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Effects of adding germinated wheat green part and seed to the diet on common carp (Cyprinus carpio L.): growth performance, somatic indices, and hemato-biochemical responses.

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ABSTRACT

This study investigated the effect of feeding of germinated wheat on growth performance, survival, somatic indices, and hemato-biochemical responses of *C.s carpio* fingerlings. Dietary supplementation at an inclusion rate of (control: no supplements, T1: 5g green part of germinated wheat, T2: 10g green part of germinated wheat, and T3: 5g whole germinated wheat seeds) were fed to the fish with average body weight 36.68g at 3% body weight, for six weeks. The final weight, weight gain, and specific growth rate at the T2 (58.38, 22.1, and 1.14 %), respectively, were found to be highest (10g green part of germinated wheat), and it also had the best feed conversion ratio (1.91). In experimental treatments (T1, T2, and T3) no significant difference ($p \geq 0.05$) was observed in some biological index such as hepatic, kidney, gill, intestine weight, and length index, while the lowest condition factor (1.37) was recorded in the control group. The results revealed that T1 and T2 were significantly higher ($p \geq 0.05$) in each of the red blood cells, haemoglobin, and hematocrit, while a significant variant was not observed in the white blood cell count. However, supplementation of germinated wheat parts had different effects on some serum biochemical and liver function parameters. The present study revealed that diets supplemented with the green part and seed of germinated wheat increased C. carpio growth and health performance.

Keywords**:** Blood, Health, Sprouting, Supplement, Survival.

INTRODUCTION

According to the FAO [1], overall aquaculture production encompassing fish, algae, ornamental seashells and pearls amounted to 114.5m tons in 2018, valued at USD 160.2bn, while finfish production amounted to 54.3m tons (US$ 139.7bn) and is projected to grow by 32% by the year 2030. High-value fish are kept in captivity for commercial purposes to satisfy the demand for white meat for human consumption. Industrial fish farming involved increasing the body weight of all the fish in order to increase productivity [2]. In aquaculture, fish grow more because they are allowed to achieve their maximum weight within a specified period of time through the use of artificial feed. [3]. New substances are introduced into fish feed to improve feed conversion efficiency and as a result, fish growth [4]. Plant-based feed additives known as photogenic are utilized to support many animals' species growth and well-being [5]. Enhancing palatability, promoting the growth of the gut microbiota, and having anti-inflammatory and antibacterial properties are some of their functional activities [6]. Cereals are the most important component of the fish diet worldwide. Globally, the most important species grown include wheat, barley, corn, soybeans, and others. Alternatives for raising the nutritional value of plant food can be found in modern food processing technology [7]. A cheap and effective method of enhancing cereal's nutritional value is germination. This method can provide results quickly and doesn't require expensive equipment or specialized knowledge [8]. Numerous studies have examined how germination affects the amino acids composed of different cereal grains [9; 10; 11; 12; 13]. The change in the amino acid, pattern in germinated barley seeds was investigated by [14], who found that glutamic acid and proline nutritional value of germinated barley content was decreased whereas essential amino acids as alanine, glycine, lysine, and arginine were increased. However, sprouting wheat has been discovered to boost protein quality, according to a book on natural foods [15]. Numerous studies have verified that supplementing fish diets with germinated grains results in healthy fish that are also more productive and have antibacterial, immune-system-boosting, maturation-accelerating, and stress-relieving qualities [16;17]. According to [16] feeding common carp a diet supplemented with 10 and 20 g/kg of germinated barley improved the fish's flesh quality and growth performance.

The nutritional content of seeds usually improves with germination [18;19;20]. Thus, the main goal of this research was to determine how supplementation by adding germinated wheat green parts and seeds had a positive effect on the common carp in terms of growth performance and health aspects.

