from brownish-red to golden brown and became crispy. Process takes around 25-30 minutes to get completed. The beans after being toasted, cooled for some time under normal room temperature. The kidney beans were ground in a mechanical grinder and the kidney bean flour was then sieved through a sieve with (80 µ diameter) pore size. Afterward, the processed kidney bean meal was stored at room temperature in an air-tight plastic container before it is utilized.

Processed kidney bean flour, Groundnut oil cake, rice bran, wheat flour and vitamin-mineral mixture were among the dry elements of the basal diets. These ingredients were completely blended to make dough, which was then put into an autoclave under 15 lbs of pressure for 30 minutes. After that, the paste was extruded using a hand pelletizer. The final diet (spaghetti shaped), had a diameter of 2.0 mm, was air dried and kept in airtight containers for further usage.

Table: 3.1 The details and proximate composition of experimental diet and treatments are

given below (%)

S. No.	Treatment Wise Ingredient's Proportion						
	Ingredients	T_0 (Control)	T_1	T_2	T_3	T_4	T_5
Experimental Diets							
1.	Basal Diet(g)	100	95	85	75	65	55
2.	PKBM (g)	0	5	15	25	35	45
3.	Moisture (%)	$7.40^{b}\pm0.00$	$7.13^{a}\pm0.02$	$7.23^{ab}\pm0.09$	$7.67^{c}\pm0.10$	$7.72^{cd}\pm0.03$	$7.92^{d}\pm0.05$
4.	Crude protein (%)	$32.56^{e}\pm0.09$	$32.43^{e}\pm0.07$	$32.17^{d}\pm0.02$	$31.92^{c}\pm0.02$	$31.66^{b}\pm0.05$	$31.41^{a}\pm0.03$
5.	Fat (%)	$4.48^{a}\pm0.03$	$5.00^{d}\pm0.04$	$4.65^{c}\pm0.03$	$4.48^{ab}\pm0.02$	$4.51^{abc}\pm0.05$	$4.62^{bc}\pm0.05$
6.	Ash (%)	$7.51^{b}\pm0.04$	$7.25^{a}\pm0.03$	$7.62^{b}\pm0.05$	$7.83^{c}\pm0.04$	$8.00^{d}\pm0.05$	$8.23^{e}\pm0.03$
7.	Carbohydrate (%)	$48.04^{ab}\pm0.06$	$48.17^{b}\pm0.07$	$48.32^{b}\pm0.15$	$48.09^{ab}\pm0.10$	$48.09^{ab}\pm0.11$	$47.80^{a}\pm0.04$

Data expressed as Mean ± SE (n=3)
Mean values in the same row sharing same superscripts are significantly similar ($p<0.05$)

3.4 PROXIMATE COMPOSITION OF EXPERIMENTAL DIETS AND FISH

To evaluate the impact of Processed Kidney bean seed meal feeding on the biochemical configuration of fish, samples of whole fish and diet were processed for the analysis of moisture, protein, fat (lipid), ash contents following AOAC (1995).

I. Moisture analysis

In a petri dish, a two-gram fresh sample of powdered fish and feed was collected, and it was dried for 24 hours in a hot air oven at 60 ± 2°C. The petri dish was then cooled in a desiccator before being weighed once again. Using the following formula: the moisture, or weight loss was calculated in percent:

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

II. Estimation of Crude Protein by KELPLUS NITROGEN ESTIMATION

SYSTEM DIGESTION

- Switch ON the system.
- Take the sample in 250 ml Macro DTL Tube.
- Take Fresh moisture free powdered sample of feed and fish weighted around 0.2 gm to 0.5 gm and note down the sample weight (W).
- Then add 3 gm - 4 gm of catalyst mixture (3 gm Na_2SO_4 + 0.5 gm $CuSO_4$).
- Add 10ml of Conc. H_2SO_4.
- Load the sample in the digestion unit with manifold.
- Open Tap water with maximum pressure for KEL FLOW System. Switch ON the digestion system.
- Now gradually, increase the temperature upto 420℃, Automatically
- Digestion process takes around 1 to 2 hrs depending on the type of sample used.
- A clear green colour indicates that the digestion of the sample is over.
- Keep the sample in the cooling rack for cooling.
- Cooling takes about half an hour.
- Close the Tap water Kel-flow
- Add 30 ml distilled water in each tube.

DISTILLATION:

- Prepare the Solutions (4% Boric Acid, 40% Alkali, 0.1 N HCl or H_2SO_4)
- Check the Distilled water tank (Water level, Tap & Cap)
- Switch ON the system.
- Wait for 'READY' indication.
- Load the Alkali, Boric Acid to the system through silicon hoses
- Provided at the back of the equipment while you wait for the READY signal.
- Load a DTL tube with some distilled water and receiver side empty conical flask.
- Before starting the sample testing open the tap water for cooling purpose (Check the INLET & OUTLET).
- Run a manual process for 9 min to pre-heat the system.
- Load the sample tube in sample side.
- Take 25 ml Boric Acid with Indicator in a 250 ml Conical Flask and place at the

Receiver end.

- Add 40 ml of the 40% Alkali (Until dark BROWN Color appears) in sample side.
- Now Start the Process for 9 mins.
- During the process, liquid Ammonia will collect in the Boric Acid and the Boric acid' s color will change based on the indicator used.
- After completion of the process remove the conical flask from the receiver end and then titrate it.
- The DTL tube from the sample side can now be removed.

TITRATION:

- Take 0.1N HCL in Burette. (Use 10 ml burette).
- First find out the Blank Value (BV).
- Titrate the sample against 0.1N HCL and note down value (TV).

CALCULATION:

- Nitrogen N % $= \frac{14.01 \times 0.1N \times (TV - BV) \times 100}{W \times 1000}$

- Protein P % = N x 6.25 (for Food Samples)

Where:

- 14.01 (Ammonia's Molecular weight)
- 0.1N (Titration solution's normality)
- TV (Titer Value)
- BV (Blank Value)
- W (Sample Weight)

III. Estimation of Fat

- Remove moisture from the beakers by placing them in an oven at a temperature of 100℃
- Now weigh the empty beaker and let the weight be W_1. This is Initial Beaker Weight.
- Now insert the thimble in the thimble holder and place it on the beaker.

- Weigh the samples and transfer them to the thimble. Let the sample weight be SW. Sample weight was around 2 to 3 grams.
- Pour the solvent into the beaker. The volume may be 80 to 100 ml.
- Load the beakers in the system. Switch ON the system and set the boiling temperature as the solvent' s maximum boiling point.
- Ex: Boiling point of Petroleum Ether is 40 - 60°C. Boiling temperature can be 60°C.
- Leave the process about 60 minutes. After the process time, increase the temperature to recovery temperature should be the range of 160 - 190°C.
- Now collect the remaining fat that was present in the sample or in the thimble.
- Now take out the beakers from the system then remove all the thimbles from the beaker and put the beakers into a hot air oven @ 100°C. After 20 to 30 minutes, take out the beakers and place them in desiccator about 10 to 15 minutes for cooling up to the room temperature.
- After cooling weigh the beakers. This is the Final Weight of the Beaker (FBW). Let the weight be W_2. By substituting SW, W_1 and W_2 in the following formula, the percentage of fat present in the sample can be calculated.

FORMULA:

$$\text{Crude Fat (\%)} = \frac{\text{Weight of fat (g)}}{\text{Weight of sample (g)}} \times 100$$

IV. Estimation of Ash

In a silicon crucible, 2 gms. of dried and powdered samples of varying experimental diets and fish were added and the final weight was noted. The samples were burned in a muffle furnace that was preheated for 4 hours at 550 °C. Then, using tongs, the burned material in a crucible was moved to a desiccator. The samples were then cooled and weighed once again. The following formula was used to determine the Ash content:

$$\text{Ash (\%)} = \frac{\text{Ash weight (g)}}{\text{Sample weight (g)}} \times 100$$

V. Estimation of Carbohydrate

The total quantity of carbohydrates was determined using the difference method. The percentage of the carbohydrate was given as follows:

Carbohydrate (%) = 100 − (% Moisture + % Crude protein + % Crude Fat + % Ash)

3.5 GROWTH PARAMETERS

The growth parameters of experimental fish Common carp *(Cyprinus carpio)* were analysed at fortnight interval. During the experimentation, the growth parameters was calculated. Body weight of fish was measured. Based on the weight of each fish, the following formulas was used to compute weight gain (WG), specific growth rate (SGR), feed conversion ratio (FCR) and survival which was mentioned below: -

- **Weight gain (g) =** Final Weight (g) – Initial weight (g)

- **(%) Weight gain (g) =** $\frac{\text{Final Weight (g)} - \text{Initial weight (g)}}{\text{Initial weight (g)}} X100$

- **Specific Growth Rate (SGR):**

$$\text{SGR} = \frac{(\text{InWt} - \text{InWo})}{\text{D}} \times 100$$

Where,

W_o = Initial weight of live fish (gm)

Wt = Final weight of live fish (gm)

D = Duration of feeding (days)

- **Food Conversion Ratio (FCR) formula:**

$$\text{FCR} = \frac{\text{Weight of feed given(g)}}{\text{Weight gain of fish(g)}}$$

- **Gross Conversion Efficiency (GCE):**

$$\text{GCE} = \frac{\text{Weight gained (g)}}{\text{Food given (g)}}$$

- **Survival %:**

$$\text{Survival\%} = \frac{\text{Total harvested number x 100}}{\text{Total stocked number}}$$

3.6 MONITORING OF EXPERIMENTAL WATER QUALITY PARAMERERS

Selected water quality parameters, including water temperature (°C), pH, Dissolved oxygen (mg/l), Total alkalinity (mg/l), Total hardness (mg/l) and Electrical conductivity (µS/cm), were tested initially and at intervals of 15 days, according to the standard procedure of APHA (2005).

I. Water temperature

Water temperature generally depends on climate, sunlight and depth. All organisms including fish possess well defined limits of temperature tolerance. Temperature also alters the dissolved oxygen content of the water. In order to measure the water's temperature, a digital temperature meter was dipped directly into the water of experimental tank and then the temperature in ºC was recorded to a single decimal place.

II. Hydrogen ion concentration (pH)

The concentration of hydrogen ions of all experimental tanks was measured by using a standard digital pH meter.

III. Electrical conductivity (EC)

The capacity of water to conduct electrical current due to the presence of ions in it is referred to as EC. The electrical conductivity of experimental water measured by using an electronic pen type conductivity meter and it is expressed as mS cm-1.

IV. Total alkalinity

By titrating a 50 ml sample of water with a standard sulphuric acid (H_2SO_4) solution of 0.02N as titrant in a conical flask and adding a few drops of phenolphthalein indicator, the alkalinity of the solution was calculated. The phenolphthalein alkalinity was determined to be at the first end point (pH 8.3). Bicarbonate alkalinity was assessed using a methyl orange indicator until the second end point (pH 4.5). The following formula was used to estimate hardness:

$$\text{Total alkalinity (mg/l)} = \frac{ml\ of\ titrant\ used}{ml\ of\ sample} \times 1000$$

V. Total Hardness

Total hardness was determined using the indicator Eriochrome Black-T, which when combined with the metal ions Ca++ and Mg++, produces the wine-red complex element. The disodium salt of EDTA has a stronger affinity for Ca++ and Mg++ as a result, when EDTA is added, the complex is disrupted and a new complex with a blue colour is produced.

