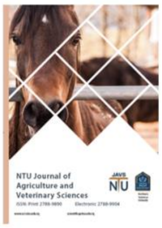
NTU Journal of Agricultural and Veterinary Sciences (2024) 4 (2) : 90-98
DOI: https://doi.org/10.56286/ntujavs.v2i2

IRAQI Academic Scientific Journals

JAVS NTU

P-ISSN: 2788-9890 E-ISSN: 2788-9904
NTU Journal of Agricultural and Veterinary Sciences
Available online at: https://journals.ntu.edu.iq/index.php/NTU-JAVS/index



The effect of adding sweet bean (*Foeniculum vulgare*) and Roselle *(Hibiscus sabdariffa)* seed powder on the digestibility coefficient and some growth parameters in common carp *Cyprinus carpio*

1st Hasan Ali Haydar Al-Kattan[1], 2nd Nuha Hameed Sadiq Al-Bassam[2]
1,2. Department of Animal Production, College of Agriculture, Tikrit University, Iraq

Article Informations

Received: 19-02- 2024,
Accepted: 13-03-2024,
Published online: 28-06-2024

Corresponding author:
Name: Hasan Ali Haydar
Affiliation :
Email:
hasan.a.haydar@st.tu.edu.iq.

Key Words:
keyword1, Sweet bean seeds
keyword2, roselle seed powder
keyword3, digestibility coefficient
keyword4, growth parameters.

ABSTRACT

Seven experimental diets were designed to feed fish of the common carp species *Cyprinus carpio* L.This diet, known as the control T1,is additive-free. Three other diets were added to sweet bean seeds in three different amounts: 0.5, 1,1.5% for the diets T2,T3,T4, respectively. Throughout a 60-day experiment, the percentages of Gujarat seed powder used in the T5, T6,T7 diets were 0.5,1,1.5%, respectively.The maximum digestibility factor was achieved by treatmentT6 89.44%,while treatments T2 and T7 gave digestibility factors of (84.02% and 83.38%), respectively.In terms of thermal growth coefficient reaching 0.022%. Treatments T1and T7 followed, with 0.017,0.013 percent, respectively.The metabolic growth rate for treatment T5 was most significant at 9.1 gm/kg/day, with treatments T1,T7 coming in second and third, respectively, at 6.9 and 5.6 gm/kg/day. The study concludes that adding currants and sweet bean powder to fish meals enhances the nutritional content of the diets while.

INTRODUCTION

Aquatic products are among the main sources of nutrition and animal protein produced throughout the world. In 2020, the global production of aquatic products for human consumption reached 157.4 million tons (excluding algae, aquatic mammals, and crocodiles). The consumption of aquatic products is linked to health benefits, as it is a product rich in vitamins and amino acids. Essential and polyunsaturated fatty acids. Eating aquatic products meets the needs of consumers looking for alternatives to a healthier diet [1]. Common carp (*Cyprinus carpio* L.) is considered a freshwater fish that is easy to raise and culture, due to its ability to resist diseases, its ability to withstand tropical climates, and is considered to have high nutritional and economic value [2].

Nutrition is a very important factor in the development of fish farming. Therefore, comprehensiveness in fish nutrition and the dissemination and deepening of knowledge and information related to it are among the most important requirements for the development of fish wealth. The great scientific progress that has been achieved in all fields, including animal production sciences, and the huge amount of information that has been made available about Through research, experiments and facts discovered in the fields of nutrition in general and fish nutrition in particular as a result of the progress in fish farming technologies, increasing fish density and the desire to raise growth rates and improve the efficiency of food utilization, it was necessary to pay attention to nutritional sciences, the most important of which is the study of the development of natural food based on plants medicinal and herbal medicine [3].

The sweet bean plant is considered one of the best medicinal plants in the world. It is a type of spice containing phenolic chemicals that benefit human health. It has many uses and great importance in the production of many medicines. Bioactive pharmaceutical components and properties, such as trans-anethole in the sweet bean, are important in maintaining human health [4]. The Gujarat plant is an important medicinal plant and is widely used because it contains extracts that have therapeutic effects such as antioxidants, anti-obesity, anti-cancer, inhibiting bladder and uterine contraction, antihypertensive, and antibacterial and antimicrobial due to the presence of phenolic compounds [5].

The current study aimed to determine how varying amounts of powdered sweet bean seeds and currants affected the apparent digestibility coefficient of the common carp, *Cyprinus carpio* L.