Material and Methods

1. Seed soaking and sprouting

In order to prevent the growth of mold and fungi during seed germination, seeds have been cleaned from foreign substances, washed down with a fungicide solution SWIFT SC; 1:2000 v.v. for approximately 30 minutes before they are soaked into water. To remove the fungicide residues, the seeds were washed several times with tap water and distilled water.; Following that, seeds were soaked in distilled water (1:10, w/v) for approximately 12 hours at a temperature of between 21 and 24 °C. After that, they are spread out over plastic trays and given five days to germinate in the dark. Four times a day, trays were filled with distilled water. At this point, the seed radicle and sprouted portion developed, and the sprouted seeds were frozen for ten hours after reaching a length of about 3 cm. For better germination, the seeds were thawed at room temperature and then dried in an oven at for 48 hrs at a temperature 40 °C (Memmert, Germany). To be used as a feed supplement later on, the whole sprouted seeds were crushed into a powder using an electric grinder (Embleme EM-100G, Germany) and kept in plastic bags at 4°C. In controlled conditions, the wheat germination time was 3 weeks.

2. Experimental procedure

The experiment was conducted in the Fish Diseases Laboratory of the Faculty of Veterinary Sciences at the University of Sulaimani. From September 1st to October15th, the average bodyweight of 36,68±0.04 g was used for 96 common carp. Before beginning the feeding trial, they were allowed to acclimate for approximately 27 days while being given commercial pellets. Fish were fed 3 % of their body weight twice a day at 9:00 a.m. and 2:00 p.m. and weighed every two weeks; the feeding levels were then recalculated based on the latest weights.

The duration of the study was six weeks. A randomized design was organized in four treatments and three replicates were organized (rectangular plastic tanks containing approximately 60 liters of water), each replicate, containing 8 fingerlings, received different treatments, as follows: control: without additions supplements, T1: 5 g green part of germinated wheat, T2: 10 g green part of germinated wheat, and T3: 5g whole germinated wheat seeds. During the acclimatization stage, variables related to the water quality of the tanks were continuously checked while half of the water was changed daily. The water's temperature was 27±1 °C, its pH was 7.5±0.2, and its dissolved oxygen content was 6.6±0.4 mg/L.

Sinking pellets were made in a laboratory for use as the experimental meal. Using typical feed ingredients available at Sulaimani municipal markets, the pellet was dried at room temperature for several days before being crushed into small particles suitable for ingestion by fish using Kenwood Multi-processors.

Table 1: Percentage of experimental diet components and chemical composition of the different types of diet by [21].

Ingredients	Ratio%	Crude Protein %	Crude Fat %	Dry Matter %	Crude Fiber %	Energy Kcal/ kg
Soya bean meal	35	48	1.1	89	7	2230
Yellow corn	13	8.9	3.6	89	2.2	3400
Barley	15	11	1.9	89	5.5	2640
Wheat bran	20	15.7	4	89	11	1300
Fish meal	15	65.4	5.6	90.5	0.00	1290
Vit + min	2	---	---	---	---	---
Total	100					
Crude protein (%)	32.56					
Crude fat (%)	3.25					
Energy (kcal.kg)	2045					

Table 2: Proximate composition of germinated wheat portions as % (dry weight basis) according to [22][1] and [23][2]

Nutrient composition	Moisture	Protein	Ash	Fiber	Fat	CHO
Green Part of Germinated Wheat[1]	6.3	25	---	30	0.90	33
Whole Germinated Wheat Seeds[2]	9.8	10.26	1.76	1.59	2.81	74.18

3. Fish growth performance

Fish were weighed at bimonthly intervals to calculate the following parameters [24]:

Weight gain (g) = W2–W1

W2: Fish weight at the end of the experiment in gram.

W1: Fish weight at the beginning of the experiment in gram.

Specific growth rate (SGR) % = (Ln W2 – Ln W1)/ T x 100

Fish survival (%) = 100 (final fish number / initial fish number)

Feed conversion ratio (FCR) = Total feed fed (g) / Total wet weight gain (g)

4. Biological and health parameters (organ somatic index)

At the end of the experiment, five fish were taken randomly from each replicate and anesthetized with clove powder (200 mg/L) before fish dissection [25]. The weight and length of the fish were taken, and then the liver, spleen, gill, viscera, kidney, and intestine weights were recorded. The following equations determined the biological index of each organ:

Fulton condition (K) factor = 100 (fish weight g / fish length cm^3)
Hepatic somatic index (HSI, %) = 100 (liver weight g / fish weight g)
Gills somatic index (GI, %) = 100 (gills weight g / fish weight g)
Spleen somatic index (SSI, %) = 100 (spleen weight g / fish weight g)
Kidney somatic index (KSI, %) = 100 (kidney weight g / fish weight g)
Intestine weight index (IWI, %) = 100 (intestine weight g / fish weight g)
Intestine length index (ILI %) = intestine length (cm) / fish length (cm) x 100

5. Blood hematology

At the end of the experiment, three fish were used from each replicate for hematological parameters; they were anesthetized with clove powder, and blood was sampled by caudal peduncle suction [26] using a heparinized tube. The samples were analyzed with the BC-2800 USA origin analyzer used for complete blood count (CBC) tests, which include: red blood cell (RBC), hemoglobin (HB), hematocrit (HCT), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC), mean corpuscular volume (MCV), and white blood cell (WBC).

6. Blood biochemical

For each replication, three fish were used for this test. After anesthesia, blood was taken out through a caudal peduncle suction. Heparinized tubes were used to collect blood samples to analyse different blood indices. containing coagulating gel, which was thereafter centrifuged at 3000 rpm for 10 minutes to extract blood serum for measuring biochemical parameters, such as: Alanine aminotransferase activity (ALT), Aspartate aminotransferase activity (AST), Total protein, Globulin, Albumin, Cholesterol, Triglyceride, High-density lipoprotein cholesterol (HDL), Low-density lipoprotein cholesterol (LDL), Glucose, Creatinine، and Creatine Kinase. Using Biochemical auto analyzer Cobas C 501 at Sarezhan Laboratory in Sulaimaniya governorate.

7. Statistical analysis

Data obtained from the various parameters were analyzed with a one-way ANOVA using XLSTAT, Pro 7.5. The differences among means were assessed using Duncan's Multiple Range Test ($p \leq 0.05$). All data are represented as mean standard deviation (Mean ±SD).

Results and Discussion

Table 3, illustrates the growth performance and feed utilization of the four treatments in the experiment. The highest average final weight (58.38 g), weight gain (22.1g), and specific growth rate (1.14) were achieved by T2, while the lowest (45.28g, 9.81g, and 0.57) respectively were achieved by control. The highest feed conversion ratio (3.24) was achieved by control, The best FCR (1.91) was achieved by T2. However Statistical analysis for survival rate showed no significant differences ($p \leq 0.05$) between all treatments.

Table 3: Effect of the germinated wheat portions on growth performance and feed utilization of common carp

Fish groups	Control	Treatment 1	Treatment 2	Treatment 3
Initial weight (g)	35.47±0.01	38.47±0.08	36.28±0.01	36.53±0.07
Final weight (g)	45.28±0.08^{c}	52.1±0.02^{b}	58.38±0.05^{a}	49.43±0.01^{b}
Weight gain (g)	9.81±0.3^{c}	13.63±0.1^{b}	22.1±0.2^{a}	12.95±0.2^{b}
SGR (%)	0.58±0.03^{c}	0.72±0.01^{b}	1.13±0.07^{a}	0.72±0.02^{b}
FCR	3.24±0.03^{a}	2.95±0.1^{b}	1.91±0.4^{c}	2.82±0.2^{b}
Total feed fed (g)	31.78±0.07^{d}	40.2±0.03^{b}	42.21±0.03^{a}	36.51±0.05^{c}
Survival rate (%)	100.0±0.00	100.0±0.00	100.0±0.00	100.0±0.00

Note: means within a row with different superscripts differ at $p \leq 0.05$.

Table 4 shows the impact of the germinated wheat parts on a few biological indices and a common carp's health-related parameter, the impact of germinated wheat portions on the HIS, KSI, GI, IWI, and ILI in treated fish was found to be not significant ($P<0.05$). However, the highest SSI (0.2) was found in T1. The condition factor increased significantly in groups T1, T2, and T3, while the lowest condition factor (1.37) was achieved in the control group.