In a conical flask, 50 ml of the water sample was taken, along with 5 drops of the Eriochrome Black-T- indicator solution and 1 ml of the ammonia buffer were added to it. Wine red coloration was developed to the water sample. The solution was titrated with EDTA solution until a distinct blue colour appeared. This was observed, and the formula used to calculate hardness was mentioned below:

$$\text{Total Hardness (mg/l)} = \frac{\text{ml of EDTA used}}{\text{Volume of sample (50 ml)}} \times 100$$

VI. Dissolved Oxygen (D.O.)

The modified Winkler's technique is used to know the dissolved oxygen content of the water. In this procedure, oxygen and manganous hydroxide react to generate higher hydroxides, which, when subjected to acidification, release iodine that is equal to the oxygen fixed. This iodine is titrated with a standard solution of sodium thiosulphate using starch indicator.

For oxygen estimate, the following procedures were used:

1. Water sample was collected in 250 ml stoppered bottles, avoiding entrapping any air bubbles.

2. Add 2 ml each of Winkler- A (manganous sulphate) and Winkler- B (alkaline iodide- azide) solutions were dispensed one after the other.

3. By agitating bottles, contents were shaken well. The oxygen that was dissolved in the water precipitated as a yellowish-brown substance, that shows the presence of oxygen. Allowed the precipitate to settle down.

4. Then 2 ml of concentrated H_2SO_4 was added and it was rapidly agitated to dissolve the precipitate.

5. To estimation of the amount of dissolved oxygen, in a conical flask, 50 ml sample water that has had the oxygen fixed was collected and titrated against sodium thio-sulphate until the colour changed to pale straw.

6. Then, added 2 drops of the starch indicator and further titrated until the blue color disappeared into colorless.

7. This used titrant volume was recorded, and the dissolved oxygen content was computed by following formula -

$$DO\ in\ (mg/l) = \frac{8 \times 1000 \times N(0.025) \times V'}{V}$$

Where,

N = Normality of titrant

V = Volume of sample of (ml)

V' = Volume of titrant used (ml)

3.7. STATISTICAL ANALYSIS

The collected data was statistically analyzed with the help of statistical package SPSS 16. These data were subjected to the "Duncan's multiple range test" to check the significant differences if any between the means and comparison were made at ($p<0.05$) level of significance.

Plate 1: Shows experimental site

Plate 2: Experimental Diet

Plate 3: Ash Estimation

Plate 4: Analysis of crude Protein content of *Cyprinus carpio* fingerlings in different treatments

4. EXPERIMENTAL RESULT

The results of the experiment, shows how the parameters of water quality, fish growth performance, proximate composition of feed and fish, functioned during the experimental period, the results were shown in Table 4.1 to 4.8 and Figures 4.1 to 4.14.

PHYSICO CHEMICAL PARAMETER

Physical and chemical characteristics of the water, including its temperature, electrical conductivity, pH, dissolved oxygen content, total alkalinity and total hardness were also measured. Table 4.1 and Figure 4.1-4.6 show the range and average values for such parameters.

Water Temperature

All living things depend on water as a critical resource to survive. Water temperature throughout the current investigation ranged from 26.2 to 30.5 °C. T_0 reported the lowest mean water temperature of 27.81 °C, while T_3 recorded the highest mean water temperature of 28.19°C. (Table 4.1& and Figure 4.1)

Electrical Conductivity

The overall ionic content of water is measured via conductivity. Due to the ions present, water has the ability to conduct electric current (EC). To calculate the EC, a digital conductivity metre was used. In the current investigation, EC values ranged from 176 -214 µS/cm. The lowest mean EC value was 192.3 µS/cm in T_0 and T_5. Where as, he highest mean EC value was 194.5 µS/cm in T_2. (Table 4.1 and Figure 4.2)

Hydrogen ion concentration (pH)

pH is the measure of hydrogen ion concentration in water and indicates the acidity and alkalinity (basicity) of water. pH affects metabolism and physiological process of fish. During the current experiment, water pH was recorded between 6.4-8.4. The minimum mean value of pH was recorded 7.31 in T_3 whereas maximum mean value of pH was recorded 7.53 in T_2 and T_5. (Table 4.1 and Figure 4.3)

Dissolved oxygen

Dissolved oxygen present in the aquaculture environment is the most important factor in water quality. Fluctuations in concentration of DO was noticed during the experiment that ranged from 5.6 to 8.2 mg/l. The highest mean value of DO (7.38mg/l) was observed in T_2 whereas the lowest mean value (6.68 mg /l) was observed in T_1 (Table 4.1 and Fig.4.4)

Total Alkalinity

Alkalinity refers to the total amount of bases in water. During the recent research phases total alkalinity was recorded between 102 -168mg/l. The maximum mean value of alkalinity (144.1 mg/l) was observed in T_4 whereas the minimum (132.0 mg/l) was observed in T_0 (Table 4.1 and Fig.4.5).

Total Hardness

During the research period Total Hardness was recorded between 400-491 mg/l. The lowest mean value of Total Hardness was observed 438.0 mg/l in T_1 whereas highest mean value of Total Hardness was observed 457.1 mg/l in T_4. (Table 4.1 and Figure 4.6)

PROXIMATE COMPOSITION OF EXPERIMENTAL DIET

The proximate composition of experimental diet principally comprise protein, lipid (fat), moisture, ash and carbohydrate. The maximum crude protein level was found in T_0 diet (32.563±0.0952) whereas the minimum crude protein level (31.41±0.0321) in T_5 (control). The highest level of crude fat (5.006±0.0497) was found in T_1 while the lowest (4.48±0.0360) was found in T_0. The highest moisture content was reported in (7.923±0.0581) T_5 and lowest in (7.136±0.0290) in T_1 respectively. The value of ash content was highest (8.236^e±0.0371) in treatment T_5 and lowest was found in (7.25±0.0346) T_1. The amount of carbohydrates in experimental diet was noticed maximum (48.323±0.1598) in T_2 and minimum (47.803^a±0.0433) being in T_5. (Fig. 4.13)

GROWTH PERFORMANCE

When the research work was finished (60 days later), the growth performances of Common carp (*Cyprinus carpio*) were evaluated for experimental diets fed with Processed kidney bean meal in varied quantities: 5%, 15%, 25%, 35% and 8% compared to the control group. The growth performance measured in terms of weight gain (WG), percent weight gain (%WG), specific growth rate (SGR), feed conversion ratio (FCR), and gross conversion efficiency (GCE) of *Cyprinus carpio* fingerlings showed a significant difference ($P<0.05$) when using different levels of Processed kidney bean meal in fish diet. The fish growth parameters are presented in Tables 4.2-4.7 and Figure 4.7-4.12.

Weight Gain

During the recent research study, the initial weight of *Cyprinus carpio* fingerlings varied from 34.380±0.098g. to 34.960±0.127g/tank for all the treatments. The highest weight gain was recorded in treatment T_1 (28.69±0.0838) followed by T_2 (25.24±0.1216), T_0 (25.22±0.0971), T_3 (23.256±0.0993), T_4 (21.14±0.1167) and lowest weight gain was recorded in treatment T_5 (20.096±0.1449). The net weight gain among treatments was significantly different ($p<0.05$). (Table 4.2 and Figure 4.7)

Percentage weight gain

The highest Percentage weight gain was observed (82.883±0.8482) in T_1 followed by (72.486±0.1097) in T_2, (72.424±0.7026) in T_0, (66.525±0.4141) in T_3, (61.467±0.4834) in T_4 and lowest (58.454±0.3945) in T_5. The per cent weight gain was also significantly different ($p<0.05$) among all the treatments. (Table 4.3 and Figure 4.8)

Feed Conversion Ratio (FCR)

During the current study the lowest (best) FCR was noticed in T_1 (2.842±0.0225) and highest FCR (3.757±0.0211) in T_5. FCR has shown a significant difference ($p<0.05$) among various treatment. (Table 4.4 and Figure 4.9)

Specific Growth Rate (SGR)

During the current experiment the highest SGR (1.006±0.0077) was observed in T_1 followed by (0.908±0.0010) in T_2, (0.907±0.0068) in T_0, (0.850±0.0041) in T_3, (0.798±0.0049) in T_4 and lowest SGR (0.767±0.0041) in T_5. The value of SGR has shown a significant difference ($p<0.05$) among all the treatments. (Table 4.5 and Figure 4.10)

Gross Conversion Efficiency (GCE)

The GCE has shown a significant difference ($p<0.05$) among all the treatments. During the current study the GCE was observed highest (0.351±0.0027) in T_1 followed by (0.317±0.0026) in T_0, (0.316±0.0002) in T_2, (0.295±0.0015) in T_3, (0.277±0.0017) in T_4 and lowest (0.266±0.0015) in T_5. (Table 4.6 and Figure 4.11)

PROXIMATE COMPOSITION OF FISH CARCASS

Proximate composition of fingerlings of *Cyprinus carpio* showed that experimental fishes that were fed with 5% inclusion level of Processed kidney bean meal were found to perform better among all treatment groups in the matter of crude protein. The highest content of crude protein (18.873±0.0218) was found in T_1 followed by (18.59±0.0435) in T_0 and lowest crude protein (18.006±0.0517) was found in T_5. The maximum content of fat (lipid) (4.436±0.0375) was observed in T_1 and lowest (4.116±0.0463) was reported in T_3. The highest carbohydrate (3.906±0.0384) was observed in T_0 whereas lowest (3.266±0.1166) in T_3. The highest ash (3.476±0.0352) was noticed in T_5 and lowest ash (3.0766±0.0233) in T_1. The highest moisture (71.063±0.0851) was found in T_3 and lowest (70.123±0.0318) in T_0. (Table 4.8 and Figure 4.14) The proximate composition of fish carcass has shown a significant difference ($p<0.05$) among all the treatments.