MATERIAL AND METHODS

The study was conducted from September 19, 2022, to November 20, 2022, in the fish laboratory of the Department of Animal Production, College of Agriculture, Tikrit University. Fourteen plastic tanks, each holding 110 liters, were utilized in the experiment, and each tank had 14 air pumps installed to pump air out of the tank. Three air pumps are administered evenly to each of the three tanks. To prevent diseases, the fish were brought into the laboratory in water that had 3% table salt added, as per [6]. The fish were acquired from a fish breeder in Salah al-Din Governorate, located in the Al-Zalaya region of Tikrit.

1 Measuring the stability of the diets

By immersing a known weight of the diet in a given volume of water in a baker, three duplicates of each diet were made at a laboratory temperature of 25°C to determine the stability of the diet. After the water in the baker was emptied, the broken pieces of the diet were separated and dried at 60°C. At intervals of 15, 30, 60, and 90 minutes, the diet's stability was computed. according to the equation that follows:

Diet stability is calculated as follows: dry weight (g) of the immersed pellets / weight (g) of the pellets prior to soaking [7]

2 Specific density measurement

By weighing the grains with a length of one centimeter using a sensitive electronic balance in accordance with [7] approach, and applying the following formula, the specific density of the diet was determined:

Density of feed pellets (g/cm^3) is calculated as follows: (mass of feed pellets) g/(length of feed pellet) cm x cross-sectional area (cm)^2.

3 Experimental diets:

Special fish feed was purchased from the Erbil Governorate feed factory. The feed was crushed and its manufacturing was adjusted by adding the amounts made by seven experimental diets for fish, one of which served as a control. Three of the diets included powdered sweet bean seeds in three different amounts, while the remaining three diets contained powdered currant seeds. Furthermore, in three distinct ratios, as indicated in Table No. (1): (T2) treatment: 0.5% of sweet bean seeds was added; (T1) control treatment: no additions; (T3) treatment: add sweet bean seeds at a dosage of 1% as the third treatment. (T4) treatment: 1.5% of sweet bean seeds should be added. (T5) treatment: Apply 0.5% of Roselle seeds. (T6) Treatment: Roselle seeds. Currants at a one percent rate, (T7) treatment: Use a 1.5% Roselle seeds addition rate for turmeric.

The rations were well mixed after the proportions were added, and warm water was added at a rate of 35% of the ration. Stirring was then necessary to produce homogeneity and gelatinization of the feed material. After that, it was put into a Toshiba milling machine manufactured in Japan that had holes drilled in it for 3 mm in order to shape it into 5 mm-long pellets. On a baking tray, the rations were then dried. For seven hours, sunlight and air blowers are used, stirring constantly.

Chemical composition of sweet bean seeds and currants

4 Experimental diets: Chemical components of the diet: In the central laboratory of the College of Agriculture and Forestry / University of Mosul, the primary chemical analysis of the diet and the body analysis of the fish that were fed on the various experimental diets were estimated using the standard procedures defined by the[9], as follows:

4-1 Dry matter:

After the samples were dried for 22 hours at 60°C in an electric oven until the weight was constant, the amount of dry matter in the experimental diets was calculated. Additionally, the fish's edible portion was dried for 72 hours at 60°C until the weight stabilized.

$$\text{Moisture } \% = \frac{\text{sample weight before drying (g)} - \text{sample weight after drying (g)}}{\text{sample weight before drying (g)}} \text{ x } 100$$

$$\text{Dry matter } \% = 100 - \text{Moisture}\%$$

4-2 Ash:

By burning the material in a muffle furnace for three hours at 600°C, the ash percentages of the experimental diet samples and the edible portions of fish were calculated.

$$\text{Ash } \% = \frac{\text{sample weight before burning (g)} - \text{sample weight after burning (g)}}{\text{sample weight before burning (g)}} \text{ x } 100$$

4-3. Ether extract:

To estimate crude fat, the Soxhlet device was employed. In containers designed for cellulose extraction, the dry samples were put, and the solvent after using petroleum ether for five hours, the solvent was heated and evaporated. After that, the sample was weighed, and the weight difference between the pre- and post-extraction samples was used to determine the amount of fat.

$$\text{Ether extract } \% = \frac{\text{sample weight before extraction (g)} - \text{sample weight after extraction (g)}}{\text{sample weight before extraction (g)}} \text{ x } 100$$

4-4 Crude fiber:

To break down the digestible components of the experimental diets, samples were heated sequentially for 30 minutes at concentrations of 1.25% sulfuric acid H2SO4 and 1.25% sodium hydroxide base NaOH. The undigested part, which refers to the crude fibers, was then filtered out.