Table 4: Effect of the germinated wheat portions on some biological index of common carp

Fish groups	Control	Treatment 1	Treatment 2	Treatment 3
HSI (%)	2.07±0.3	2.38±0.4	2.2±0.3	2.58±0.8
SSI (%)	0.08±0.2^{b}	0.20±0.9^{a}	0.19±0.3^{a}	0.17±0.9^{a}
KSI (%)	0.56±0.05^{a}	0.52±0.03^{a}	0.54±0.04^{a}	0.55±0.04^{a}
GI (%)	3.29±0.09^{a}	2.97±0.01^{a}	3.15±0.2^{a}	3.37±0.1^{a}
IWI (%)	3.41±0.09^{a}	3.7±0.1^{a}	3.04±0.2^{a}	3.67±0.3^{a}
ILI (%)	43.42±0.08^{a}	43.78±0.1^{a}	42.76±0.09^{a}	43.51±0.05^{a}
Condition factor (K)	1.37±0.09^{b}	1.73±0.08^{a}	1.79±0.05^{a}	1.69±0.01^{a}

Note: means within a row with different superscripts differ at $p \leq 0.05$.

The hematological data of common carp fed on the parts of germinated wheat are displayed in Table 5. According to the findings, The fish groups that were fed on 5 and 10 g green parts of germinated wheat T1 and T2 had the highest values of RBC (1.45 and 1.52 1012 cells/L), HB (13.25 and 13.75 g/L), HCT (34.93 and 35.22 %), and MCHC (381.1 and 389.5 g/L) respectively, also had the lowest values of MCV. The results showed that there were no significant differences (p<0.05) between the parameters for white blood cells WBC.

Table 5: Effect of the germinated wheat portions on some hematological data of common carp

Fish groups	Control	Treatment 1	Treatment 2	Treatment 3
RBC (10^{12} cells/L)	$1.12±0.03^c$	$1.45±0.06^{ab}$	$1.52±0.02^a$	$1.36±0.06^b$
WBC (10^9cells/L)	$20.950±0.03^a$	$21.457±0.05^a$	$22.002±0.02^a$	$21.233±0.02^a$
HB (g/L)	$10.5±0.1^c$	$13.25±0.01^a$	$13.75±0.1^a$	$12.02±0.07^b$
HCT (%)	$27.8±0.06^c$	$34.93±0.02^a$	$35.22±0.03^a$	$32.9±0.02^b$
MCV (fl)	$246.95±0.04^a$	$239.7±0.01^b$	$231.15±0.03^c$	$240.95±0.01^b$
MCH (pg)	$93.3±0.04^a$	$91.7±0.07^{ab}$	$90.75±0.09^b$	$88.25±0.04^c$
MCHC (g/L)	$376.5±0.04^c$	$381.1±0.06^b$	$389.5±0.04^a$	$362.7±0.09^d$

Note: means within a row with different superscripts differ at p≤0.05.

The serum biochemical data of treated common carp is shown in Table 6. According to the findings, the control has the highest value of glucose (5.3 mm/L) and creatinine (10.93) as compared to other treatment groups. When 10 g green part of germinated wheat (T2) was used, the greatest levels of triglycerides (279 mm/L), cholesterol (166.3 mm/L), and HDL (88.17 mm/L) were observed, whereas the highest level of LDL (42.54 mm/L) was found in the control. The findings show that there is not a significant difference in the value of Creatine kinase across all treated fish groups

Table 6: Effect of the germinated wheat portions on some serum biochemical data of common carp.

Fish groups	Control	Treatment 1	Treatment 2	Treatment 3
Glucose (mm/L)	$5.3±0.04^a$	$4.43±0.2^b$	$4.18±0.01^b$	$5.07±0.2^a$
Creatinine	$10.93±0.3^a$	$3.79±0.5^c$	$3.38±0.5^c$	$4.09±0.6^b$
Creatine Kinase (U/L)	$1549.85±0.07^a$	$1537.06±0.2^a$	$1519.2±0.06^a$	$1556.1±0.2^a$
Triglycerides (mm/L)	$159.43±0.01^c$	$221±0.1^b$	$279±0.1^a$	$212±0.05^b$
Cholesterol (mm/L)	$145.966±0.2^c$	$157.89±0.3^b$	$166.3±0.2^a$	$157.25±0.1^b$
LDL (mm/L)	$42.54±0.3^a$	$26.68±0.4^b$	$22.43±0.3^c$	$27.84±0.08^b$
HDL (mm/L)	$71.54±0.7^b$	$87.01±0.3^a$	$88.17±0.1^a$	$87.01±0.2^a$

Note: means within a row with different superscripts differ at p≤0.05. If there are no letters, there are no treatments that vary significantly.

