The impact of *Lavandula officinalis* essential oil on growth performance and hematology of common carp (*C.carpio*)

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Abstract

Effects of lavender essential oil (LEO) on the growth, hematology, and biology of common carp was investigated. A total of 120 healthy fishes were distributed into 12 plastic tanks for four treatments in triplicate. The fish were fed a diet of 0, 1 ml, 2 and 4 ml/kg of LEO for 60 days. Results showed that WG and SGR significantly were increased at the different levels of LEO ($p < .05$). The highest of WG was found in (T4) and 4 ml/kg of LEO and SGR was found in (T3) 2 ml/kg of LEO of LEO. In contrast, FCR was decreased with increasing of dietary supplemental of LEO there were significant differences ($p < 0.05$), for (hgb, mch and wbc). However, there were no significant differences for (rbc, mchc, plt, mcv, granules, lymphocyte and monocyte) of LEON treatment compared to the control ($p < .05$). Finally, there were significant differences for biological traits except Hepatosomatic index and Spleenosomatic index. Overall, our results interestingly demonstrated that the effect of supplemental dietary LEON had a positive and significant effect on some growth, hematological and biological traits of common carp (*C.carpio*).

Keywords: Essential oil, Hematological, Biochemical, Lavendar, Common carp.

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Introduction

Fish are considered a valuable part of a healthy diet (Adams and Standridge, 2006). There are enormous differences between the countries in terms of aquaculture growth and development. The improvement of aquaculture economics depends on the progress of biology, nutrition, and the environmental management of production cycles. Many products are looking for improved fish growth stimulants and antibiotics and agrochemicals (Santos *et al.*, 2009). The pharmaceutical properties of aromatic plants are partially attributed to essential oils (Edris, 2007). Essential oils are volatile, natural, and complex compounds characterized by strong odors and formed by aromatic plants as secondary metabolites. The biological effects of essential oils are due to the synergy of all molecules or to the highest reflection of major molecules (Bakkali *et al.*, 2008). Essential oils are produced by various methods such as expression, fermentation, or extraction, but steam distillation is the most commercially used method. Essential oils consist mainly of two classes of compounds: terpenes and phenylpropenes. Terpenes are divided into monos, sesqui, and diterpenes based on 5 – carbon isoprene units, whose number of isoprene units is 2, 3, and 4, respectively, and phenylpropenes are composed of 6 – carbon aromatic rings and 3 – carbon side chains (C6–C3 compounds) (Clegg *et al.*, 1980; Cooke *et al.*, 1998). Lavandula officinalis belongs to the Labiatae (Lamiaceae) family and is known as lavender.

Zuzarte *et al.*, (2013) reported that lavender essential oil contains different compounds such as camphor, fenchone, borneol, terpineol, and cineole. Immunostimulators also have the ability to increase resistance to microinfections and stressors such as handling, transport, classification, and poor water quality in cultivated fish (Raa, 2000). Nanoemulsions consist of a fine dispersion of oil in water and have droplets of 100–600 nm size range (Sarker, 2005). Nanoemulsion has a higher period of physical stability, antibacterial effect, and fine particle size that prevent them from joining and flocculating. They also require a low concentration of superagents. According to previous research, some studies have been conducted on the effect of EON on fish performance. But so far, there has been no research on the effects of LEON on common carp (*C. carpio*), one of the innovations in this research. Therefore, this study determined the effects of different LEON levels on the growth performance, hemoglobin, and immunity of common carp (*C. carpio*).

Materials and methods

Experimental fish: An 8-week experiment was conducted on 108 common carp (*C. carpio*) brought from the local fish ponds of Daquq/ Kirkuk/ Iraq. The weight of the fish varies from 60to 61.7 gm. The fish were distributed in experimental plastic Aquarium the acclimation and feeding of commercial pellets in the laboratory (the percentage of their ingredients and chemical composition were shown in table 1 and table 2) were conducted 21 days before the real feeding tests.