4-5 crude protein:

Using a microcalcial nitrogen measurement tool, crude protein was calculated in three steps as follows:

a. **The digestion stage:** involved adding 10 ml of concentrated sulfuric acid to around 0.25 g of the material in a 50 ml conical flask. Three days were passed while the sample was left. After heating the glass beaker with a glass heater and bringing it to a boil for five to ten minutes, one or two milliliters of acid were added. Continue heating the sample until its color becomes clear, then gradually add the perchlorate to the contents.

b. **The distillation stage:** After the sample has cooled, 50 ml of distilled water are added to the beaker to make up its volume. Five milliliters of this liquid are then taken and sent to the distillation unit, where 10 milliliters of a 40% sodium hydroxide solution are added. The ammonia that is released during the reaction is then collected in a receiving medium that contains ten milliliters of acid. The mixture of boric acid (4%), methyl red dye (1 gram) and methyl blue dye (1,235 grams) in 100 milliliters of ethanol was created as the indicator, and 20 milliliters of it was added to the liter of boric acid. The development of ammonium borate is shown by the indicator's color changing.

c. **Smoothing step:** The reception medium was calibrated using a standard solution of 0.014 m hydrochloric acid to find the amount of acid required to neutralize the ammonia in the ammonium borate after the indicator's original color returned. The nitrogen percentage was then computed using the following formula:

$$N\% = \frac{14 \times 0.014 \times (\text{plank Hcl volume} - \text{sample Hcl volume})}{1000} \times \frac{5}{50} \times \frac{1000}{\text{sample weight}}$$

Secondly, the crude protein (%) = (%) nitrogen x 6.25 equation was used to determine the crude protein percentage.

4-6 Extract without nitrogen:

The amount of nitrogen-free extract was determined by deducting the moisture, ether extract, crude fiber, and crude protein percentages from 100.

Nitrogen-free extract (%) = 100 – (moisture + ether extract + % crude fiber + Crude protein).

5. Digestion laboratory experiments:

After completing the growth experiment, 1% of chromium oxide (Cr2O3), a green color, was added to each of the seven experimental diets. This was done on the experimental fish to determine the apparent digestibility factor of the diet. After being pulverized, the diets were remanufactured with chromium oxide added. After two weeks of feeding, the fish were removed. After 30 minutes, uneaten fodder is collected, and two hours later, the waste is gathered using a fine clip with holes 50 microns in size, until the necessary amount is acquired for performing analyses in accordance with the protocol developed by [10].

Following many washes and filters, it was put on petri plates as shown in Figure No. 9. It was sealed tightly in plastic containers and allowed to dry under the effect of fans before being sent straight to the College of Agriculture and Forestry / University of Mosul at the central laboratory for chemical analysis in food and trash.

The digestion technique was used to quantify the amount of chromium oxide. 0.5 grams of each sample were taken, and concentrated nitric acid and perchloric acid were added [11]. The absorbance was then measured using an atomic absorption spectrometer, as shown in Figure No. (9), and the result were substituted. In the equation that follows:

$$Y = 0.2089X + 0.0032$$

Where (Y) = absorbance at wavelength (350nm)

(X) = concentration of chromium oxide 1 mg / 100 ml.

5-1 The feed's apparent digestibility coefficient, according to [12].

Cr_2O_3% in food:

$$\text{Apparent digestibility factor} = 100 - \left(100 \times \frac{\%Cr_2O_3 \text{ in diet}}{\%Cr_2O_3 \text{ in waste}}\right)$$

6. Growth criteria

6.1. Total increase in fish weight:

WG (gm/fish) = Final weight - Initial weight [13]

6.2. Growth rate:

$$\text{(DGR)Daily weight gain (gm/day)} = \frac{\text{Weight gain}}{\text{Experimental period}} \; [13]$$

6.3. Thermal growth coefficient

It is estimated according to the equation mentioned by [14]:

$$\text{Thermal growth coefficient} = \left(\frac{(\text{Final weight})^{0.3333} - (\text{Initial weight})^{0.3333}}{\text{Experiment duration} \times \text{temperature}}\right) \times 100$$

6.4. Metabolic growth rate

It is calculated on the basis of the total body mass per metabolic body mass per day and is estimated according to the equation mentioned by [15].

Metabolic growth rate = [weight gain (g) / {(initial weight /1000/)$^{0.8}$ +final weight /1000/)$^{0.8}$ }/ 2]/ duration of study.

6.5. Survival rate

Survival rate (%) = (remaining fish)/(total fish number) x 100 [16].

6.6. Statistical analysis:

The data were analyzed using Complete Randomized Design (CRD) and version 25 of the ready-made statistical software Statistical Package for Social Science. The effect of the experimental parameters on the studied criteria was examined, and Duncan's multiple tests were used to determine whether there were any significant differences between the averages of the studied characteristics. Multiple ranges test Duncan's [17] according to the following mathematical equation:

$$Y_{ij} = \mu + T_i + e_{ij}$$

Since:

Y_{ij} = the jth observation value of transaction i.

