



Effect of Thyme Essential Oil on Serum Lipid Profile and Renal Function in *Meleagris gallopavo*

Fouzia Dahmani^{1,2}, Karima El-Mouhdi^{3,4*}, Hajar El Omari^{3,4}, Fatima El Kamari⁵, Amina Chlouchi^{6,7}, Anjoud Harmouzi⁸, Mouna Essadki⁹, Mohammed Piro¹⁰, Abdelfettah C. Benabdallah¹¹, Mohammed Ibriz¹

¹Laboratory of Plant and Animal Production and Agro-Industry, Faculty of Sciences, Ibn Tofail University, Kenitra, Morocco

²Ministry of Health and Social Protection, Higher Institute of Nursing and Health Techniques, Fez, Morocco

³Ministry of Health and Social Protection, Higher Institute of Nursing and Health Techniques, Meknes, Morocco

⁴Natural Resources Management and Development Team, Laboratory of Health and Environment, Faculty of Sciences, Moulay Ismail University, Meknes, Morocco

⁵Laboratory of Natural Substances, Pharmacology, Environment, Modeling, Health and Quality of life, Faculty of Sciences Dhar EL Mahraz, Sidi Mohamed Ben Abdellah University, Fez, Morocco

⁶National Higher School of Chemistry Kenitra, IUT, Morocco

⁷Laboratory of Natural Resources and Sustainable Development, Ibn Tofail University, Kenitra, Morocco

⁸Organic chemistry, catalysis and environment laboratory, Sciences Faculty, Ibn Tofail University, Kenitra, Morocco

⁹Ministry of Education, Qualifying Secondary School Teacher, Morocco

¹⁰Agronomic and Veterinary Institute IAV Hassan I, Morocco

¹¹Fez Veterinary Practice, Morocco

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ABSTRACT

Currently, aromatic plants and their extracts have become an interesting area of research as a means of improving animal health and productivity. This study aimed to evaluate the effect of thyme essential oil (thymol) on key metabolic functions in turkeys. Twenty (20) wild female turkeys (*Meleagris gallopavo*) aged 16 days were used for the study. The animals were divided into two groups of 10 turkeys each. Group 1 (control) were fed with the normal diet, while group 2 (treatment) had thyme essential oil added to their diet, and administered for 30 days. The body weights of the animals were monitored throughout the treatment duration. After the treatment period, renal function parameters and serum lipids were evaluated. The average weight of the animals in the treatment group was 1420 g, which was twice as high as that of the control (690 g). Supplementation of poultry diet with thyme essential oil reduced serum levels of total cholesterol (2.76 ± 0.08 g/L), triglycerides (1.90 ± 0.52 g/L), urea (3.91 ± 0.95 g/L), and creatinine (1.68 ± 0.61 g/L), compared to the control group which had higher serum total cholesterol (5.15 ± 0.46 g/L), triglycerides (4.93 ± 0.95 g/L), urea (8.75 ± 2.25 g/L), and creatinine (6.45 ± 0.56 g/L). The present study highlighted the beneficial effect of thyme essential oil by improving serum biochemical parameters in turkeys. Therefore, the use of thyme essential oil in poultry feed should be encouraged in order to improve poultry health and productivity.

Keywords: Metabolic function, Essential oils, Thyme, Thymol, Serum parameters, Turkeys

Introduction

Today, the emergence of public health problems associated with antibiotic-resistant bacteria has prompted the scientific community to develop natural alternatives as growth promoters in animal feed.¹ Consumers are increasingly concerned not only with the nutritional value of food but also with its benefits for animal and human health. As a result, the use of natural extracts is essential in the development of components that can be added to animal diets to provide health-promoting benefits.²

*Corresponding author. E mail: k.elmouhdi@ispitsmeknes.ac.ma
Tel: +212 618-320461