SURVIVAL RATE

During the experimental study the *Cyprinus carpio* fingerlings had a 100 % survival rate. The survival rate of each treatment groups was found to be unaffected by different concentration of Processed kidney bean meal diets

Table 4.1: Range and mean values of water quality parameters during experimental period of 60 days in different treatments

Parameters	T_0	T_1	T_2	T_3	T_4	T_5
Water Temperature (°C)	26.2-30.2 (27.81)	26.4 - 30.5 (27.97)	26.4-30.4 (28.08)	26.3-30.4 (28.19)	26.4-30.2 (28.12)	26.4-30.2 (28.07)
pH	7.1-7.9 (7.49)	6.8-8.1 (7.46)	6.8-8 (7.53)	6.7-7.8 (7.31)	6.4-8.4 (7.43)	6.9-8.1 (7.53)
Dissolved oxygen (mg/l)	6-8 (7.26)	5.6-7.4 (6.68)	6.4-7.9 (7.38)	6-7.8 (7.21)	5.6-8.2 (6.93)	6-7.9 (7.0)
Total Alkalinity (mg/l)	102-151 (132.0)	128-151 (138.4)	125-159 (141.8)	130-152 (139.6)	129-168 (144.1)	112-164 (140.5)
Total Hardness (mg/l)	410-480 (443.7)	410-479 (438.0)	417-470 (438.6)	400-480 (448.0)	420-491 (457.1)	410-479 (450.5)
Electric conductivity (µS/cm)	182-209 (192.3)	179-211 (193.3)	179-212 (194.5)	178-212 (193.0)	176-214 (192.9)	176-204 (192.3)

Note- Figure in bracket shows average values

Table 4.2: Net weight gain of *Cyprinus carpio* fingerlings fed with different levels of processed kidney bean meal as Supplementary feed

in different treatments.

eatments	Initial wt.(g)	Fish weight gain (g)					
		0-15 days	16-30 days	31-45 days	46-60 days	0-60 days	Total weig gain
(Control)	34.826^{ab}±0.216	6.206^{d}±0.0504	6.163^{d}±0.0290	6.4^{e}±0.0378	6.45^{d}±0.0529	25.22^{d}±0.0971	60.046^{d}±0.01
T_1	34.620^{ab}±0.257	7.206^{e}±0.0384	6.953^{e}±0.0536	7.19^{f}±0.0378	7.34^{e}±0.0288	28.69^{e}±0.0838	63.310^{e}±0.01
T_2	34.820^{ab}±0.128	6.343^{d}±0.0592	6.276^{d}±0.0352	6.163^{d}±0.0636	6.456^{d}±0.0352	25.24^{d}±0.1216	60.060^{d}±0.02
T_3	34.960^{b}±0.127	5.97^{c}±0.0529	5.723^{c}±0.0352	5.716^{c}±0.0348	5.846^{c}±0.0643	23.256^{c}±0.0993	58.216^{c}±0.01
T_4	34.393^{a}±0.082	5.343^{b}±0.0466	5.216^{b}±0.0384	5.386^{b}±0.0693	5.193^{b}±0.0433	21.14^{b}±0.1167	55.533^{b}±0.04
T_5	34.380^{a}±0.098	5.07^{a}±0.0458	5.03^{a}±0.0360	5.003^{a}±0.0581	4.993^{a}±0.0768	20.096^{a}±0.1449	54.476^{a}±0.02

Data expressed as Mean ± SE (n=3)

Mean values in the same column sharing different superscripts are significantly different ($p<0.05$)

Table 4.3: Percent weight gain of *Cyprinus carpio* fingerlings fed with different levels of processed kidney bean meal in different meal as supplementary treatments.

Treatments	Percent weight gain (%)				
	0-15 days	**16-30 days**	**31-45 days**	**46-60 days**	**0-60 days**
T_0 (Control)	$17.822^{d}\pm0.1303$	$15.021^{c}\pm0.1448$	$13.561^{d}\pm0.1458$	$12.035^{c}\pm0.1406$	$72.424^{d}\pm0.7026$
T_1	$20.819^{e}\pm0.2316$	$16.625^{d}\pm0.1902$	$14.740^{e}\pm0.1255$	$13.114^{d}\pm0.0983$	$82.883^{e}\pm0.8482$
T_2	$18.216^{d}\pm0.1109$	$15.248^{c}\pm0.0245$	$12.991^{c}\pm0.0913$	$12.046^{c}\pm0.1185$	$72.486^{d}\pm0.1097$
T_3	$17.077^{c}\pm0.2012$	$13.983^{b}\pm0.0918$	$12.253^{b}\pm0.0635$	$11.164^{b}\pm0.1256$	$66.525^{c}\pm0.4141$
T_4	$15.536^{b}\pm0.1719$	$13.128^{a}\pm0.1082$	$11.982^{b}\pm0.1596$	$10.316^{a}\pm0.0919$	$61.467^{b}\pm0.4834$
T_5	$14.747^{a}\pm0.1424$	$12.750^{a}\pm0.1229$	$11.248^{a}\pm0.1144$	$10.090^{a}\pm0.1314$	$58.454^{a}\pm0.3945$

Data expressed as Mean ± SE (n=3)

Mean values in the same column sharing different superscripts are significantly different ($p<0.05$)

Table 4.4: Feed Conversion Feed (FCR) of *Cyprinus carpio* fingerlings fed with different levels of processed kidney bean meal as supplementary feed in different treatments.

Treatments	Feed Conversion Feed (FCR)				
	0-15 days	**16-30 days**	**31-45 days**	**46-60 days**	**0-60 days**
T_0 (Control)	$2.525^{b}\pm0.0183$	$2.996^{b}\pm0.0291$	$3.318^{b}\pm0.0355$	$3.740^{b}\pm0.0439$	$3.152^{b}\pm0.0262$
T_1	$2.162^{a}\pm0.0239$	$2.707^{a}\pm0.0310$	$3.053^{a}\pm0.0257$	$3.431^{a}\pm0.0258$	$2.842^{a}\pm0.0225$
T_2	$2.470^{b}\pm0.0151$	$2.951^{b}\pm0.0047$	$3.464^{c}\pm0.0243$	$3.736^{b}\pm0.0371$	$3.156^{b}\pm0.0025$
T_3	$2.635^{c}\pm0.0307$	$3.218^{c}\pm0.0209$	$3.672^{d}\pm0.0191$	$4.031^{c}\pm0.0455$	$3.384^{c}\pm0.0172$
T_4	$2.897^{d}\pm0.0318$	$3.428^{d}\pm0.0281$	$3.756^{d}\pm0.0499$	$4.362^{d}\pm0.0389$	$3.606^{d}\pm0.0223$
T_5	$3.052^{e}\pm0.0297$	$3.529^{e}\pm0.0338$	$4.001^{e}\pm0.0406$	$4.461^{d}\pm0.0578$	$3.757^{e}\pm0.0211$

Data expressed as Mean ± SE (n=3)

Mean values in the same column sharing different superscripts are significantly different ($p<0.05$)

Table 4.5: Specific Growth Rate (SGR) of *Cyprinus carpio* fingerlings fed with different levels of processed kidney Bean meal as supplementary feed in different treatments.

Treatments	Specific Growth Rate (SGR)				
	0-15 days	**16-30 days**	**31-45 days**	**46-60 days**	**0-60 days**
T_0 (Control)	1.093^{d}±0.0073	0.933^{d}±0.0084	0.847^{d}±0.0085	0.757^{c}±0.0083	0.907^{d}±0.0068
T_1	1.260^{e}±0. 0127	1.025^{e}±0.0108	0.916^{e}±0.0072	0.821^{d}±0.0058	1.006^{e}±0.0077
T_2	1.115^{d}±0.0062	0.946^{d}±0.0014	0.814^{c}±0.0053	0.758^{c}±0.0070	0.908^{d}±0.0010
T_3	1.051^{c}±0.0114	0.872^{c}±0.0053	0.770^{b}±0.0037	0.705^{b}±0.0075	0.850^{c}±0.0041
T_4	0.962^{b}±0.0099	0.822^{b}±0.0063	0.754^{b}±0.0095	0.654^{a}±0.0055	0.798^{b}±0.0049
T_5	0.917^{a}±0.0082	0.800^{a}±0.0072	0.710^{a}±0.0068	0.640^{a}±0.0079	0.767^{a}±0.0041

Data expressed as Mean ± SE (n=3)

Mean values in the same column sharing different superscripts are significantly different ($p<0.05$)

Table 4.6: Gross Conversion Efficiency (GCE) of *Cyprinus carpio* fingerlings fed with different levels of processed kidney bean meal as supplementary feed in different treatments.

Treatments	Gross Conversion Efficiency (GCE)				
	0-15 days	**16-30 days**	**31-45 days**	**46-60 days**	**0-60 days**
T_0 (Control)	0.396^{d}±0.0029	0.333^{c}±0.0032	0.301^{d}±0.0032	0.267^{c}±0.0031	0.317^{d}±0.0026
T_1	0.462^{e}±0.0051	0.369^{d}±0.0042	0.327^{e}±0.0027	0.291^{d}±0.0021	0.351^{e}±0.0027
T_2	0.404^{d}±0.0024	0.338^{c}±0.0005	0.288^{c}±0.0020	0.267^{c}±0.0026	0.316^{d}±0.0002
T_3	0.379^{c}±0.0044	0.310^{b}±0.0020	0.272^{b}±0.0014	0.248^{b}±0.0027	0.295^{c}±0.0015
T_4	0.345^{b}±0.0038	0.291^{a}±0.0024	0.266^{b}±0.0035	0.229^{a}±0.0020	0.277^{b}±0.0017
T_5	0.327^{a}±0.0031	0.283^{a}±0.0027	0.250^{a}±0.0025	0.224^{a}±0.0029	0.266^{a}±0.0015

Data expressed as Mean ± SE (n=3)

Mean values in the same column sharing different superscripts are significantly different ($p<0.05$)

Table 4.7: Summary of growth parameters of *Cyprinus carpio* fingerlings fed with different levels of processed kidney bean meal as supplementary feed in different treatments.

Treatments	Net weight gain (g)	Percent weight gain	FCR	SGR	GCE
T_0 (Control)	25.22[d]±0.0971	72.424[d]±0.7026	3.152[b]±0.0262	0.907[d]±0.0068	0.317[d]±0.0026
T_1	28.69[e]±0.0838	82.883[e]±0.8482	2.842[a]±0.0225	1.006[e]±0.0077	0.351[e]±0.0027
T_2	25.24[d]±0.1216	72.486[d]±0.1097	3.156[b]±0.0025	0.908[d]±0.0010	0.316[d]±0.0002
T_3	23.256[c]±0.0993	66.525[c]±0.4141	3.384[c]±0.0172	0.850[c]±0.0041	0.295[c]±0.0015
T_4	21.14[b]±0.1167	61.467[b]±0.4834	3.606[d]±0.0223	0.798[b]±0.0049	0.277[b]±0.0017
T_5	20.096[a]±0.1449	58.454[a]±0.3945	3.757[e]±0.0211	0.767[a]±0.0041	0.266[a]±0.0015

Data expressed as Mean ± SE (n=3)

Mean values in the same column sharing different superscripts are significantly different ($p<0.05$)

Table 4.8: Proximate composition of carcass of *Cyprinus carpio* fingerlings fed with different levels of processed kidney bean meal as supplementary feed in different treatments.