μ = the general average of the studied trait.

T_i = effect of treatment i.

e_{ij} = random error is normally and independently distributed with a mean equal to zero and a variance of Se.

RESULTS AND DISCUSSIONS

1. The chemical composition of diets

The diets' chemical composition is displayed in Table (4), where a low number of significant differences ($P \leq 0.05$) were found in the percentage of dry matter. Treatment 3T had the highest percentage (95.34%), followed by treatment T7 (95.20%), and treatment T1, the control treatment (94.44%), had the lowest percentage of all the treatments. There were not many variations in the moisture percentage at a significant level ($P \leq 0.05$). Treatment T1 had the greatest percentage (5.56%) compared to the other treatments, followed by treatment T2, which had a percentage of 5.48%, and treatment T3, which had the lowest percentage (4.66%). Treatment T3 had the highest proportion of protein (21.70%), followed by treatment T4 (20.82%) and treatment T7 (20.21%). Treatment T2 had the lowest protein percentage, at 13.47%. The experiment by [18], in which Nile tilapia fingerlings were fed gujarat seed powder and kenaf seed powder in amounts of 15%, 30%, and 45% for a duration of 70 days with values of (302.0, 301.7, 301.0) g/kg, respectively, produced different results in terms of the percentage of protein. by including seeds, of the total protein consumed. While there were no discernible differences between the 45% protein control diet and the diets including (15, 30) % protein from gujarat seed powder, the 45% protein treatment was surpassed by the control treatment and the diets containing (15, 30)% protein from gujarat seeds.

Gujarat protein's effects on growth rates, feed efficiency, and weight gain. The amount of protein in the experiment is based on what [19] discovered when they investigated the impact of substituting sunflower seeds for soybean meal as a source of protein in the diet of fingerling fish (*Clarias* *gariepinus*), finding that the percentage of protein reached 25.49%. Treatment T1 showed the highest percentage of fat at 4.74%, which was higher than all other treatments at a significant level (P≤ 0.05). Treatment T7 came in second with 4.70% and treatment T6 with 4.01%, while treatment T3 had the lowest percentage of fat at 2.21%. The largest proportion of ash was found in treatment T1, at 12.85%, while treatment T4 had the lowest amount, at 10.20%. Between the remaining treatments, there were no discernible changes.

At 26.76%, treatment T4 had a higher proportion of fibers than treatment T6, which came in second at 23.98%. With a percentage of 14.47%, treatment 3T had the lowest amount of fibers. Similar to Table No. (12), the T2 treatment outperformed the other treatments in terms of the chemical composition of the feed and the percentage of nitrogen-free extract (47.31%), which was followed by the 3T treatment (46.21%). This experiment was also created in the form of feed manufacturing with [20] They used various preparations of gujarat seed powder (raw, soaked, boiled, sprouted, and fermented) to show how it affected weight gain, growth rates, and feed utilization. As with Nile tilapia, According to the results, the treatment that included fermented gujarat was the most effective one for feeding the fish. This treatment produced the highest specific growth rate (0.30) grams, feed efficiency rate (66.67%) grams, weight gain (369.11) grams, and feed conversion rate (1.50) grams.

2. The stability of diets

Table No. (5) Illustrates the stability of the diets containing nuts and powdered sweet bean seed. After 15 minutes, treatments T2 and T5 performed best, yielding (98, 99) %, respectively. Treatments T3, T4, and 7T followed, providing (96, 95, 96%, respectively), and T1 and T6 provided the lowest percentage, 93%. Thirty minutes later, therapy T2 had a high level of stability, giving 94%. Following at 91% were T1 and T5, while T7 had the lowest rate of any therapy at 85%. The control therapy had the greatest proportion, 86%, at minute 60. With percentages of (82, 83, 82) %, the stability percentages for treatments T2, T3, and T5 were similar.

The respective (82, 83, 82) %. Remarkably, treatment T7 had the lowest percentage at 70%, while treatment T1, the control, had the greatest value at 75% in the 90th minute. Five, six, and seven treatments were close together. 70%, 69%, 71, and 70% were the percentages that were reported, with T6 having the lowest proportion at 61%.

3. Density measurements

The specific densities of the diets containing Roselle and sweet bean seed powder are displayed in Table No. (6). The control treatment had the highest specific density, measuring 0.33 g/cm3, while treatments T7 and T4 had the highest values, except T1, which measured 0.29 g/cm3. The two treatments T3 and T5 were next, with values of 0.27 and 0.19 g/cm3, and T4 had the lowest weight.