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In this context, aromatic plants and their extracts have been an interesting choice for scientific research as a means of improving animal health and productivity³ and as a safe alternative to antibiotics.⁴ In fact, studies have shown that essential oils improve poultry production and have cholesterol-lowering, coccidiostatic, and anti-inflammatory effects.⁵⁻⁸ In addition, their role in supporting metabolic functions and their effect on biological functions and regulatory mechanisms in severe and chronic diseases has been demonstrated in several studies.⁹⁻¹² Similarly, laboratory experiments have demonstrated the antimicrobial activity of essential oils, particularly *Thymus vulgaris* (thyme) essential oil, whose main component is thymol,^{13,14} to reduce the negative effects of antibiotics, protect and improve the health of consumers.¹⁵⁻¹⁷ In this regard, Mousavi and colleagues have claimed that phytochemical essential oils improve gut health indices in laying hens.¹⁸ However, variable results have been reported on their effects on overall broiler productivity.^{19,20} Studies have also shown the therapeutic effects of thyme on skin ulcers caused by leishmaniasis in rats, and also as a traditional herbal treatment to combat the insect vectors that transmit leishmaniasis, providing antimicrobial, antioxidant, and insecticidal activities.²¹⁻²⁶ Since the 1990s, several studies have been carried out on the effects of essential oils on the zootechnical performance of poultry especially

broilers and laying hens by optimizing and promoting the use of nutrients and general state of health.^{3,5}

In terms of global poultry production, turkeys are second only to broilers,³ but there is limited study on the role of phytochemical products as a new feed additive in turkey production. The available studies show that the use of phytochemical products in turkey diets is promising because, in addition to their performance benefits, they can also act as antioxidants.³ Against this background, the rearing of *Meleagris gallopavo* turkeys as a wild bird has made significant progress in recent years. This is partly due to the turkey's high growth rate, high weight, and developed muscle mass, which provides high-quality meat at low cost.²⁷

The importance attached to poultry and the improvement of its meat quality through natural products is a major challenge for the industry and the scientific community. Therefore, the present study was carried out to evaluate the effect of thyme essential oil (thymol) on the main metabolic functions particularly cholesterol, triglycerides, urea, and creatinine of *Meleagris gallopavo* turkeys. The results of this study will be of great importance in the field of aromatherapy, in terms of the rational use of aromatic natural products, and in the field of veterinary medicine, in terms of improving the general well-being of turkeys and protecting animal and human health.

Materials and Methods

Thyme essential oil (Thymol)

The thyme-based essential oil was donated by the Laboratory of Molecular Biology of Bacterial and Fungal Diseases at the Faculty of Science in Fez. The certification of the different components of the essential oil shows that thymol is the main component of thyme and oregano essential oils.^{11,28}

Animals and Treatment

A total of 20 female *Meleagris gallopavo* turkeys (meat type) aged 16 days were obtained from the animal house, Plant, Animal Production and Agro-Industry Laboratory, Faculty of Science, Ibn Tofail University, Kenitra, Morocco. The animals were divided into two groups of 10 animals each. Group 1 which served as the control group received the normal diet, while group 2 (treatment group) received thyme essential oil (mixed with the diet) for 30 days (d16 - d47). Administration of thyme essential oil, monitoring of the turkeys, and collection of blood samples were the responsibility of the veterinarian. It should be noted that all the turkeys were in good health throughout the study period.

Determination of serum biochemical parameters

The serum biochemical parameters evaluated included total cholesterol (TC), triglycerides (TG), creatinine (CRT), and urea (UREE). Blood samples were collected in dry 10 mL glass tubes. The serum was separated from the cells by centrifugation. Twenty (20) blood samples and 40 serum samples were prepared and stored at -20°C, from which were performed 160 biochemical analyses using commercial kits. The serum concentration of each parameter was determined according to the manufacturer's protocol. The assays were performed using the colorimetric kinetic technique and absorbance readings were taken using a spectrophotometer.