Table 7 shows how feeding common carp on the experimental diet by supplying germinated wheat portions affect the liver function parameters. According to the findings, using groups 5% and 10% wheat grass significantly raised total protein, albumin, and globulin compared with control and 5% whole germinated wheat seeds. No significant differences were seen in ALT, AST, and ALP.

Table 7: Effect of the germinated wheat portions on liver function parameters of common carp

Fish groups	Control	Treatment 1	Treatment 2	Treatment 3
Total Protein (g/L)	$43.1±0.2^b$	$45.82±0.3^a$	$46.35±0.3^a$	$44.6±0.1^{ab}$
Albumin (g/L)	$1.56±0.8^b$	$2.67±0.4^a$	$2.7±0.8^a$	$2.2±0.05^a$
Globulin (g/L)	$41.53±0.2^b$	$43.12±0.4^a$	$43.67±0.2^a$	$42.49±0.1^{ab}$
ALT (U/L)	$69.02±0.02^a$	$67.69±0.01^a$	$69.41±0.03^a$	$68.58±0.02^a$
AST (U/L)	$105.03±0.3^a$	$104.65±0.7^a$	$104.41±0.1^a$	$103.89±0.2^a$
ALP (U/L)	$38.71±0.2^a$	$39.05±0.6^a$	$38.11±0.04^a$	$37.98±0.4^a$

Note. Means within a row with different superscripts differ at p≤0.05. If there are no letters, there are no treatments that vary significantly.

Herein, germinated wheat portion or sprouted wheat was used as an additive in common carp feeding. The impacts on growth performance, feeding conversion, biological parameters, blood hematology and biochemical profile were investigated. The study of growth performance and feed conversion ratio is a critical indicator for determining the possibility of utilising feed additives in aquaculture .[27]Based on the current study's results, the group that fed on the green portion of germinated wheat at a 10% inclusion level is thought to have the best growth and feed utilization of fingerling *C.s carpio*. From this viewpoint, it can be inferred that this element, green sections of germinated wheat, is advantageous to the growth of aquaculture. [28] found that adding 20 g/kg of germinated barley to the diet of the common carp improved both the feed conversion ratio and growth performance. Additionally, [29] proposed that supplementing the diet with wheat and barley grass juice might enhance the common carp's growth and meat quality. Their findings and our findings are consistent. The biological composition of the green portions of germinated wheat must first be understood to explain these impacts on growth and feed consumption. Fish growth is highly dependent on the protein ratio in the fish diet, the prior findings found that germination increases the quality and amount of protein in wheat [15]. Also, [28] found that barley germination increases its nutrient digestibility and absorption; therefore, the beneficial effects of the green portion of germinated wheat in common carp in this study may be attributed to these reasons.

The biological indicator is an effective tool for assessing the effects of stress on fish. Organ somatic indices provide detailed information on the function of a certain organ, which changes in size faster than animal weights and lengths and also indicate the relative size of organs and the status of organ systems [30].

The research examined somatic indicators (HIS, KSI, GI, IWI, and ILI) showed no differences across all treatments , which means that the fish successfully adjusted to the applied treatments. [31] found the same results when they used germinated barley powder in common carp diet. The fish's hematopoietic capacity and immunological condition are both reflected in the spleen somatic index [32]. The increase in spleen somatic index in this study can be related to the increase in fish weight gain when fish feed on diets that are supplied with a green portion of germinated wheat, this finding lines up with the findings of [33], who reported that using germinated lentils in a common carp diet caused a significant rise in spleen somatic index. Through the combination of feeding conditions, parasite diseases and physiological parameters, the condition factor (K) of a fish reflects physical and biological circumstances and fluctuations [34].