4. Apparent digestibility coefficient: The impact of adding sweet bean seed powder and curds in various amounts on the digestibility coefficient of common carp fish is displayed in Table (7). The T689.44% treatment was shown to be the most effective of all the treatments, whereas there were no significant distinctions between the T2 and T7 treatments (84.02 and 83.38%). With a digestibility coefficient of 72.31%, the control treatment T1 achieved the lowest result.

According to [18], the high protein, low fiber, and high nutrient content in the diet may be the cause of the high digestibility factor in T3. At T6, it might be explained by the feed's proportions being in balance and the nitrogen-free extract being reduced [21].

5. Growth criteria

Table No. (8) Illustrates the impact of varying the amounts of sweet bean seed powder and husks on the ultimate weight as well as the overall and daily weight gain of common carp fish. Treatments T5, T6, and T7, with husk weights of (21.24, 24.07, 22.12) grams, respectively, outperformed the control treatments T1 and T4. (18.06, 19.29 g), and T2 and T3 did not show any significant differences. When compared to the control treatment and the remaining treatments, the weight gain criteria for fish and all treatments showed a significant impact at the level (P≤0.05).

This study demonstrated that the addition of powdered Roselle and sweet bean seeds increased fish daily growth rate by a significant amount (P ≤ 0.05), with the T6 treatment (0.401 g) outperforming the control treatment T1 and the best treatment (1% of Roselle seed powder) over the remaining treatments. Additionally, it was noted that in terms of daily growth rate, treatments T5 and T7, with weights of (0.354 and 0.368) grams, respectively, exceeded the control treatment T1 (0.250 grams) and all other treatments except treatment T6. These outcomes corroborated those of [22].

Using fennel seed powder at (1, 2, 3)% in the meals of Nile tilapia fish, the experimental treatment at 1% produced 13.87 grams, which was more than the growth rates and weight increase of the control treatment and the other treatments combined. Furthermore, Treatment T5 had a higher thermal growth factor—0.02%—than Treatment T1, which came in second with 0.017%, and Treatment T7, which came in third with 0.013%. The lowest quantity, 0.004%, was noted in transactions T2 and T3, whereas treatments T4 and T6 showed a rate of 0.011%.

The treatments' levels of metabolic growth were also presented; treatment T5 had the greatest value, 9.1 g/kg/day, followed by treatment T1 at 6.9 g/kg/day, treatment T7 at 5.6 g/kg/day, and treatments T4 and T6 had comparable percentages. With a value of 1.6 g/kg/day, they had the lowest metabolic growth in the T3 therapy, reaching (4.3, 4.7), respectively.

Since there were no fish fatalities over the 60-day research period, the survival rate for all treatments was 100%.

5. Chemical composition of fish bodies:

The results of this research indicate that the addition of currants and sweet bean seed powder in amounts of0.5,1 and 1.5%) resulted in slightly significant differences (P ≤0.05) in the moisture percentage of the fish's edible portion; a significant increase was noted in the control treatment T1 (769.90%) in comparison to treatment T2 (76.63%), which significantly (P ≤0.05) decreased from treatment T1. The rest of the treatments did not show any statistically significant differences.

In terms of percentage of protein, there were no appreciable differences between the control treatment T1 (17.02%) and the treatments T2 and T5 with ratios (17.01 and 17.03)%, respectively, and the treatments T3, T4, T6, and T7 with ratios (17.26, 17.27, 17.41, 17.65)%, respectively, which performed better than the treatments T1, T2, and T5. Regarding the fat content of the consumed piece of fish flesh, there were no noteworthy variations across the treatments at (P < 0.05). According to Table (9), the control treatment T1 performed better than the other treatments in terms of ash by 5.04%.

There was a similarity in the current study with the study of [5] on Nile tilapia fish, where the phenolic compounds of the galls were used to demonstrate their effect on the chemical composition of fish meat, and three percentages (0.5, 1, 1.5)% were added to the diet and compared with the control diet without galls and were given The moisture percentage was (72.70, 72.72, 72.74)%, respectively, the protein percentage was (60.67, 60.71, 60.75)%, respectively, the fat percentage was (21.26, 21.20, 21.13)%, respectively, and for ash it was (16.60, 16.66, 16 .64) % respectively.

CONCLUSION

From this study, it can be concluded that the addition of sweet bean seeds and Roselle has positive effects on growth performance, as indicated by an increase in total and daily weight, thermal growth coefficient, and metabolic growth rate. Increased fish nutrient uptake also improves the food utilization value factor.

ACKNOWLEDGMENT

My gratitude extends out to the Iraqi Ministry of Agriculture and to the Animal production Department, at the University of Tikrit, where I studied and performed research, and the University of Mosul, where I administered the tests.