Table 1: Chemical composition of the various diets by NRC (1993).

Constituents	Crude protein %	Crude fat %	Dry matter %	Crude fiber %	Energy kcal/ kg
Concentrate of Animal protein	40	5	92.9	2.2	2107
Yellow corn	8.9	3.6	89	2.2	3400
Soybean meal	48	1.1	89	7	2230
Barely	11	1.9	89	5.5	2640
Wheat bran	15.7	4	89	11	1300

Table 2: Experimental diet composition.

Ingredients (%)	Control 1st treatment	2nd Treatment	3rd Treatment	4th treatment
Yellow corn	15 %	15 %	15 %	15 %
Wheat bran	15 %	15 %	15 %	15 %
Animal concentrate protein	20 %	20 %	20 %	20 %
Barley	15 %	15 %	15 %	15 %
Soya bean meal 48%	35 %	35%	35%	35%
lavendar essential oil	0	1 ml	2 ml	4 ml
Total	100			
Calculated chemical composition				
Crud protein	28.06			
Gross energy (kcal/kg feed)	2242.7			

Experimental design: In the study, 12 plastic Aquarium (70 litres of water) were used in four treatments, each of which was replicated three times and experiment was conducted at animal science department, college of agricultural engineering sciences/university of Sulaimani. Each Aquarium had a proper continuous air suspension, using a Chinese aerator, Hailea aco-318. Each replica was stocked with five fish. Reproductions were randomly placed to reduce the differences between treatments. Daily cleaning by siphoning method to remove remaining feed and feces from the system. The experimental study included four treatments and three replicates; each replicate contained 10 fish.

Diet Formulation: Experimental diets contained standard ingredients found in the markets of the city of Saimani, enriched with lavender. Then, mix the ingredients to get the dough. Then, use an electrical cutter for pelleting by Kenwood multiprocessors. A room temperature drying period of four days and the resulting fine particles were crushed. The food is given twice a day at 9 a.m. And at 2 p.m. It was 3% of the body

weight. The fish in each tank were weighed together twice a month. The feed level is then recalculated according to the new weight. The feeding tests lasted 8 weeks.

At the end of the experiment period, three fish were collected randomly from each experiment group. All fish samples were individually measured and measured in weight. The blood samples of each fish of each group were collected by cutting the caudal veins. The entire blood sample was collected in a small plastic container, containing EDTA, and stored in a cooling bag. The number of erythrocytes (RBCs: 1012 cells/l), the average concentration of mchc, the average g/dl, the average volume of MCV, the average fl, the hemoglobin (HB, g/dl) and the platelet (plt, 109 cells/l).

Biochemical parameters:

Alanine aminotransferase activity (ALT), aspartate aminotransferase activity (AST), total proteins, globulin (g/dl), albumin (g/dl).

The growth and food supply parameters: All fish (gm) weigh together for each repetition every two weeks. Each replica's feed consumption was read only by biomass obtained every two weeks.

Total Weight gain (gm/fish) = mean of weight (g) at the end of the experimental period – weight (gm) at the beginning of the experimental period.

Weight gain (gm/fish) = w2 – w1

where:

W2: fish weight (gm) at the end of experimental period

W1: fish weight (gm) at the beginning of the experimental period

Daily weight gain (g/day) = weight gain / experimental period

= w2 – w1 / t

T: time between w2 and w1 (60 days)

Relative growth rate % = weight gain / initial weight x 100

= w2 – w1 / w1 x 100 (brown, 1957)

Specific growth rate (SGR) = (ln final body weight–ln initial body weight)

/experimental period) x100 = (ln w2 – in w1) / t) x 100 (Lagler, 1956).

Feed conversion ratio (FCR) =total feed fed (gm) / total wet weight gain (g) (uten, 1978).

Feed efficiency ratio (FER) = total weight gain (gm) / total feed fed (gm) (uten, 1978).