Treatments	Moisture (%)	Crude protein (%)	Fat (%)	Ash (%)	Carbohydrate (%)
T_0 (Control)	$70.123^{a}\pm0.0318$	$18.59^{d}\pm0.0435$	$4.21^{ab}\pm0.0115$	$3.17^{ab}\pm0.0346$	$3.906^{b}\pm0.0384$
T_1	$70.23^{a}\pm0.0305$	$18.873^{e}\pm0.0218$	$4.436^{c}\pm0.0375$	$3.0766^{a}\pm0.0233$	$3.383^{a}\pm0.0491$
T_2	$70.636^{b}\pm0.0926$	$18.433^{c}\pm0.0375$	$4.26^{b}\pm0.0288$	$3.266^{b}\pm0.0348$	$3.403^{a}\pm0.0829$
T_3	$71.063^{c}\pm0.0851$	$18.276^{b}\pm0.0352$	$4.116^{a}\pm0.0463$	$3.276^{b}\pm0.0520$	$3.266^{a}\pm0.1166$
T_4	$70.59^{b}\pm0.0635$	$18.203^{b}\pm0.0290$	$4.293^{b}\pm0.0466$	$3.41^{c}\pm0.0404$	$3.503^{a}\pm0.1317$

Data expressed as Mean ± SE (n=3)

Mean values in the same column sharing different superscripts are significantly different ($p<0.05$)

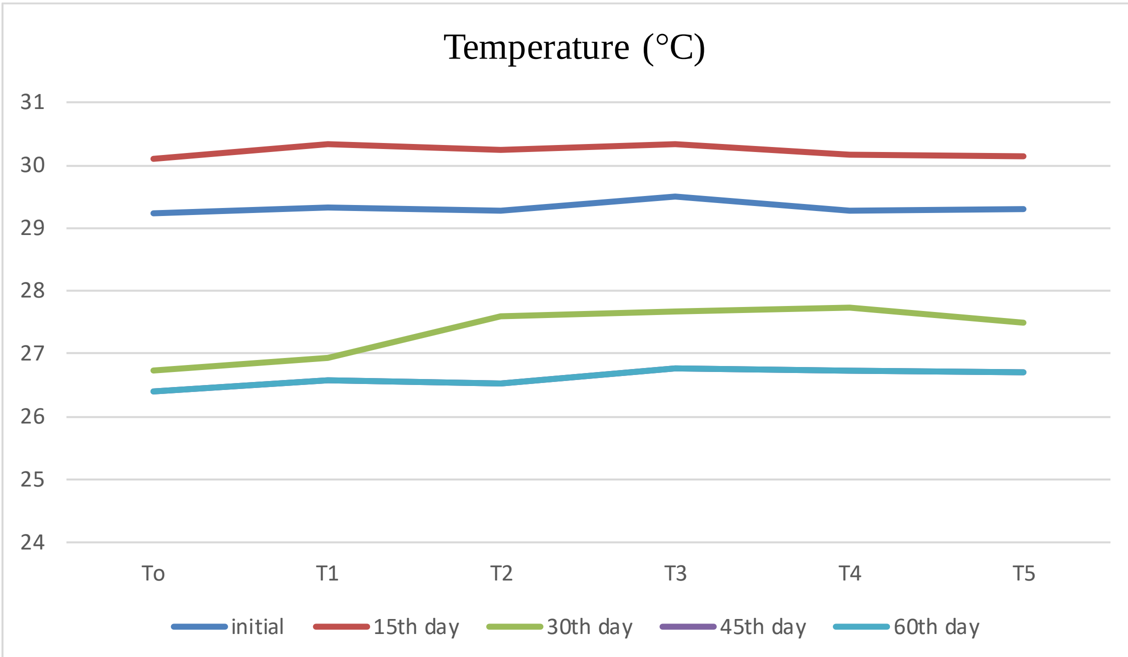


Fig. 4.1: Water temperature during the experimental period of 60 days in different treatments.

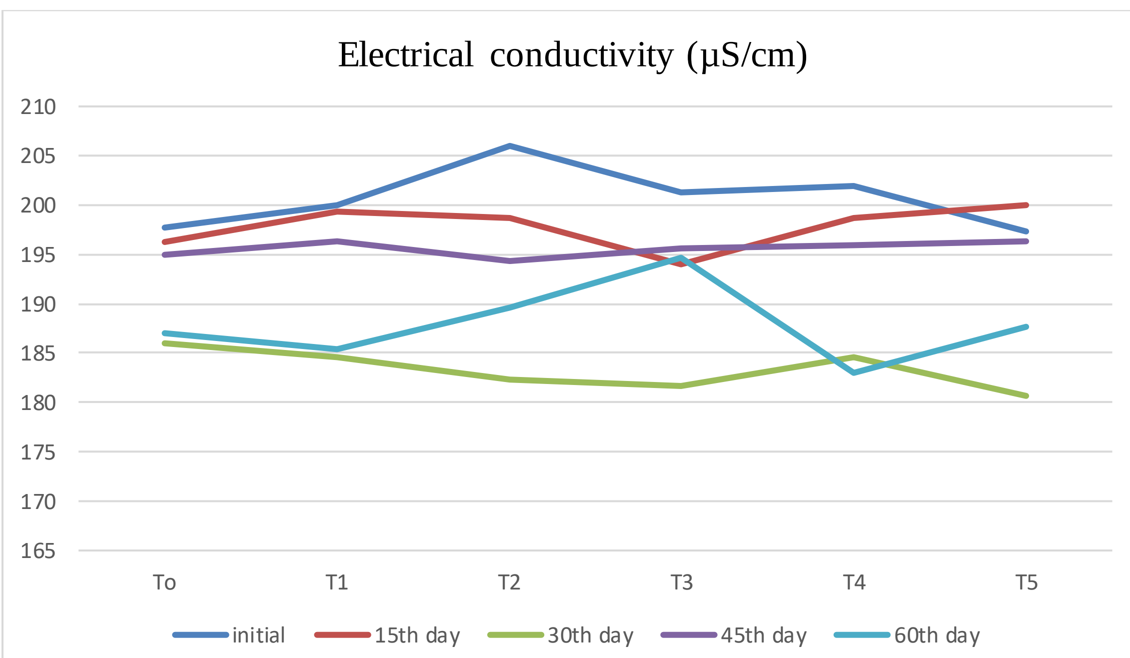


Fig. 4.2: Electrical conductivity of water during the experimental period of 60 days in different treatments

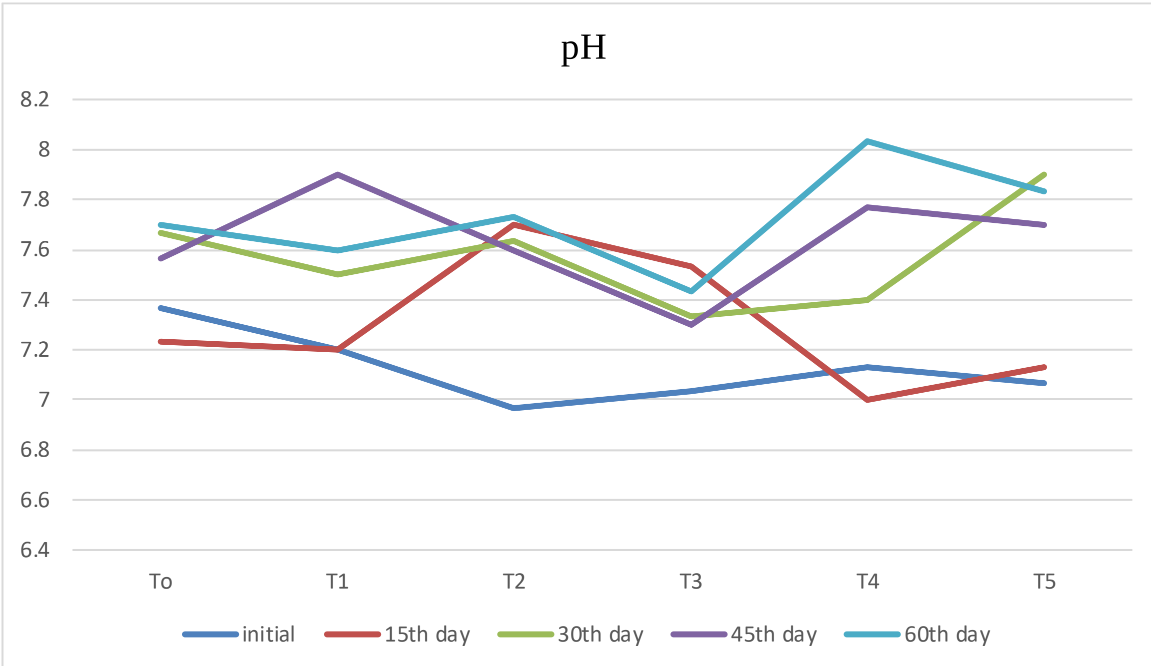


Fig. 4.3: pH of water during the experimental period of 60 days in different treatments

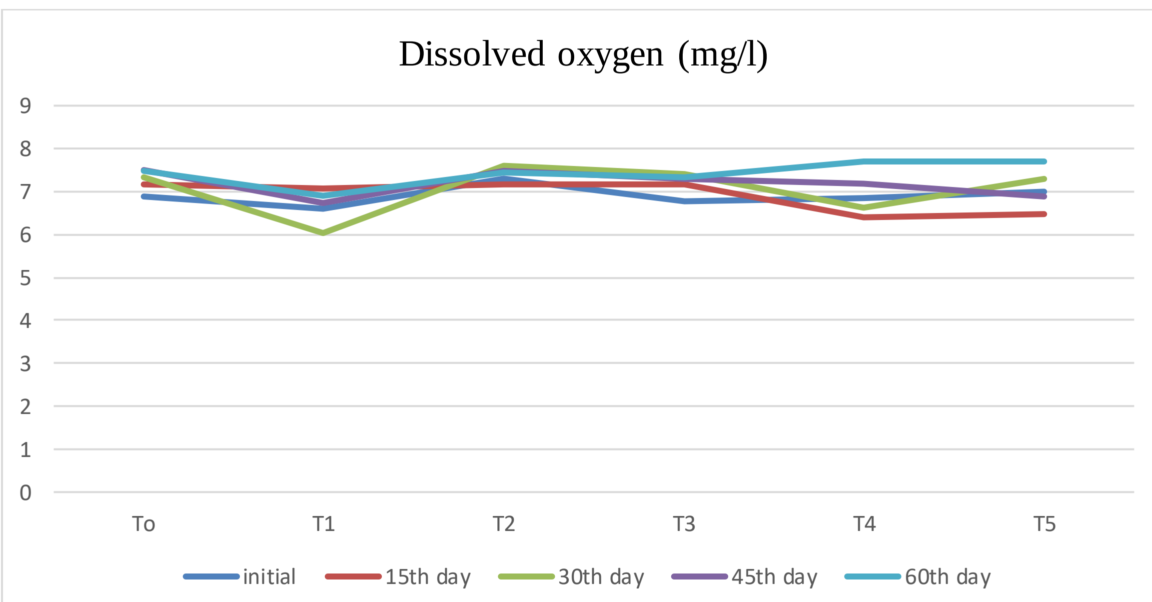


Fig. 4.4: Dissolve oxygen in water during the experimental period of 60 days in different treatment