REFERENCES

[1] Presenza, L., Teixeira, B. F., Galvão, J. A., & de Souza Vieira, T. M. F. (2023). Technological strategies for the use of plant-derived compounds in the preservation of fish products. *Food Chemistry*: 136069; Volume 419.

[2] Sarhadi, I., Alizadeh, E., Ahmadifar, E., Adineh, H., & Dawood, M. A. (2020). Skin Mucosal, Serum Immunity and Antioxidant Capacity of Common Carp Fed Artemisia. *Annals of Animal Science*, *20*(3): 1011-1027.

[3] ÖZEL, O. T., Cimagil, R., GÜRKAN, S. E., COŞKUN, İ., Mustafa, T. Ü. R. E., & Kutlu, I. (2023). The effects of Fennel (*Foeniculum vulgare*) Essential Oils on Growth Performance and Digestive Physiological Traits in Black SeaSalmon (*Salmo labrax* PALLAS 1814) Juveniles. *Journal of Agricultural Sciences*, *29*(1): 362-370

[4] Noreen, S., Tufail, T., Badar Ul Ain, H., & Awuchi, C. G. (2023). Pharmacological, nutraceutical, functional and therapeutic properties of fennel (*foeniculum vulgare*). *International Journal of Food Properties*, *26* (1): 915-927.

[5] El Mesallamy, A. M., Ahmad, M. H., Souleman, A. M., El Morsy, A. T., & Abd El-Naby, A. S. (2016). Effects of Roselle calyx (*Hibiscus sabdariffa* L.)-supplemented diets on growth and disease (*Aeromonas hydrophila*) resistance in Nile tilapia (*Oreochromis niloticus* L.). *Egyptian Pharmaceutical Journal*, *15*(2): 78.

[6] Muhaisen, Farhan Damad (1983). Fish diseases and parasites. Basra University Press, Basra, Republic of Iraq: 227 pages.

[7] Misra, C.K.; Sahu, N.P. & Jain, K.K. (2002). Effect of extrusion processing and steam pelleting diets pellet durability, water absorption and physical response of macro brachium rosenberger. India, Anim. Sci., *15*(9): 1354-1358.

[8] N.R.C. (1993). National Research Council. Nutrient Requirements of Fish. Washington,337p.

[9] AOAC,(2003). Association of Official Analytical Chemists , (2000) Official Methods of Analysis Inc.S.Williws, (ED) U.S.A.:1141.p.

[10] Talbot, C. (1985). Laboratory methods in fish feeding and nutritional studies In:Fish Eneregties, Tytler, P. and Calow, P: (eds) 125-155p.

[11] Furukawa, A. & Tsukahara, H. (1966). On the acid digestion method for the determination of chromic oxide as an index substance in the study of digestibility of fish feed. Bull. Jap. Soc. Sci Fish.*32*(6): 502-507.

[12] Hardy, R.W. & Halver, J.E. (2002). Diet formulation and manufacture- In Fish nutrition. 3rd edit. Academic press, 506-601.

[13] Schmalhusen, L. (1926) Studien uber washstum and differentzierung III die embryonal wachstum skurvedes hiichen. Wilhem Roux Arch. Entwicklungsmech . Organization: 322 - 387.

[14] Cho, C.Y.(1992). Feeding systems for rainbow trout and other salmonids with reference to current estimates of energy and protein requirements. Aquaculture, *100*: 107-123.

[15] Dabrowski, K. ; Murai, T. & Becker, K. (1986). Physiological and nutritional aspects of intensive feeding of carp. In: Aquaculture of cyprinids (ed. by R. Billard and J. Marcel), INRA, Paris: pp 55–70.

[16] Farsani, M. N., Hoseinifar, S. H., Rashidian, G., Farsani, H. G., Ashouri, G., & Van Doan, H. (2019). Dietary effects of *Coriandrum sativum* extract on growth performance, physiological and innate immune responses and resistance of rainbow trout (*Oncorhynchus mykiss*) against Yersinia ruckeri. Fish and shellfish immunology, *91*: 233-240.

[17] Duncan, C.B. (1955). Multiple rang and Multiple ― F ‖ test. Biometric, 11: 1-12.