This also suggests changes in food reserves, another indicator of overall fish status [17]. According to the current study's outcomes, germinated wheat portions are considered best for the optimal condition factor of *C. carpio* fingerlings because all treatments had a significantly better condition factor than the control group.

The hematological parameter data is a useful tool for evaluating fish health. Due to their high sensitivity to environmental changes, several hematological indicators can provide information about physiological issues before their external symptoms appear [35]. Temperature changes, stress management, nutrition، and crowding may have a suppressive effect on innate parameters, while some dietary additives and immunostimulants may improve certain innate characteristics. Low dietary protein levels cause physiological stress, which impacts the liver and lowers the amounts of RBC and Hb [36] .Results show that there are slight increases in the values of RBC, Hb, and HCT parameters of the common carp fed with % 5 and %10 g green part of germinated wheat compared to that fed with % 5 all parts of germinated seed and control because wheat grass, the green portion of germinated wheat which is rich in nutrients, enhances blood health by increasing the red blood cell count (RBC) because of its high chlorophyll content, which is similar to hemoglobin [37]. [38] showed that adding 50 g/kg germinated wheat to the common carp diet raised RBC and HB levels, which agrees with our result.

According to [39], the leukocyte count (WBC) is a crucial indicator of the immunological status of vertebrates. One of the most often used and easily studied indicators to determine the health of fish from blood is the differential leukocyte count. In the current study, there was no difference in WBC in *C. carpio* across treatments. Our result agrees with [40], who found that barley sprout powder did not affect WBC levels in common carp. Adding 10 g/kg of germinated wheat to the common carp diet increased WBC counts [17]. Moreover, altars have been found in the MCH, MCV, and MCHC levels of common carp in the present study, since their amounts are directly related to RBC, HB, and HCT levels; therefore, variations in their levels may be the source of these alterations.

Serum components and other blood biochemical and physiological markers could be utilized for investigating positive effect for aquatic animal health from natural feed additives [42]. Among the crucial indicators that fish are resistant to environmental stressors are blood cortisol and glucose levels [43]. Elevated cortisol levels cause elevated blood glucose levels, which in turn stimulate hepatic gluconeogenesis [44]. In the current research, compared to the control group, the fish that were given green parts of sprouted wheat had lower glucose levels. It was possible that sprouted wheat had an antistress impact and reduced the amplitude of increased cortisol, which in turn decreased the amount of blood glucose. In this study, sprouted wheat did not influence the Creatine Kinase level, while the Creatine level decreased, thus we can consider that germinated wheat portions have a low hepatoprotective activity. Our findings are consistent with [45], who found the same results when they supplemented wheatgrass The literature discusses the various impacts of phytoadditives on cholesterol levels. juice in a common carp diet.

As a component of cell membranes and a precursor to all steroid hormones, cholesterol has a variety of physiological functions, [45]. Our findings show that the highest levels of cholesterol and triglycerides were seen when 10 g of the green part of germinated wheat was consumed. Similar to our results, earlier research discovered that feeding common carp 50 g/kg of germinated lentils and wheat raised cholesterol levels [38; 34]. Conversely, other researchers discovered that guar sprout meal reduced triglyceride and cholesterol levels in Nile tilapia *Oreochromis niloticus.* The primary organs that create triglycerides and cholesterol are the liver. These substances determine the physiological alterations that fish undergo after receiving short feedings. A shortage of essential amino acids can lead to fatty acid beta-oxidation impairment, increased lipogenesis, and liver dysfunction, all of which can significantly elevate plasma lipid levels [45].

To evaluate the nutritional state and overall health of fish, one crucial parameter is the blood's total protein level [44]. Fish serum's protein content varies based on several factors, including food diet, species, season, sexual maturation level, and water temperature [46;47]. The condition of specific humeral immunity is indirectly reflected in the levels of globulin and total protein [48;49]. The most important serum protein for transporting steroid hormones is albumin [45]. Hypoalbuminemia, or low albumin, can be brought on by a variety of conditions, including cancer, genetic changes, late pregnancy, burns, nephrotic syndrome, malabsorption, protein-losing enteropathy, and artifacts. Hyperalbuminemia, or high albumin, is usually invariably the result of dehydration [51]. All treatment groups in this research had blood total protein levels, including globulin and albumin, significantly higher than those of the control group. These findings align with prior research by [52], who found that an inclusion rate of 25% and 50% of the guar sprout meal significantly increased total proteins and albumin in Nile tilapia *Oreochromis niloticus*. [53;54], represent that increasing serum protein levels is an important component in modifying a fish's immunity.