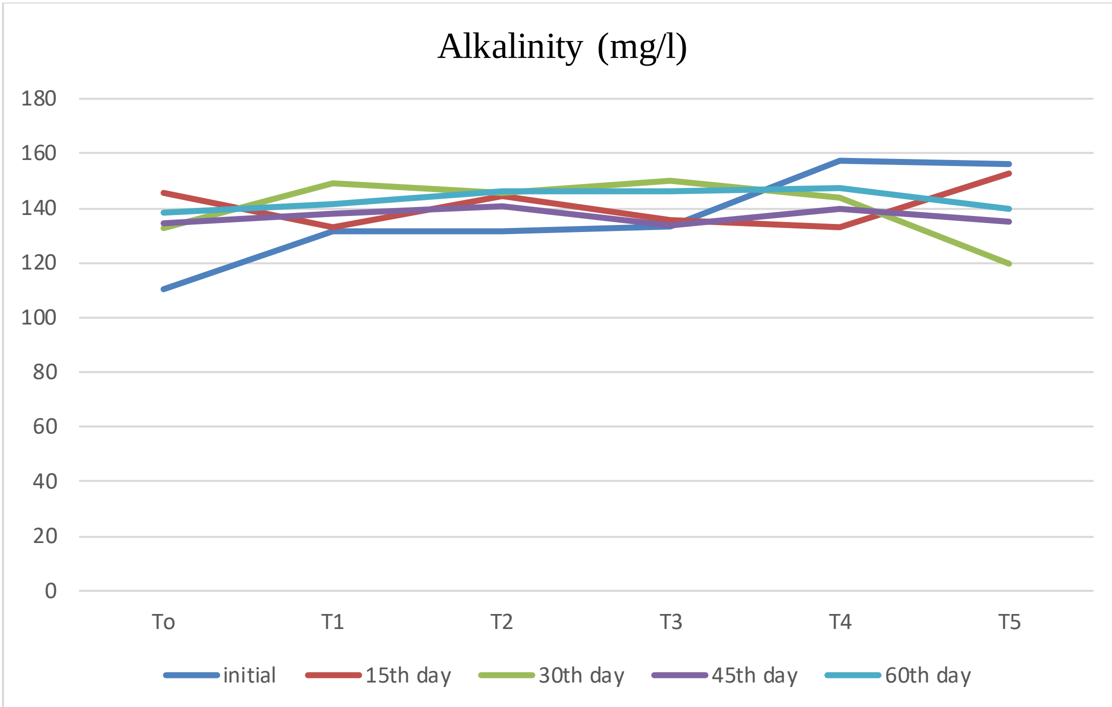


Fig. 4.5: Alkalinity of water during the experimental period of 60 days in different treatments

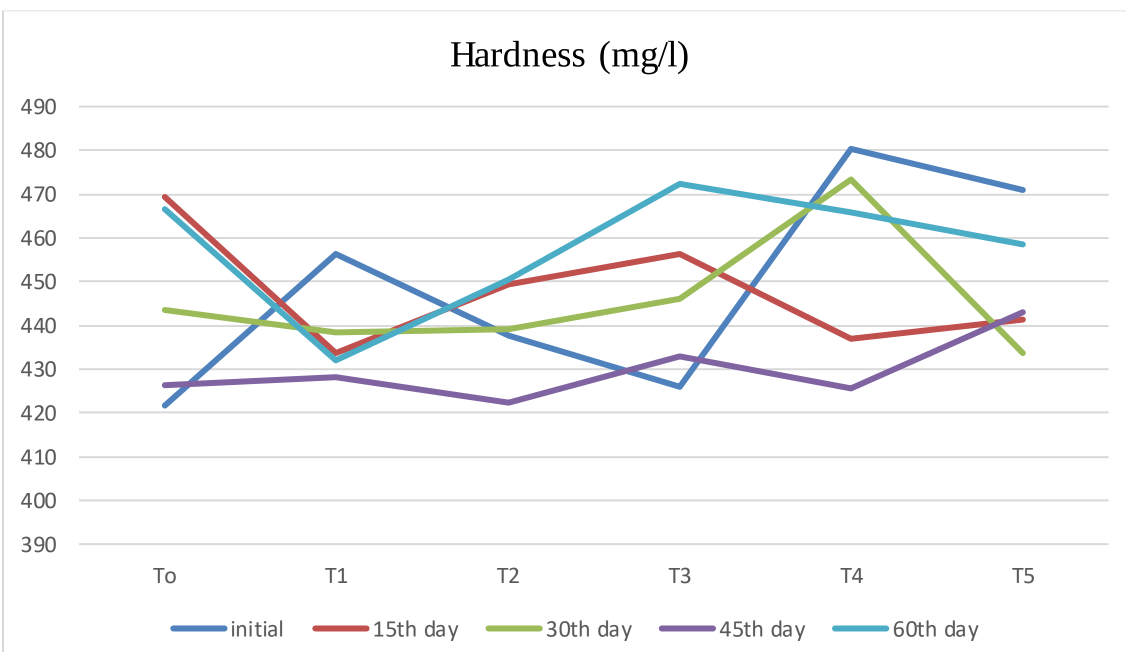
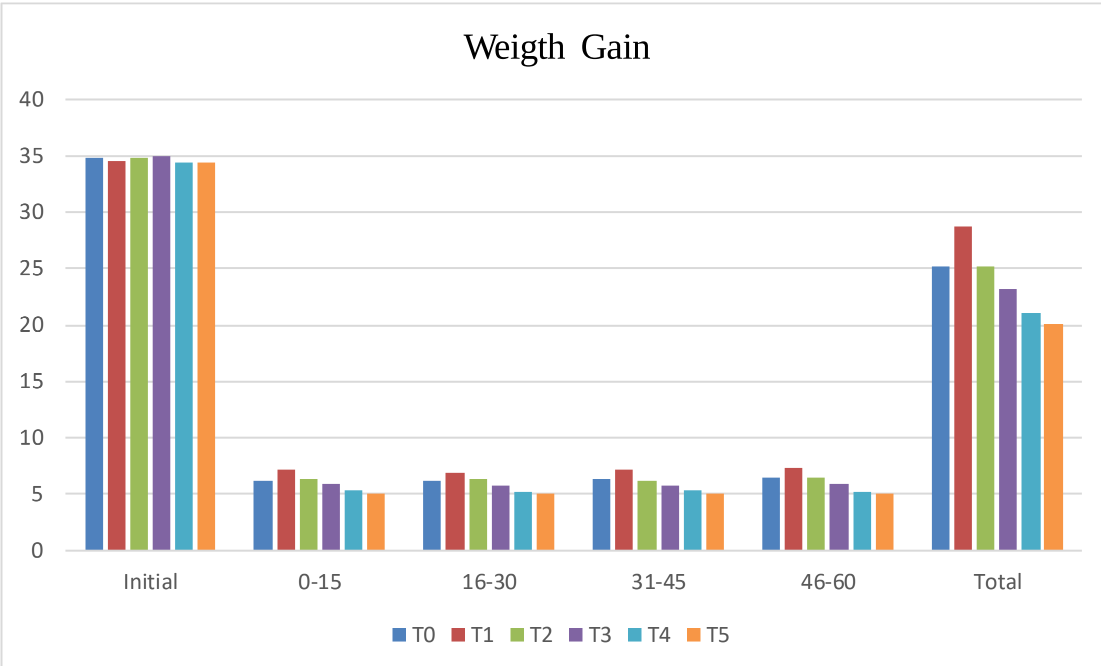


Fig. 4.6: Hardness of water during the experimental period of 60 days in different treatments



4.7: Weight gain of *Cyprinus carpio* fingerlings in different treatments

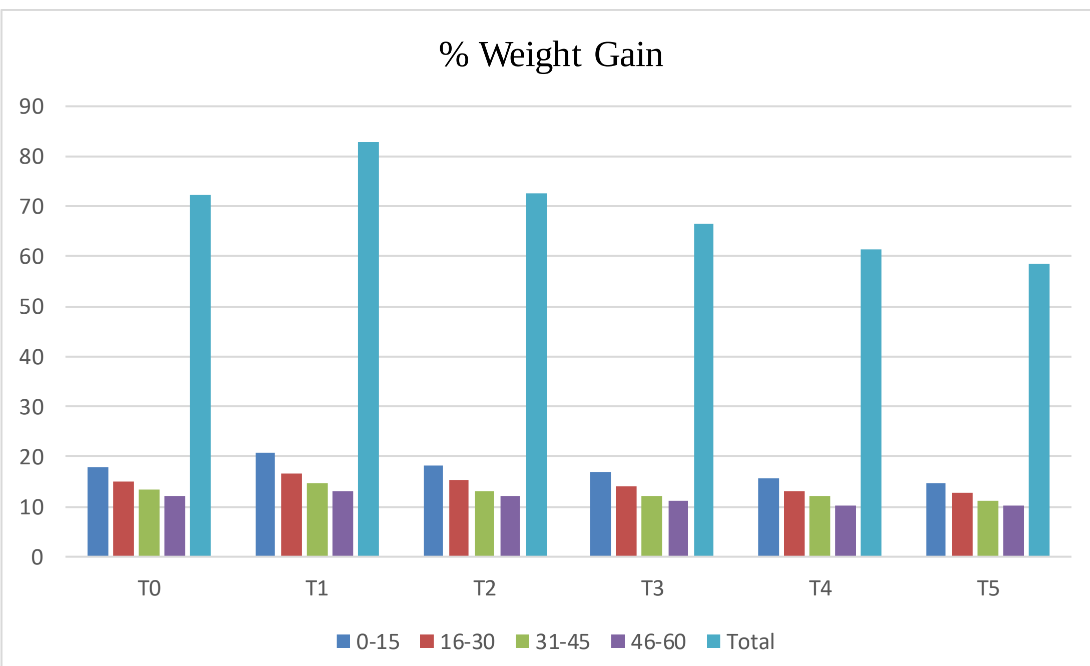


Fig. 4.8: Percent weight gain of *Cyprinus carpio* fingerlings in different treatments

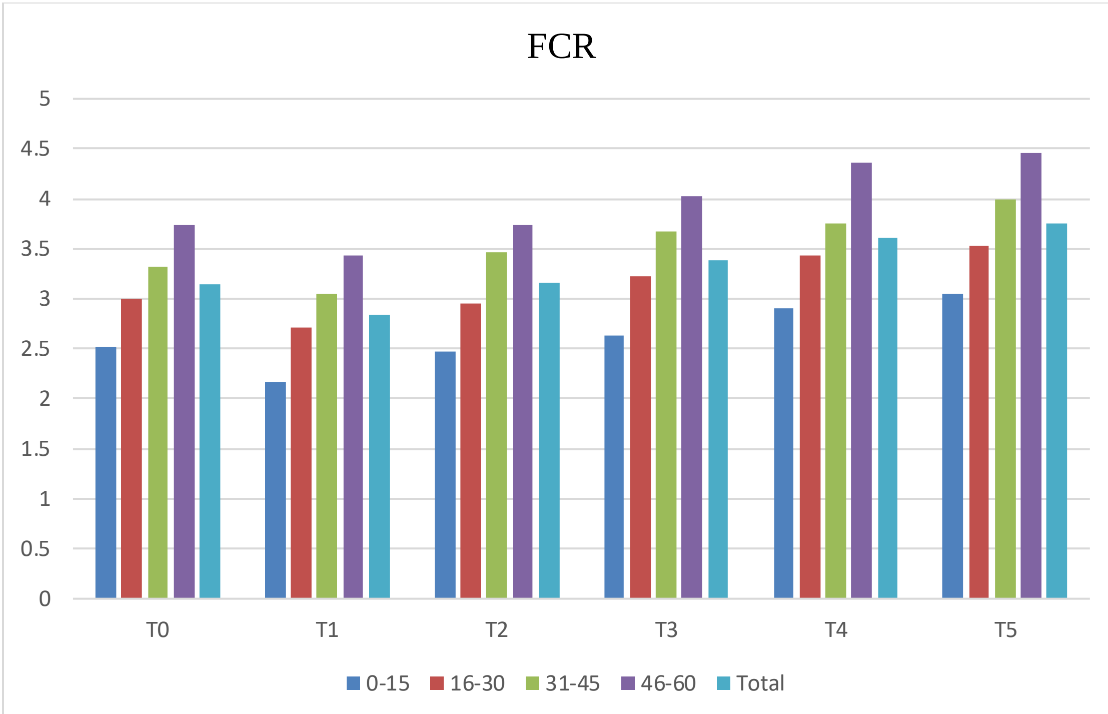


Fig. 4.9: Feed conversion ratio of *Cyprinus carpio* fingerlings in different treatments