Health (biological) parameters

All fish specimens were dissected and the abdominal cavity was opened to weigh each organ alone, and they calculated as follows:

Hepatosomatic index %= Liver weight (gm) / Fish weight (gm) x 100 (Schreck and Moyle, 1990).

Spleenosomatic index%= Spleen weight (gm) / Fish weight (gm) x 100 (Schreck and Moyle, 1990).

Intestine weight index % = intestine weight (gm) / fish weight (gm) x 100(Lagler, 1956).

Intestine length index % = intestine length (cm) / fish length (cm) x 100(Lagler, 1956).

Condition factor = fish weight (gm) / fish length (cm)3 (Lagler, 1956).

Gill index % = gill weight (gm) / fish weight (gm) x 100(Lagler, 1956).

Fish weight index % = fish weight without viscera (gm) / fish weight (gm) x 100(Lagler, 1956).

Meat weight index % = fish weight without viscera & head (gm) / fish weight (gm) x 100 (Lagler, 1956).

Statistical analysis

The trial was conducted by one way (ANOVA) with a completely randomized design (CRD) and general linear models (glm) procedure of xlstat 2016 version.02.28451. Duncan's test were used to compare among treatments means.

Results

There were significant differences ($p< 0.05$) in weight gain between treatment 4 and other treatments, and the highest weight gain value was observed in Treatment 4. The relative growth rate, specific growth rate, food conversion rate, and food efficiency rate. Fish was significantly affected by the use of essential oil from *Lavandula officinalis*. In addition to the food conversion ratio, other parameters were attained with the highest values of the control parameters (Table 3).

Mean values for (rbc, hgb, mcv, mch, mchc, mcv, plt, wbc, granules, lymphocyte, and monocyte) were presented in table 4 as mean± se. According to the results, there were significant differences ($p <0.05$), for (hgb, mch and wbc). However, there were no significant differences for (rbc, mchc, plt, mcv, granules, lymphocyte, and monocyte).

Table 3: Effect of feeding with lavender oil levels on growth and feed utilization parameters of young common carp (*C. carpio*).

Parameters	t1 control	t2 1ml LEO	t3 2ml LEO	t4 4ml LEO
Total weight gain	3.22±0.42 C	5.485±0.39 C	8.275±0.39 B	12.925±0.47 A
Relative growth rate	17.989±2.16 B	31.068±6.40 B	60.84±0.38 A	73.97±11.22 A
Specific growth rate	5.43±0.03 B	5.59±0.09 B	7.19±0.07 A	5.87±0.10 B
Food conversion ratio	1.513±0.05 A	1.579±0.25 A	1.579±0.05 A	0.778±0.03 B
Food efficiency ratio	0.657±0.02 B	0.667±0.09 B	0.635±0.02 B	1.290±0.04 A

Note: Different letters in same rows mean significant differences ($p<0.05$).

Table 4: Effect of feeding with lavender oil levels on some hematological indices of young common carp (*C. carpio*).

Parameters	t1 control	t2 1ml LEO	t3 2ml LEO	t4 4ml LEO
Rbcs (10^{12}cells/l)	1.83±0.13 A	2.73±0.27 A	5.900±0.13 A	1.29±0.10 A
Hb (g/dl)	10.90±0.10 C	10.00±2.95 B	5.53±2.99 B	9.8±3.11 A
Mch (pg)	32.0±0.35 A	24.0±1.77 B	32±0.7 A	32±1.04 A
Mchc (g/dl)	24.0±1.2 A	27.400±3.20 A	30.35±3.60 A	29.2±2.33 A
Mcv (fl)	100±2.12 A	99±1.06 A	91.200±3.19 A	99±1.28 A
Plt (10^{9}cells/l)	8±1.06 A	8±5.67 A	13±3.19 A	12±3.33 A
Wbc (10^{9}cells/ l)	9.0±0.24 B	8.65±1.77 A	8.75±1.77 B	9.0±1.54 Ab
Granulocytes (%)	56.25±2.13 A	57.45±2.17 A	55.82±1.04 A	58.60±1.13 A
Lymphocytes (%)	9.29±1.99 A	9.47±0.56 A	10.54±2.41 A	9.09±1.93 A
Monocytes (%)	33.54±3.29 A	32.98±0.94 A	33.63±0.980 A	33.12±1.680 A

Note: Different letters in the same rows mean significant differences ($p<0.05$).

