Iran. J. Ichthyol. (Special Issue 1, 2022): 161-165

P-ISSN: 2383-1561; E-ISSN: 2383-0964
http://www.ijichthyol.org

Research Article

The effect of dietary supplementation of *Mentha piperita* (Lamiaceae) and *Eruca vesicaria* subsp. *sativa* on some biochemical traits and intestinal bacterial content in broilers

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Abstract

The current study was performed to evaluate the effects of dietary supplementation of *Mentha piperita* (Lamiaceae) (MPLP) and *Eruca vesicaria* subsp. *sativa* (EVSP) powder on some biochemical traits and microbial content of intestines in broilers. A total of 600 referenced broiler chicks were used in this study from 1-45 days of old (duration of the experiment). The sixty chicks were randomly distributed into three groups (20 chicks per group); the MPLP group was received 2% MPLP per Kg of diet, the EVSP group 2% EVSP per Kg of diet), and the control group a normal diet. At the end of the experiment, six blood samples and six intestinal content samples were collected from six birds of each group. The aspartate aminotransferase (AST), alanine aminotransferase (ALT), alkaline phosphatase (ALP), glucose, cholesterol, triglycerides, protein, and urea were evaluated in the blood samples of all groups. The intestinal-content bacterial-count (ICBC) of the total bacteria, coliforms, and lactobacilli was recorded for each group. The findings showed significant improvements in the levels of the tested enzymes in the EVSP group. The MPLP and EVSP groups showed a significant decrease in the serum glucose, cholesterol, and triglycerides, and significant increases in the total serum protein. However, the blood urea levels were significantly higher in the EVSP while were significantly lower in the MPLP. For the ICBC, both treatment groups showed significant decreases in the total bacteria, coliforms, and lactobacilli when were compared with those from the control group. The present study showed promising effects of *M. piperita* and *E. vesicaria* in enhancing the performance of broilers with less bacterial contents.

Keywords: Broilers, Chickens, Eruca, Mentha, Poultry.

Citation: Al-Zuhairi, Z.A.; Alethari, I.A.M. & Khudair, M.A. 2022 The effect of dietary supplementation of *Mentha piperita* (Lamiaceae) and *Eruca vesicaria* subsp. *sativa* on some biochemical traits and intestinal bacterial content in broilers. Iranian Journal of Ichthyology 9(Special issue 1, 2022): 161-165.

Introduction

Human population growth has led to the need for animal food production. Broiler farming is predicted to solve the shortfall in animal protein worldwide (Hatab et al. 2019; Kpomasse et al. 2021). Poultry production has faced many problems that endanger the broiler's performance, such as high climate temperature, which can induce certain health concerns, e.g., increased reactive oxygen species (ROS). Some plant leaves may provide excellent sources for enhancing the broiler performance, perhaps due to their anti-ROS materials (Rahimi et al. 2020). In addition, some nutrients found in food have medicinal value and may be utilized to cure or prevent various illnesses. A common name for these nutrients is nutraceutic, a combination of nutrition and pharmaceutics. The potential therapeutic benefits of nutraceuticals, as well as their safety, have drawn a lot of interest. On the other hand, Nutraceuticals may be safer and free of side effects since they are made from natural ingredients. Glucosinolates (GLSs) and flavonoids are two of the

most studied classes of nutraceutical chemicals (Gugliandolo et al. 2018).

Mentha is a genus of the Lamiaceae family, which its plants have the strong aromatic and widely dispersed, with simple, distinctive leaves emitting a delightful scent. The *Mentha* contains 42 species and 15 hybrids, and it is quite complex, containing numerous variants and cultivars (Salehi et al. 2018). The hybrids have been developed from *M. arvensis* L., *M. spicata* L., *M. aquatica* L., and *M. longifolia* (L.) species. The majority of the hybrids are sterile but may be reproduced because of their incredibly spreading rhizome. These plants are perennial and utilized for essential oil manufacturing in USA, Iran, China, and India. Fresh and dried parts from the *Mentha* are frequently utilized for various purposes such as flavoring food and medicines and in pharmaceuticals and cosmetics (Tafrihi et al., 2021).