Fish are among the many animal species for which serum enzyme levels can be used as health indicators. Kinases and phosphatases often mediate them and are necessary for signal transduction and cell regulation. The degradation of organs such as the liver, kidneys, and gills is thought to be indicated by elevated levels of the enzymes ALT, AST, and ALP .[55] Fish might have increased activity in their enzyme concentrations, which results in an increase in aspartate and alginate from using sugar to create glucose for stress adaptation [56]. In this study, ALT, AST, and ALP were not statistically significant across all groups. This finding aligns with a previous publication by [44], who reported that the enzymes ALT and ALP in *C. carpio* were unaffected by diets containing wheat grass juice. Bioactive substances cause positive impacts on conserving normal histoarchitecture and metabolic enzyme levels in phytoadditives, which act as antioxidants, and positive impacts on growth performance and blood profile were observed in this study.

Conclusion

According to the results obtained from our study, the addition of 5 and 10 g of the green part of germinated wheat has a positive impact on common carp C. carpio growth, feed conversion, and health performance, so it could be considered for use in fish culture. In addition, further research is needed on the use of higher amounts of wheatgrass to achieve better results.

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تأثير إضافة الجزء الأخضر من القمح المنبت وبذوره إلى العليقة على أسماك الكارب الشائع (.L *Cyprinus carpio*): أداء النمو والمؤشرات الجسدية والاستجابات الدموية والكيميائية الحيوية.

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الخلاصة

أجريت هذه الدراسة لتقييم الدور المفيد للجزء الأخضر من القمح النابت وبذوره في أداء النمو والبقاء والمؤشرات الجسدية والاستجابات الدموية والكيميائية الحيوية لإصبعيات أسماك الكارب الشائع *C. carpio*. المكملات الغذائية بمعدل إدراج (ا السيطرة: لا توجد مكملات، المعاملة الأولى بنسبة اضافة 5غرام الجزء الأخضر من القمح النابت، المعاملة الثانية 10 غرام الجزء الأخضر من القمح النابت، ولمعاملة الثالثة 5 غرام من بذور القمح النابتة الكاملة) تمت تغذيتها للأسماك بمتوسط وزن جسم (36.68 غرام) بنسبة 3% من وزن الجسم لمدة ستة أسابيع. وجد أن الوزن النهائي وزيادة الوزن ومعدل النمو النوعي (58.38، 22.1، و1.14)، على التوالي، هي الأعلى في *T2* (10 غرام الجزء الأخضر من القمح النابت)، وكان لها أيضًا أفضل نسبة التحويل غذائي (1.91). لم يلاحظ أي اختلاف معنوي في بعض المؤشرات البيولوجية مثل مؤشر الكبد، الكلى، الخياشيم، وزن الأمعاء، مؤشر الطول، بينما سجل أقل عامل للحالة (1.37) في مجموعة السيطرة. أظهرت النتائج أن المعاملة الأولى والثانية كانتا أعلى معنويا في كل من خلايا الدم الحمراء والهيموجلوبين و حجم خلاًّ الدم المرصوص ، في حين لم يلاحظ تباين معنوي في عدد خلايا الدم البيضاء. ومع ذلك، كان لمكملات أجزاء القمح النابتة تأثيرات مختلفة على بعض المعايير البيوكيميائية ووظائف الكبد في الدم. كشفت الدراسة الحالية أن الوجبات الغذائية المكملة بالجزء الأخضر من القمح النابت والبذور زادت من نمو *C. carpio* والأداء الصحي.

الكلمات المفتاحية : الدم، الصحة، الإنبات، تكملة ، البقاء على قيد الحياة.