Fig. 4.10: Specific growth rate of *Cyprinus carpio* fingerlings in different treatments

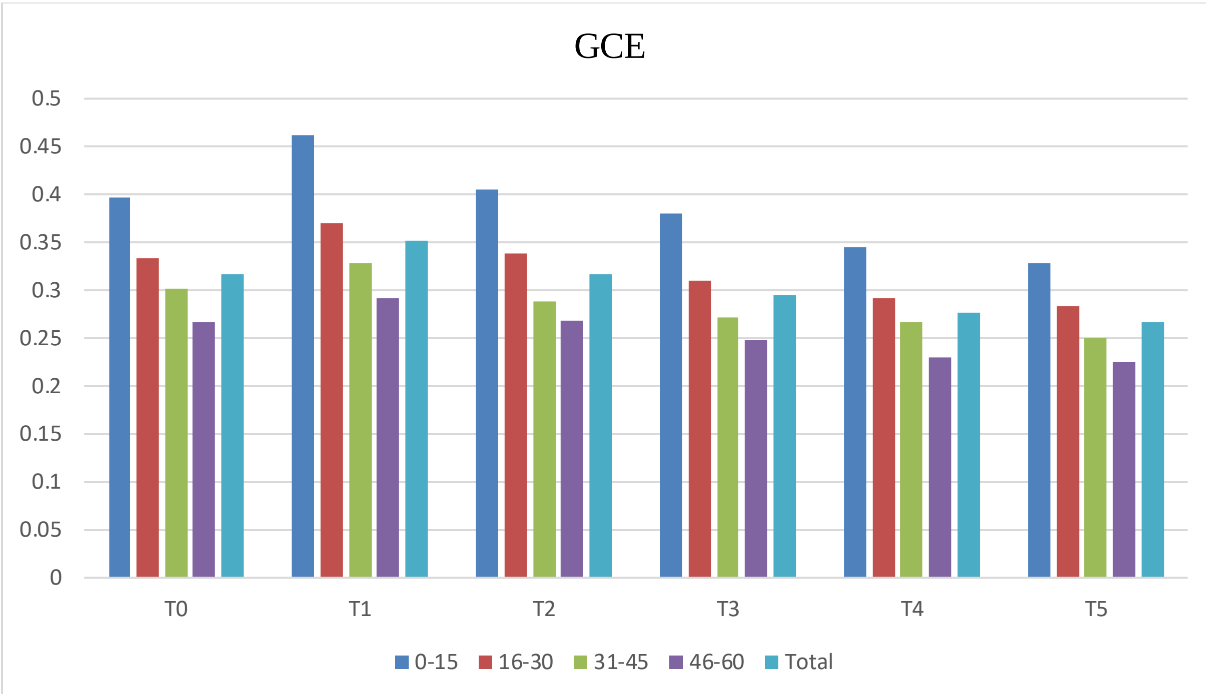


Fig. 4.11: Gross conversion efficiency of *Cyprinus carpio* fingerlings in different treatments

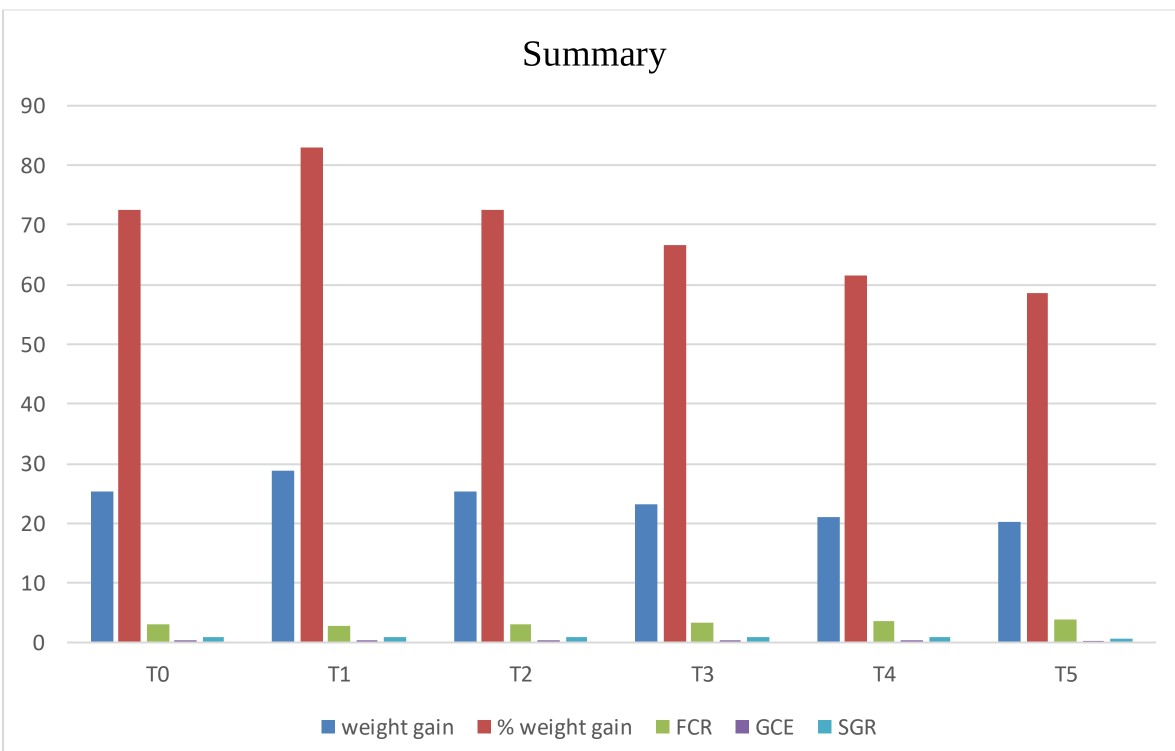


Fig. 4.12: Summary of growth parameters of *Cyprinus carpio* fingerlings

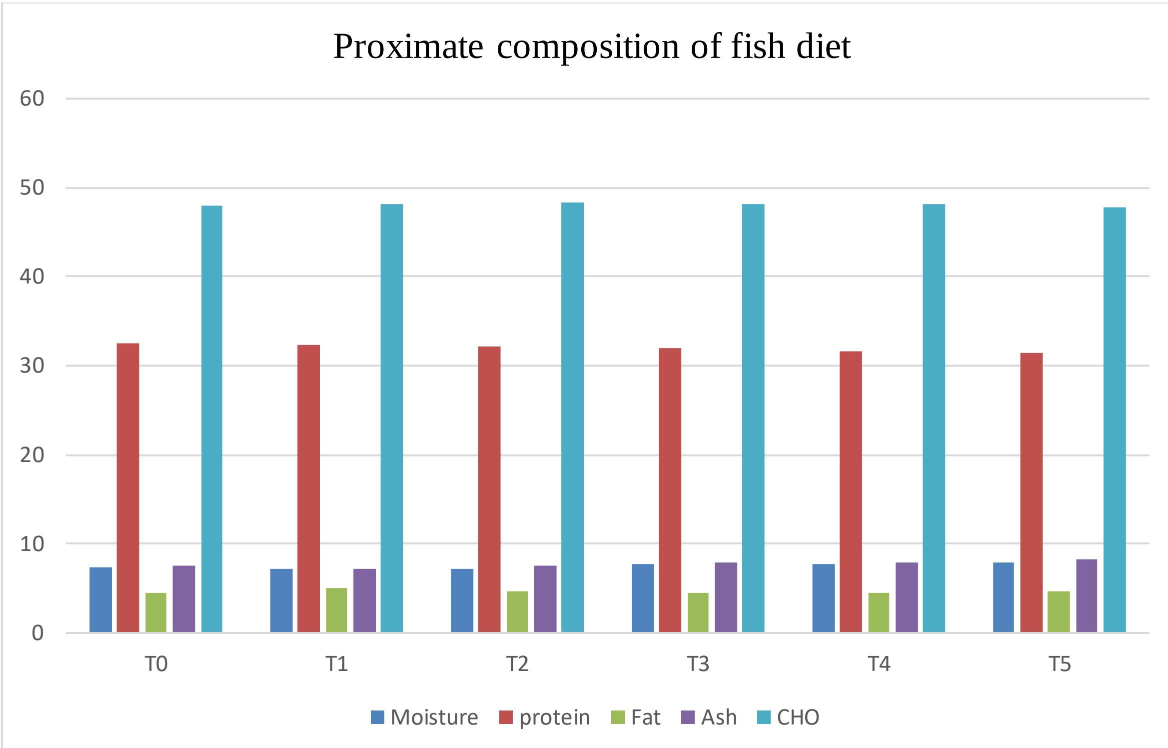


Fig. 4.13: Proximate composition of experimental diet of *Cyprinus carpio* fingerlings in different treatments

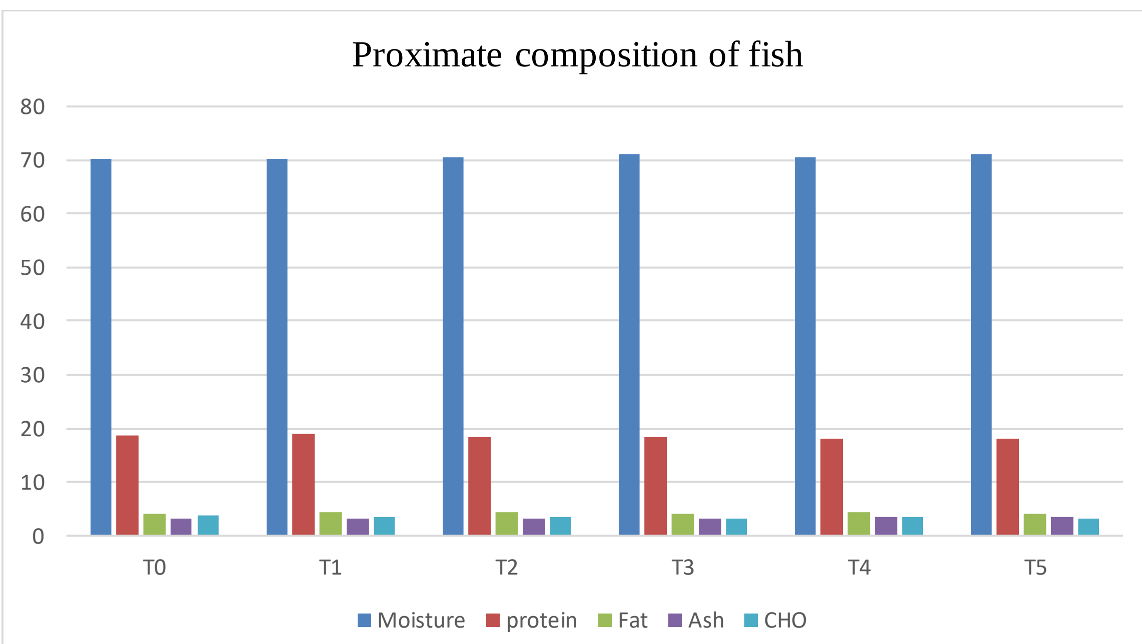


Fig. 4.14: Proximate composition of fish carcass of *Cyprinus carpio* fingerlings in different treatments

5. DISCUSSION

The current study investigated the administration of a processed kidney bean meal enriched diet to *Cyprinus carpio* fingerlings. The experimental fish common carp's growth indices, including weight gain, percent weight gain, SGR, FCR and GCE, were shown to be better than the control group in all treatments, promoting/ validating the use of processed Kidney bean meal as a supplement in fish diet. All treatments maintained the water's physical and chemical parameters that were desirable for the growth of fish in a productive way. The current research effort's findings are detailed in Table 4.1-4.8, and the findings of this research work are reviewed below.