Commercially significant crops such as *Eruca vesicaria* subsp. *sativa* known as rockets are grown throughout the world. It is customary to eat the leaves raw in salads for their particular spicy and peppery flavors. These plants are highly rich in GLS, having medicinal effects (Bell et al. 2017; Bell & Wagstaff 2019). The current study was conducted to evaluate the effects of dietary supplementation of *M. piperita* (MPLP) and *E. vesicaria* (EVSP) on some biochemical traits and microbial content of intestines in broilers.

Materials and Methods

Broilers, experimental design, and sample collection: The experiment was conducted in a commercial broiler farm in Al-Diwaniyah City, Iraq. A total of 600 referenced broiler chicks were used from 1-45 days old for the experiments. The birds were fed a starter diet from day one to day-21, which then was replaced by a finisher diet from day-22 until the end of the experiment. The ingredients of both diets are shown in Table 1. The feed was purchased from local markets and provided to the birds as *ad libitum* way.

The sixty chicks were randomly categorized into three groups (20 chicks per group); the MPLP group was received 2% MPLP per Kg of diet, the EVSP 2% EVSP per Kg of diet, and the control group a normal diet. After the end of the experiment, six blood samples (in anti-coagulant-based tubes) and six intestinal content samples (in sterile containers) were collected from six birds of each group. The blood samples were further processed by centrifuging at 3000rpm/min for 15min to separate the serum and kept in a fridge for further analyses. The aspartate aminotransferase (AST), alanine aminotransferase (ALT), alkaline phosphatase (ALP), glucose, cholesterol, triglycerides, protein, and urea were evaluated in the blood samples of all groups. The intestinal-content bacterial count (ICBC) of the total bacteria, coliforms, and lactobacilli was recorded for each group.

Statistical analysis: The data were analyzed by SPSS (v24). The mean of the results was compared using One-Way ANOVA and presented as mean±SE. The tests were considered as significant if P was less than 5%.

Results

The results of the blood samples revealed significant (P<0.05) improvements in the levels of the measured enzymes, which only were observed in the EVSP group (Table 2). The MPLP and EVSP groups showed significant (P<0.05) decreases in the serum glucose, cholesterol, and triglycerides, and increases in the total serum protein (P<0.05). However, the blood urea levels were significantly (P<0.05) higher in the EVSP while were significantly (P<0.05) lower in the MPLP than the control group (Table 3). For the ICBC, both treatments showed significant (P<0.05) decreases in the total bacteria, coliforms, and lactobacilli compared with those from the control group (Table 4).

Discussion

The performance, growth, and carcass quality in the broiler industry face different challenges decreasing their quality, leaving the birds disposed to diseases,

Table 1. Components of the starter and finisher diets in the current experiment.

Ingridents	Starter (%)	Finisher (%)
Yellow corn	65	73
Soybean	31	23
Premix *	3	3
Limestone	0.7	0.7
Salt	0.3	0.3
Total	100	100
Crude protein%	22	19.2
Metabolic energy kilo calories / kg feed	2950	3152.2
Fat	2.8	3.8
Ash	3	4.8
Fiber	2.5	2.5
Calcium	0.9	0.79
Phosphorus	0.5	0.5
Lysine	1	0.1
Methionine	0.5	0.4

The chemical composition of the diets was calculated according to NRC feed analysis. The plant leafs were cleaned up for getting the best purity and then crushed using an electric crusher.

Table 2. Levels of liver function enzymes of birds supplemented with *Mentha piperita* (Lamiaceae) powder or *Eruca vesicaria* subsp. sativa powder**.**

Groups / Parameter	Control	MPLP	EVSP
AST	1.02±0.05[a]	1.05±0.02[b]	98±0.08[c]
ALT	10.6 ±0.05[a]	13.06±0.05[b]	9.25±0.03[c]
ALP	32.4±0.03 a	35.6±0.05[a]	28.2±0.04[c]

consequently leading to low meat grade or high mortalities (Souza et al. 2016). The current study showed that the liver function enzymes were lower in the EVSP group due to its antioxidants that help remove the ROS, enhancing the broiler performance. The quality of life may be affected by the quality of food eaten and how much they eat. Research on cruciferous vegetables shows that fruits and vegetables may help reduce the risk of diseases like rocket that contains a variety of health-improving phytochemicals, such as fibers, carotenoids, polyphenols, vitamin C, and GLs (Villatoro-Pulido et al. 2012).