Values of alt, ast, total protein, globulin, and albumin in fish plasma were significantly higher ($p <0.05$) in treatments 2, 3, and 4 than those in treatment 1(control). While the highest activity of alt was in t1 (control) than those in treatments 2, 3, and 4, which was 32.17±3.63. Highest blood glucose value was in t1 (control) and significantly differed with treatment 3 and 4 ($p <0.05$, table 5).

Table 5: Effect of feeding with lavender oil levels on some blood biochemical parameters of young common carp (*C. carpio*).

Parameters	t1 control	t2 1ml LEO	t3 2ml LEO	t4 4ml LEO
Alanine aminotransferase activity (alt)	130.45±3.63 A	84.46±2.91 A	88.21±1.64 A	69.85±1.66 A
Aspartate aminotransferase activity (AST)	586.99± 2.23 A	592.87±2.24 A	106.055±0.98 B	714.10±1.63 A
Total proteins	45.56±2.14 A	28.76±0.55 AB	26.66±2.51 B	29.42±1.53 AB
Globulin (g/dl)	44.50±1.76 A	28.200±0.35 AB	26.35±2.35 B	28.550±3.09 AB
Albumin (g/dl)	0.92±0.359 A	0.51±0.193 A	0.235±0.165 A	0.805±0.257 A

Note: Different letters in same rows mean significant differences ($p<0.05$).

Significant differences ($p<0.05$) were noted among treatments in all parameters listed in Table 6 except hepatosomatic index and spleenosomatic index. highest condition factor was treatment 4. However, the highest values of meat weight index were observed in treatment 2 (table 6).

Table 6: Effect of feeding with lavender oil levels on some physio-biological parameters of young common carp (*C. carpio*).

Parameters	t1 control	t2 1ml LEO	t3 2ml LEO	t4 4ml LEO
Hepatosomatic index	1.42±0.08 A	1.84±0. 69 A	1.31± 0.18 A	0.666 ±0.21 A
Spleenosomatic index	1.42±0.08 A	2.04±0.035 A	1.44± 0.27 A	1.62 ±2.13 A
Kidneysomatic index	0.517±0.08 AB	0.353± 0.08 B	0.680 ±0.11 A	0.460± 0.02 A
Gillsomatic index	6.53±1.38 A	6.23±0.47 A	6.35±0.08 A	4.69±0.32 A
Intestine weight index	5.39±0.21 A	3.57±0.20 B	5.29±0.14 A	2.85±0.13 B
Fish weight index	83.47±7.03 A	96.52± 0.97 A	84.96± 1.47 A	85.90±2.26 B
Meat weight index	61.08±1.07 AB	70.59±0.27 A	58.20± 0.34 B	63.63±0.52 AB
Condition factor	1.76± 0.008 B	1.81±0.055 B	1.89±0.097 AB	2.35±0.06 A

Note: Different letters in same rows mean significant differences ($p<0.05$).

Discussion

Medical plants can be used as growth and immunity stimulants in aquaculture (Kirubakaran *et al.*, 2010). *L. officinalis* is a plant medicine of the Lamiaceae family that has long been used for antibacterial, antifungal, and antidepressants (Nikfarjam *et al.*, 2017). *L. officinalis* EO contains monoterpenes (1–3%). The main components are linalinal acetate (30–55%), linalinal acetate (20–35%), beta-ocimine, cineol, camphor, sesquiterpene, caryophyllene oxide, tannin, rosmarinic acid derivatives, coroma and flavonoids (Denner, 2009). The results of the experiment showed that LEON nutritional supplement levels had a positive impact on the growth and use of common carp foods, as well as the hemodynamic and immune parameters.