A commercial aquaculture enterprise's success depends on providing an ideal environment for rapid development of aquatic organisms (fishes, prawns etc.) at the lowest possible cost of resources and capital. The sum of all the physical, biological and chemical parameters that impact the growth and welfare of cultured organisms is referred to as water quality. Water quality influences the overall state of cultured organisms since it directly or indirectly regulate their health and growth circumstances. Water quality is thus an important aspect to consider when planning for high aquaculture production.

Temperature tolerance limitations are well recognised in every type of organism, including fish. Temperature also alters the dissolved oxygen content in the water. Water temperature has a significant impact on fish ingestive variation, reproductive development and breeding period. The chemical changes in both soil and water are greatly influenced by temperature. The higher the temperature, the greater the need for oxygen and food, and the faster the growth rate. Temperature also has an important influence in provoking gonadal development and spawning activity in carps. Takeuchi *et al*. (2002) revealed that the preferred ideal temperatures for common carp growth were lie between 30 and 32°C. Sapkale *et al*. (2011) in his findings concluded that estimated best temperature for the growth of spawn of *Cyprinus carpio* is at 26 °C water temperature. Flajšhans and Hulata (2007) research report, in which he shows that Common carp best growth was obtained at water temperature of 23-30°C. During the current research work, the water temperature was between the ideal range of 26.2 to 30.5 °C, which is similar to the data mentioned in Handbook of fisheries and aquaculture (2019) that the temperature required for the optimum growth of carps are 27°to 32°C.

The capacity of water to conduct electrical current due to the presence of ions in it is referred to as EC. Electric conductivity (EC) is typically measured in Siemens per metre (S/m). The ions in water determine the EC of water. Conductivity is a measure of the overall ionic content of water. The electrical conductivity (EC) range of 140 to 182 µS/cm showed in Rao *et al.* (2023) research paper suggested that this range was ideal for common carp fingerling's growth. During the present study, EC was found between 176-214 µS /cm and was ideal for fish growth.

The concentration of hydrogen ions in water is measured as pH, which shows the acidity and alkalinity (basicity) of the water. Fish metabolic and physiological processes are affected by pH. The optimum pH required for the for the growth of carps are 7.5 to 8.3 as per Handbook of fisheries and aquaculture (2019). Sapkale *et al.* (2011) concluded that the estimated best pH is 7.3 and can promote maximum growth of *C. carpio* spawn. Wu *et al.* discovered that a pH range of 7.0-8.0 generated the optimal functioning of numerous physiological responses and enzyme activity in carp. According to Heydarnejad (2012), common carp survive and thrive best when exposed to water pH levels ranging from 7.5 to 8.0. During the recent study, the pH ranged from 6.4 to 8.4, indicating that the water was moderately alkaline.

The most essential aspect of water quality is dissolved oxygen in the aquaculture environment. In intensive aquaculture, dissolved oxygen is the most crucial and limiting factor. Animals will be stressed if proper DO levels are not maintained, making them prone to sickness and mass mortality. According to Boyd (1979), the most important factor in preserving fish life and survival is dissolved oxygen. The optimal DO concentration for a fish pond is normally maintained at 5mg/l to saturation level for healthy fish growth and reproduction in tropical waters. During the present study, dissolved oxygen was found between 5.6-8.2 mg/l. According to Bhatnagar and Singh (2010) and Bhatnagar *et al*. (2004), a DO level of more than 5ppm is required for excellent fish production.

Alkalinity refers to the total amount of bases in water. Ponds with alkalinity of 50 ppm were described as productive and alkalinity of 90-100 ppm are highly productive water. According to Handbook of fisheries and aquaculture (2019); A total alkalinity of 80-120 mg $CaCO_3$/litre is ideal for carp's growth. According to Alikunhi (1957), the alkalinity in highly productive water should be greater than 100 ppm. According to Santhosh and Singh (2007), 50-300 mg/l alkalinity is optimum for fish production. Alkalinity in an aquaculture pond was ideal between 75 and 200 mg/l, according to Wurts and Durborow (1992). During the recent study, the alkalinity range was found to be between 102 and 168 mg/l.

According to Swain *et al.* (2020), Water hardness is defined as the sum of all divalent cations, especially calcium and magnesium. It is regarded as a significant abiotic factor impacting aquaculture. It is commonly expressed as mg/L calcium carbonate ($CaCO_3$). He found that generally, calcium is more important than magnesium in aquaculture water management since it is necessary for the water hardening of newly fertilized freshwater fish egg and calcification of larval skeletal structure. Sinha *et al.* (2018) reported that the species (catla, rohu and mrigal) showed maximum growth at a hardness of 180 mg/L. Fish grow well over a wide range of hardness, although range of 120 to 400 ppm are optimal; nevertheless, her research study suggests that even higher values of hardness are more favourable for major carp's growth. During the current research study, the hardness varies from 400-491 mg/l. The hardness range of 420 to 664 mg/l, according to Matoria *et al.* (2020), was appropriate for the growth of fish.

Fish growth is highly dependent on a number of factors, including fish species, feed quality and environmental conditions. Feeding is an important aspect in the intense culture of fish spawn, fry and fingerling. Their growth and development is mostly determined by the quality of the feed given.

Different amounts of processed kidney bean meal were fed to fish in the ongoing research study to assess growth and the research results demonstrate a significant difference between different treatments at a 5% significance level. During the current experiment, highest growth was found in T_1 at 5 % processed kidney bean meal. T_1 had the best net weight gain, percent weight gain, specific growth rate and gross conversion efficiency, with values of 28.69±0.0838, 82.883±0.8482, 1.006±0.0077 and 0.351±0.0027, respectively, and T_1 was having the lowest (best) food conversion ratio as (2.842±0.0225). Azevedo *et al.* (2017) reported 6.2% kidney bean by-product meal inclusion in the feed maintained growth performance, fish productivity or body composition of Tilapia fish whereas, He also emphasised that the decline in protein productive value in fishes fed @12.4% bean by-product meal is probably due to a lesser protein availability in the diet with an increased amount of incorporation of bean by-product flour, due to the presence of antinutritional factors (e.g., trypsin inhibitors). Hossain *et al.* (2001) assessed better growth with *Sesbania aculeata* seed meal as a potential source of protein in the diet of common carp, and reported that including 12% Sesbania meal considerably superior than the other dietary groups respectively, on the basis of observed growth rate, FCR, PER, apparent net protein utilisation and energy retention. The lower growth performance of fish fed diets containing higher levels of Sesbania meal is thought to be due to the presence of various antinutrients such as tannins and saponins in Sesbania seeds.

In order to create the most cost-effective compound diet for fish, programming of nutritional ingredients must be done. Several species of fishes in the world have been studied in detail for evolving standards diets. The common carp is the one of the carps that nutritionists have researched the most. Feeds are necessary for hatcheries and nurseries to provide healthy stocking material in addition to grow out systems, which also need them. Any nutritionally balanced compounded diet, according to Halver (1976), must have an energy source that is rich enough in critical amino acids, essential fatty acids and non-energy elements (vitamins and minerals) to support and promote growth. In the current experiment, the proximate composition of the fish diet was 31.41±0.0321 to 32.563±0.0952 crude protein percent, 4.48±0.0360 to 5.006±0.0497 fat percent, 47.803±0.0433 to 48.323±0.1598 carbohydrates percent, 7.25±0.0346 to 8.236±0.0371 ash percent and 7.136±0.0290 to 7.923±0.0581moisture percent. The ingredients that contain 20% or more protein are grouped as protein supplements. (Handbook of fisheries and aquaculture 2019). Sharma, *et al.* (2021) reported 29.78% Crude protein (CP), 46.7 % carbohydrate, ash 6.6% and moisture 8.54% in diet of *Cyprinus carpio* with inclusion of germinated fenugreek seed meal (GFSM). Azevedo, *et al.* (2017) reported crude protein 35%, ash 8.5- 8.8 % in diet of Nile tilapia with incorporation of *Phaseolus vulgaris* bean by-product flour.

Studies on the *Cyprinus carpio* optimal requirement was shown that quantity of crude protein level between 30 to 38% seem to be sufficient for the fish (Jauncey, 1982; Watanabe, 1988). According to Ogino *et al.* (1976), common carp proficiently utilised carbohydrates as a fuel source. Later Takeuchi *et al.* (1979) added their support for the nutritional benefit of carbohydrates as energy source. According to the findings of several research, the ideal range of dietary carbohydrates for common carp is between 30 to 40 percent. The ideal dietary fat content for carp and prawn diets is often thought to be 7-9%.

In the present experimental study, the result of fish carcass show that the crude protein, fat, ash, carbohydrate, and moisture are significantly different ($P<0.05$). The crude protein in fish carcass was found between the range of 18.006±0.0517 to 18.873±0.0218, fat 4.116±0.0463 to 4.436±0.0375, carbohydrate 3.266±0.1166 to 3.906±0.0384, Ash 3.0766±0.0233 to 3.476±0.0352 and moisture 70.123±0.0318 to 71.063±0.0851. Sharma, *et al.* (2021) reported crude protein 18.1-18.6 %, fat 3.1 - 3.2 % and ash 3.1 - 3.2 % in fillet of common carp. Yadav, *et al.* (2023) reported, 3.8- 4.1% ash, carbohydrates 3.6 to 4.0 % and moisture 70.72- 71.17 % in fillet of *Cyprinus carpio.*

According to the findings and discussions, supplementation of processed kidney bean meal in fish diets has a beneficial effect on common carp fingerlings. The graded level of processed kidney bean meal in the experimental fish diet had a noticeable impact on growth and growth metrics without degrading the water's quality. As a result, the growth rate and growth performance (SGR, FCR etc.) were seen best in T_1 at 5 % processed kidney bean meal as compared to T_0 (control), T_2 (15%), T_3 (25%), T_4 (35%) and T_5 (45%). Therefore, it is clear from the data that none of the higher inclusion levels of processed kidney bean meal are adequate for achieving the best growth in fish since they contain antinutritional factors such trypsin inhibitors, polyphenols and hemo-agglutinins etc., which may affect nutrient uptake and growth in fishes. The inclusion of processed kidney bean meal at 5% in fish diet is therefore supported by the result of the current study as being suitable for achieving improved *Cyprinus carpio* fingerling production. However, further field research is advised for improved outcomes.