By hydrolyzing GLs due to the action of myrosinases, a range of biologically active degradation metabolites can be generated. Plant nutrition and growth development are both affected by these products. GLs affect the health and the prospective value of plants. Sulforaphane, a degradation-resulted product that belongs to isothiocyanates (ITCs) and generated from the hydrolysis of GLs may be mostly involved in the beneficial properties of cruciferous vegetables (Villatoro-Pulido et al. 2012). In in vitro and in vivo studies, SF has been the most extensively studied ITC, resulting from the degradation process of GL glucoraphanin. The antioxidant and anti-inflammatory characteristics of glucoraphanin and sulforaphane safeguard the cardiovascular system by reducing oxidative stress, improving lipid profiles, and lowering blood pressure. Clinical investigations have shown that sulforaphane has bacteriocidal and chemoprotective benefits in people with *Helicobacter pylori* (Villatoro-Pulido et al., 2012;

Table 3. Levels of some blood parameters of birds supplemented with *Mentha piperita* (Lamiaceae) powder or *Eruca vesicaria* subsp. sativa powder.

Groups / Parameter	Control	MPLP	EVSP
Glucose	215±0.25[a]	194±0.26[b]	185±28[c]
Cholesterol	160±0.22[a]	135±0.25[b]	126±21[c]
Protein	7.35±0.04[a]	8.19±0.05[c]	8.49±0.04[b]
Triglyceride	80.67±0.23[a]	75.62±0.26[b]	74.43±0.02[c]
Urea	55.19±0.38[a]	52.65±0.49[b]	59.67±0.43[c]

Table 4. Intestinal bacterial content of birds supplemented with *Mentha piperita* (Lamiaceae) powder or *Eruca vesicaria* subsp. sativa powder.

Groups / Parameter	Control	MPLP	EVSP
Total bacteria	6.29±0.05[a]	5.94±0.03[b]	5.83±0.04[c]
Coliform	12.32±0.01[a]	11.2±0.02[b]	10.8±0.07[c]
Lactobacilli	5.18±0.02[a]	4.93±0.03[b]	4.78±0.02[c]

Zappia et al. 2019).

Our results agree that these metabolites can help improve the lipid profile, which was seen in the EVSP group. These indications of such improvement in the liver function enzymes and lipid profile provide evidence for better glucose metabolism and blood levels. Hetta et al. (2017) found that the EVSP extracts enhance the glucose metabolism in the liver, muscle, and adipose cell lines and suggested that it could be due to the fatty acid contents of this plant. In the current study, the same activities found for the EVSP were also reported for the MPLP. Park et al. (2019) showed that *Mentha* species have anti-oxidant activities with about 89% compared to those from ascorbic acid (93%). However, the MPLP revealed effects in increasing liver function enzymes, indicating hepatotoxicity events. This detrimental effect may occur due to the impacts of some components of these leaves, and that was reported for other species of *Mentha*, such as *M. piperita* and *M. pulegium*, which contain pulegone which can be degraded into menthofuran, both considered as hepatotoxic compounds (Douros et al. 2016; Gürbüz 2020; Tafrihi et al. 2021).

For the intestinal bacterial contents, both MPLP and EVSP demonstrated influential activities in decreasing the bacteria present in the intestines of the treated birds could be due to the antibacterial activity of the essential oil that helps eliminate the bad bacteria such as *E. coli* (Saba & Anwar, 2018; Ansari et al. 2022; Bokov et al. 2022).

Conclusion

The present study shows promising effects of *M. piperita* (Lamiaceae) powder, especially *E. vesicaria* subsp. *sativa* powder enhances broilers' performance with less bacterial contents of their intestine, leading overall health of the birds and consumers.

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