Some drugs cause the stimulation of appetite and pancreatic glands, the secretion of digestive enzymes, and the improvement of digestion (Nobakht *et al.*, 2013). Herbs and their derivatives, such as natural production, can control digestive activity and limit the colonization of pathogenic and non-pathogenic bacteria in fish's intestines. This can improve food use efficiency, enhance growth performance, and improve feed efficiency (Raverter, 2014).

Evaluation of hemodynamic parameters is a tool for promoting fish health management (Chen et al., 2004) which can help diagnose anemia, toxicity, infectious diseases, and food shortages in aquatic animals (Fazio *et al.*, 2003). The study showed that RBC, Hct, Hb, and MCH were increased in 200 ml/kg LEON, indicating the positive effect of higher LEON concentrations. In this respect, the intake of LEON supplement products with 200 mg/kg Echinacea purpurea leaf extract demonstrated significant improvements in hemoglobin indexes such as RBC and Hb after 60 days of feeding studies (Akbary and Kakoolaki, 2019).

This study observed that the level of lavender essential oil in the diet affects the growth and effectiveness of the utilization of common meat. High levels of lavender essential oil in the diet have increased growth. These observed differences in growth and fcr were consistent with the results observed by Chari and colleagues (2020). Farsani *et al.* (2019), 2% of Coriander seeds (*C. sativum*) were found to significantly increase the SGR value, final weight (FW), and condition factor (CF) of *O. mykiss*. Similarly, fish fed with *S. lavandulifolia* extracts of 2% and 8% had the highest weight, SGRs, and average daily growth (Moghanlou *et al.*, 2018).

Conclusion

According to our results showed that lavender essential oil had significant effect on the physiological, biological, and nutritional parameters of common carp. Lavenderlavender essential oil could be used to feed common carp in aquaculture.

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تأثير زيت اللافندر على أداء النمو والصفات الدموية في الكارب الاعتيادي (*C. Carpio*)

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المستخلص

دُرس تأثير زيت اللافندر الأساسي (LEO) على النمو والصفات الدموية والحيوية لأسماك الكارب الاعتيادي. تم توزيع إجمالي 108 أسماك صحية في 12 خزاناً بلاستيكياً على أربع معاملات في ثلاث مكررات. تمت تغذية الأسماك بنظام غذائي يتكون من 0، 1 مل، 2 و 4 مل/كجم من LEO لمدة 60 يوماً. أظهرت النتائج أن WG وSGR قد زادا بشكل ملحوظ عند مستويات مختلفة من LEO (P <.05). تم العثور على أعلى نسبة WG في (T4) و4 مل/كجم من LEO وSGR تم العثور عليها في (T3) 2 مل/كجم من LEO من LEO. في المقابل، انخفض معدل FCR مع زيادة المكملات الغذائية من LEO وكانت هناك اختلافات معنوية (P <0.05)، لـ (Hgb، Mch وWbc). ومع ذلك، لم تكن هناك فروق ذات دلالة إحصائية لـ (RBC، MCHC، PLT، MCV، الحبيبات، الخلايا الليمفاوية وحيدات الخلية) في معاملة LEON مقارنة بالسيطرة (P <.05). وأخيرا، كانت هناك فروق معنوية في الصفات الحيوية باستثناء مؤشر الكبد ومؤشر الطحال. بشكل عام، أظهرت النتائج التي توصلنا إليها بشكل مثير للاهتمام أن تأثير النظام الغذائي التكميلي للزيت كان له تأثير إيجابي ومعنوي على بعض الصفات الحيوية للنمو ودم الكارب الاعتيادي.

الكلمات المفتاحية: الكارب الاعتيادي، النمو، هيماتولوجى، اللافندر، البيوكيميائية

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