[18] Fagbenro, O. A., Akande, T. T., Fapohunda, O. O., & Akegbejo-Samsons, Y. (2004, September). Comparative assessment of roselle (*Hibiscus sabdariffa var. sabdariffa*) seed meal and kenaf (*Hibiscus sabdariffa var. altissima*) seed meal as replacement for soybean meal in practical diets for fingerlings of Nile tilapia, Oreochromis niloticus. In *6th International Symposium on Tilapia in Aquaculture* (pp. 277-287)

[19] Usman, U., Diyaware, M. Y., Hassan, M. Z., & Shettima, H. M. (2023). Effects of Roselle (*Hibiscus sabdariffa*) Seeds as a Substitute for Soya Bean on Growth and Nutrient Utilization of *Clarias gariepinus* (Burchell, 1822). *Aquaculture Studies*, *23*(6).

[20] Yunusa, A., & Oyegbile, B. (2019). In-vivo and in-vitro nutrients digestibility of raw and processed *Hibiscus Sabdariffa* (*Roselle*) seed meal fed to the Nile Tilapia (*Oreochromis niloticus*). *Nigerian Journal of Animal Science*, *21*(1): 110-120.

[21] Al-Jader, Nebras Abdul Malik Muhammad (2020). Studying the possibility of partially replacing fish meal with shrimp meal (Metapenaeus affinis) in the diet of common carp (*Cyprinus carpio* L.). Master's thesis in Agricultural Engineering, Animal Production Department, University of Baghdad. 105 pages.

[22] Abd El Hakim, N. F., Ahmad, M. H., Azab, E. S., Lashien, M. S., & Baghdady, E. S. (2010). Response of Nile tilapia, Oreochromis niloticus to diets supplemented with different levels of fennel seeds meal (*Foeniculum Vulgare*). *Abbassa International Journal of Aquaculture*, *3*: 215-230.

Table 1. Components of the experimental diets (%) containing sweet bean seed powder and Roselle seeds in different proportions.

Ingredients	T1 Control (0%)	T2 Sweet bean (0.5%)	T3 Sweet bean (1%)	T4 Sweet bean (1.5%)	T5 Roselle seeds (0.5%)	T6 Roselle seeds (1%)	T7 Roselle seeds (1.5%)
Soybean oil	2	2	2	2	2	2	2
Soybean meal	53	53	53	53	53	53	53
Sweet bean seed powder	-	0.5	1	1.5	-	-	-
Roselle seed powder	-	-	-	-	0.5	1	1.5
Spelled flour	20	20	20	20	20	20	20
Yellow corn	22	22	22	22	22	22	22
Premix	3	3	3	3	3	3	3

Table 2. Chemical composition of the ingredients that are used to make the components of the feed

Ingredients	Moisture %	Crude protein %	Ash%	Ether extract %	Fiber %	Carbohydrate %
Soybean meal	9.82	45	1.84	6.33	5.76	31.25
Soybean oil	0.5	-	99	-	-	-
Spelled flour	8.86	12.80	1.63	1.95	2.24	72.52
yellow corn	10.80	9.03	4.34	2.33	2.01	71.49

Based on a dry matter calculation [8].

Table 3. Chemical composition of seeds of sweet bean and Roselle plants

Chemical composition	Estimated sweet bean powder	Estimated Roselle seeds powder
Dry matter %	94.48	94.90
Moisture %	5.52	5.10
Crude protein %	17.15	21.43
Fiber %	47.18	44.33
Ether extract %	2.07	2.27
Ash%	11.05	6.30
*NFE (%)	17.03	20.57

*Nitrogen-free extract: (NFE %) = 100 - (% moisture + % extract ether + % ash + % crude protein).

Table 4. Chemical composition of the diets

Ingredients	Dry %	Fat %	Protein %	Ash %	Fiber %	NFE (%)
T1 Control (0%)	94.44 g	4.74 a	14.76 f	12.85 a	21.94 c	40.15 e
T2 Sweet bean (0.5%)	94.52 f	3.67 e	13.47 g	10.40 e	19.67 d	47.31 a
T3 Sweet bean (1%)	95.34 a	2.21 g	21.70 a	10.75 c	14.47 g	46.21 b
T4 Sweet bean (1.5%)	94.90 e	3.34 f	20.82 b	10.20 g	26.72 a	33.78 g
T5 Roselle seeds (0.5%)	95.00 d	3.84 d	19.60 d	10.35 f	19.18 e	42.03 d
T6 Roselle seeds (1%)	95.18 c	4.01 c	18.37 e	10.90 b	23.98 b	37.92 f
T7 Roselle seeds (1.5%)	95.20 b	4.70 b	20.21 c	10.95 d	15.40 f	44.24 c

*Different lowercase letters within one column indicate the presence of significant differences ($p \leq 0.05$) between the treatments