6. SUMMARY

The purpose of the current study was to determine the " Effect of Processed Kidney bean *(Phaseolus vulgaris - pinto group)* seed Meal on Proximate composition, Growth performance and survival of the *Cyprinus carpio* (Linnaeus, 1758) Fingerlings" sought to understand the Effect of Processed Kidney bean meal on growth performance, water quality, the proximate composition of fish carcasses. This experimental study's goals were to:

4. To study the effect of Processed Kidney bean *(Phaseolus vulgaris-pinto group)* seed meal supplementation on proximate composition of *Cyprinus carpio* fingerlings
5. To examine the effect of Processed Kidney bean *(Phaseolus vulgaris-pinto group)* seed meal on growth performance and survival of *Cyprinus carpio* fingerlings
6. To monitor water quality during experimental period

For 60 days, the current experiment was accomplished from 4 April 2023 to 4 may 2023, at Department of Aquaculture, College of fisheries, Maharana Pratap University of Agriculture and Technology; Udaipur (Rajasthan). From the Aquaculture Research and seed production unit, Directorate of Research, MPUAT, Udaipur provided 200 healthy fingerlings of common carp species. The healthy fingerlings of common carp having unvarying size were placed in rectangular plastic tanks that can hold 225 liters of water. Processed Kidney bean meal was added to the basal diet at five different levels to create the experimental diets, with the basal diet being replaced in equal amounts by the treatments T_1 (5%), T_2 (15%), T_3 (25%), T_4 (35%) and T_5 (45%) and the control diet being T_0 (excluding Processed Kidney bean meal).

The data from the study has been organised into 8 tables and 14 figures, and this thesis is thoroughly organised into 6 chapters.

The first chapter includes a brief outline and introduction of the relevant research. The overview of the various discoveries and studies on pertinent subjects is included in the second chapter. The full specifics of the approach and steps used throughout the experiment were explained in the third chapter. Chapter four explains the results from the full trial period.

Water quality is often rated in fish culture as being adequate for fish growth and survival. During the trial period, T_0 reported the lowest mean water temperature of 27.81 °C, while T_3

recorded the highest mean water temperature of 28.19°C. T_0 and T_5 was having the lowest mean electrical conductivity (192.3 µS/cm), while T_2 had the highest (194.5 µS/cm). The minimum mean value of pH was 7.31 in T_3 whereas maximum mean value of pH was 7.53 in T_2 and T_5. The mean dissolved oxygen levels were lowest in T_1 as 6.68 mg/l and highest in T_2 as 7.38 mg/l, respectively. The minimum and maximum mean total alkalinity was 132.0mg/l in T_0 and 144.1mg/l in T_4 respectively. The lowest and highest mean total hardness was 438.0mg/l and 457.1 mg/l in T_1 and T_4, respectively.

The administration of Processed Kidney bean meal at various inclusion levels results in improved growth performances in the experimental fish *Cyprinus carpio*. The highest weight gain was seen in T_1 at 5 % inclusion of Processed Kidney bean meal (28.69±0.0838), while the lowest was observed in T_5 at (20.096±0.1449). In T_1, there was highest percent weight gain (82.883±0.8482), while in T_5, there was a lowest percent gain (58.454±0.3945). The lowest (best) FCR was noticed in T_1 (2.842±0.0225) and highest FCR (3.757±0.0211) in T_5. The SGR values were highest in T_1 as (1.006±0.0077) and lowest SGR in T_5 as (0.767±0.0041). The GCE was highest in T_1 at (0.351±0.0027) and lowest in T_5 at (0.266±0.0015).

According to the approximate composition of *Cyprinus carpio* fingerlings, the experimental fishes that were fed with Processed Kidney bean meal at an inclusion level of 5% outperformed all other treatment groups. T_1 had the highest crude protein content (18.873±0.0218) while T_5 had the lowest (18.006±0.0517). T_1 had the maximum content of fat (lipid) (4.436±0.0375), whereas T_3 had the lowest (4.116±0.0463). The highest ash (3.476±0.0352) was noticed in T_5 and lowest ash (3.0766±0.0233) in T_1. The highest moisture (71.063±0.0851) was found in T_3 and lowest (70.123±0.0318) in T_0.

The findings from the study of other researchers, which are covered in the fifth chapter, provide support for the results. Chapter 6 is a detailed description of the overall results of this experimental study. At the end of the thesis, there is presented the complete list of references.

It is clear from the study's results and discussion in the fifth chapter that inclusion of Processed kidney bean meal to fish diets at a level of 5 % promotes fish growth in terms of weight gain, percent weight gain, specific growth rate, feed conversion ratio, gross conversion efficiency ratio in the diet of *Cyprinus carpio* fingerlings. However, supplementation of Processed kidney bean meal to fish diets at a rate of 5 % is advised for use in aquaculture to improve growth performance, fish carcasses quality and Feed efficiency of common carp fingerlings.

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Effect of Processed kidney bean *(Phaseolus vulgaris - pinto group)* Seed meal on Proximate composition, Growth performance and survival of the *Cyprinus carpio* (Linnaeus, 1758) Fingerlings

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ABSTRACT

To determine the effect of processed kidney bean *(Phaseolus vulgaris - Pinto group)* seed meal on Proximate composition, Growth performance and survival of the *Cyprinus carpio* (Linnaeus, 1758) fingerlings the present experiment was carried out for 60 days. This experiment was performed from 4 April 2023 to 4 may 2023. Processed kidney bean meal was added to the basal diet at five different levels to create the experimental diets, with the basal diet being replaced in equal amounts by the treatments T_1 (5%), T_2 (15%). T_3 (25%), T_4 (35%) and T_5 (45%) and T_0 (control), (excluding processed kidney bean meal). Fingerlings were fed at the rate of 3% of their body weight. Feed was given twice a day. The diet of the study, supplemented with processed kidney bean meal, had no detrimental effects on the measures of the water quality and the other treatments only slightly altered these parameters. A wide range of water quality parameters were assessed in the experimental study, including: water temperature between 26.2 to 30.5°C, electrical conductivity between 176 to 214 µS/cm, pH between 6.4 to 8.4, dissolved oxygen between 5.6 to 8.2 mg/l, total alkalinity between 102 to168 mg/l, and total hardness between 400 to 491 mg/l. The increased weight gain, percent weight gain, SGR, GCE and lowest (best) FCR, combined with the better proximate composition of different treatments, strongly illustrate the effectiveness of Processed kidney bean meal supplemented diet. Throughout the course of the experiment, growth parameters showed a significant difference ($P<0.05$) with T_1 showing the highest weight gain (28.69 ±0.0838) compared to other treatment groups, T_1 show the highest percent weight (82.883±0.8482), the highest SGR (1.006±0.0077), the highest GCE (0.351+0.0027) and the best FCR was noticed in T_1 as well (2.842±0.0225) On the other hand, the maximum crude protein content in fish carcasses was found to be (18.873±0.0218) in T_1, the highest fat (lipid) to be (4.436±0.0375) in T_1, highest ash (3.476±0.0352) in T_5, the highest carbohydrate to be

(3.906±0.0384) in To and the highest moisture content to be (71.063±0.0851)in T_3. Throughout the research investigation, treated fishes had a 100% survival rate. From the aforementioned data and results, it can be inferred that inclusion of processed kidney bean meal in fish diets at a level of 5 % can enhance fish growth and raise aquaculture production.

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"*साइप्रिनस कार्पियो* (लिनिअस, 1758) अंगुलिकाओं के अनुमानिक संगठन, विकास और उत्तरजीविता पर प्रसंस्कृत किडनी *बीन (फेंसीओलस बलोरिस, पिंटो समूह)*

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शोध छात्र

अनुक्षेपण

अनुक्षेपण

साइप्रिनस कार्पियो (लिनिअस, 1758) अंगुलिकाओं के अनुमानिक संगठन, विकास और उत्तरजीविता पर प्रसंस्कृत किडनी बीन *(फेसिओलस वालोरिस -प्रिंटो ग्रुप)* वीज भोजन के प्रभाव को निर्धारित करने के लिए वर्तमान अनुसंधान 60 दिनों तक किया गया था। यह अध्ययन 4 अप्रैल 2023 से 4 मई 2023 तक किया गया था। प्रायोगिक आहार बनाने के लिए प्रसंस्कृत राजमा बीज को पांच अलग-अलग स्तरों पर बेसल आहार में जोड़ा गया था, बेसल आहार को उपचार T_1 (5%), द्वारा समान मात्रा में प्रतिस्थापित किया गया था। T_1 (5%), T_2 (15%). T_3 (25%), T_4 (35%), T_5 (45%) और T_0 (नियंत्रण), (प्रसंस्कृत राजमा भोजन को छोड़कर) । फिगरलिंग को उनके शरीर के वजन के 3 % की दर से भोजन दिया गया। दिन में दो बार चारा दिया जाता था। अध्ययन के आहार, प्रसंस्कृत राजमा भोजन के साथ पूरक का पानी की गुणवता के उपायों पर कोई हानिकारक प्रभाव नहीं पड़ा और अन्य उपचारों ने इन मापदंडों में केवल थोड़ा बदलाव किया। (प्रायोगिक अध्ययन में जल गुणवत्ता मापदंडों की एक विस्तृत श्रृंखला का मूल्याकन किया गया, जिसमें शामिल है पानी का तापमान 26.2 से 30.5 डिग्री सेल्सियस के बीच, विद्युत चालकता 176 से 234 μS /सेमी के बीच, पीएच 6.4 से 8.4 के बीच ,घुलनशील ऑक्सीजन 5.6 से 82 मिलीग्राम/लीटर के बीच कुल क्षारीयता 102 से 168 मिलीग्राम/लीटर के बीच, और कुल कठोरता 400 से 491 मिलीग्राम/लीटर के बीच अधिकतम अर्जित भार प्रतिशत अर्जित भार एसजीआर जीसीई और सबसे कम

(सर्वोत्तम) एफसीआर, विभिन्न उपचारों की बेहतर अनुमानित संरचना के साथ मिलकर, प्रसंस्कृत किडनी बीन भोजन पूरक आहार की प्रभावशीलता को दृढ़ता से दर्शाते हैं। प्रयोग के दौरान विकास मापदंडों में एक महत्वपूर्ण अंतर (पी$<$0.05) देखा गया, जिसमें T_1 ने अन्य उपचार समूहों की तुलना में सबसे अधिक वजन में वृद्धि (28.69 ±0.0838) दिखाई, T_1 ने उच्चतम प्रतिशत वजन (82.883±0.8482) दिखाया, जो सबसे अधिक था। एसजीआर (1.006±0.0077), उच्चतम जीसीई (0.351±0.0027) और सबसे अच्छा एफसीआर T_1 (2.842 ± 0.0225) में भी देखा गया। दूसरी ओर, मछली के शवों में अधिकतम क्रूड प्रोटीन (18.873±0.0218) पाई गई, T_1 में (71.063+0.0851),उच्चतम वसा (लिपिड) (4.436 ±0.0375) T_1 में, उच्चतम राख (3.476± 0.0352) T_5 में ,उच्चतम कार्बोहाइड्रेट (3.906±0.0384) T_0 में और उच्चतम नमी सामग्री T_3 में (71.063±0.0851) है । शोध अध्ययन के दौरान उपचारित मछलियों में 100% जीवित रहने की दर पाई गई है। उपरोक्त आंकड़ों और परिणामो से ,यह अनुमान लगाया जा सकता है कि मछली के आहार में 5 % के स्तर पर प्रसंस्कृत राजमा भोजन को शामिल करने से मछली की वृद्धि बढ़ सकती है और जलीय कृषि उत्पादन बढ़ सकता है।

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