Table 5. % of the diets had Sweet bean and Roselle seeds

Ingredients	15 min	15 min	15 min	15 min
T1 Control (0%)	93	91	86	75
T2 Sweet bean (0.5%)	98	94	82	70
T3 Sweet bean (1%)	96	89	83	69
T4 Sweet bean (1.5%)	95	87	77	71
T5 Roselle seeds (0.5%)	99	91	82	70
T6 Roselle seeds (1%)	93	88	80	61
T7 Roselle seeds (1.5%)	96	85	70	65

*Different lowercase letters within one column indicate the presence of significant differences

Table 6. shows the specific density of treatments containing sweet bean seed powder and Roselle

Treatments	Specific density g/cm^3
T1 Control (0%)	0.33
T2 Sweet bean (0.5%)	0.25
T3 Sweet bean (1%)	0.27
T4 Sweet bean (1.5%)	0.19
T5 Roselle seeds (0.5%)	0.27
T6 Roselle seeds (1%)	0.25
T7 Roselle seeds (1.5%)	0.29

Table 7. Indicates how adding Roselle and sweet seeds in various amounts affect the common carp fish's apparent digestibility coefficient.

Treatments	Apparent digestibility coefficient
T1 Control (0%)	72.31±0.211 d
T2 Sweet bean (0.5%)	84.02±1.379 b
T3 Sweet bean (1%)	86.25±0.715 ab
T4 Sweet bean (1.5%)	74.94±1.721 cd
T5 Roselle seeds (0.5%)	78.18±0.682 c
T6 Roselle seeds (1%)	89.44±0.518 a
T7 Roselle seeds (1.5%)	83.38±0.731 b

*Significant differences (P≤0.05) are indicated by different letters in the same column.

Table 8. The effect of adding sweet seeds and Roselle in different proportions on the final weight, total and daily weight gain, thermal growth coefficient, metabolic growth rate, and survival rate of common carp fish.

Treatments	Initial weight (g)	final weight (g)	Total weight gain (g)	Daily growth rate (g/day)	Thermal growth coefficient %	Metabolic growth rate (g/kg/day)	Survival rate %
T1 Control (0%)	202.02±0.120 b	217.04±0.190 b	15.02±0.312 b	0.250±0.222 e	0.017 b	6.984 b	100%
T2 Sweet bean (0.5%)	171.04±1.031 c	189.10±0.125 c	18.06±1.144 ab	0.301±0.516 d	0.004 e	2.016 e	100%
T3 Sweet bean (1%)	215.21±1.320 a	234.50±1.120 ab	19.29±0.461 ab	0.321±1.321 c	0.004 e	1.691 f	100%
T4 Sweet bean (1.5%)	216.22±0.412 a	231.30±0.314 ab	15.08±0.351 b	0.251±0623 e	0.011 d	4.397 d	100%
T5 Roselle seeds (0.5%)	153.10±0.511 d	174.34±0.172 d	21.24±1.211 a	0.354±1.022 b	0.022 a	9.177 a	100%
T6 Roselle seeds (1%)	218.11±0.343 a	242.18±0422 a	24.07±1.271 a	0.401±0.152 a	0.011 d	4.775 d	100%
T7 Roselle seeds (1.5%)	200.12±1.022 b	222.24±1.103 b	22.12±0.213 a	0.368±0.471 b	0.013 c	5.617 c	100%

*Different letters in the same column indicate significant differences (P≤ 0.05).

Table 9. Chemical analysis of the edible portion of fish (averages ± standard error)

Treatments	Moisture%	Protein%	Ash%	Fat%
Before the experiment	77.76	16.07	5.11	0.73
T1 Control (0%)	76.90 ± 0.24 a	17.02 ± 0.08 b	5.04 ± 0.20 a	1.04 ± 0.12 a
T2 Sweet bean (0.5%)	76.63 ± 0.20 b	17.01 ± 0.05 b	4.22 ± 0.09 b	1.33 ± 0.09 a
T3 Sweet bean (1%)	77.25 ± 0.17 ab	17.26 ± 0.10 a	4.27 ± 0.15 b	1.14 ± 0.06 a
T4 Sweet bean (1.5%)	77.23 ± 0.07 ab	17.27 ± 0.05 a	4.16 ± 0.13 b	1.32 ± 0.26 a
T5 Roselle seeds (0.5%)	77.37 ± 0.18 ab	17.03 ± 0.13 b	4.18 ± 0.05 b	1.14 ± 0.17 a
T6 Roselle seeds (1%)	77.09 ± 0.01 ab	17.41 ± 0.30 a	4.29 ± 0.12 b	1.21 ± 0.17 a
T7 Roselle seeds (1.5%)	77.09 ± 0.03 ab	17.65 ± 0.03 a	4.23 ± 0.01 b	0.91 ± 0.02 a

*Different lowercase letters within one column indicate the presence of significant differences (p ≤ 0.05) between the treatments.