Determination of total cholesterol

Serum cholesterol was determined by an enzymatic method using cholesterol esterase and cholesterol oxidase. Cholesterol esters are first hydrolyzed by esterase to free cholesterol, and then the free cholesterol is oxidized to cholestenone with the production of hydrogen peroxide.

Determination of triglycerides

After enzymatic hydrolysis and oxidation, the triglycerides present in the sample form a coloured complex which can be quantified spectrophotometrically. The indicator, quinone imine, is formed from hydrogen peroxide, 4-amino-antipyrine and chlorophenol under the

action of peroxidase. The absorbance of the coloured complex formed was measured at a wavelength of 546 nm.

Determination of creatinine

The creatinine in the samples was measured by the Jaffé reaction.²⁹ Creatinine reacts with picrate in an alkaline medium to form a colored complex which can be quantified spectrophotometrically at 492 nm.

Determination of urea

This was done using the urease method. The urea present in the blood is decarboxylated by an enzyme called urease, which is specific for urea in aqueous media. The action of the mixture of salicylate and sodium hypochlorite on the ammonium ion formed in the presence of nitroprusside produces a green coloured indophenol which can be quantified spectrophotometrically at 630 nm.

Ethical approval

This work complied with all regulations and ethical standards in force at the Moroccan Ministry of Agriculture, as well as international ethical standards (European Union Directive 2010/63/EU) and the ARRIVE (Animal Research Reporting of *In Vivo* Experiments) guidelines.

Statistical Analysis

Data were expressed as Mean \pm Standard Deviation (SD). Data were analysed using one-way analysis of variance (ANOVA). Significant differences between means were set at P-value less than 0.05 ($P < 0.05$).

Results and Discussion

Effect of thyme essential oil on the body weight of turkeys

After 30 days of monitoring, the average weight of the control group was 690 g, while the weight of the treatment group was 1420 g (Table 1). This shows that the administration of thyme essential oil increased the body weight of turkeys. Therefore, thyme essential oil can be used to improve meat production in poultry especially in turkeys.

Effect of thyme essential oil on the lipid profile of turkeys

The lipid profile evaluated in this study focused mainly on total cholesterol and triglycerides. The results of the biochemical analysis revealed a mean value of 5.15 ± 0.46 g/L for total cholesterol and a mean value of 4.93 ± 0.95 g/L for triglycerides before the administration of thyme essential oil. After administration of the oil, total cholesterol and triglyceride levels were measured as a function of time. The results of the analysis revealed a remarkable decrease in the cholesterol level to a value of 2.76 ± 0.08 g/L and in the triglyceride level to a value of 1.90 ± 0.52 g/L (Table 2).

In addition, the results showed that the administration of thyme essential oil altered the serum lipid profile (total cholesterol and triglycerides). This suggests that addition of thyme essential oil (thymol) to turkey feed could protect against arteriosclerosis due to hyperlipidemia. Thyme has also been reported to significantly reduce cholesterol and triglycerides levels in quail.³⁰ Studies have shown the beneficial effect of essential oils on the reduction of total cholesterol and triglycerides in the blood of poultry, particularly broilers.³¹ Other research has reported that the administration of certain diets rich in essential oils to growing broilers had a significant effect on cholesterol reduction.^{32,33}

Table 1: Effect of thyme essential oil on the body weight of turkey

Group	Body Weight (g)	
	Mean	Standard Deviation
1 (Control)	690.00	25.00
2 (Treatment)	1420.00	73.33

Table 2: Effect of thyme essential oil on lipid profile and renal function in turkeys

Values in g/L	Lipid Profile				Renal function			
	Cholesterol		Triglycérides		Creatinine		Urea	
	Treatment	Control	Treatment	Control	Treatment	Control	Treatment	Control
Minimum	2.64	4.67	1.43	4.06	1.87	1.97	105	58
Maximum	2.88	5.73	2.68	6.59	21.40	12.50	105	130
Mean	2.76	5.15	1.90	4.93	1.68	6.45	3.91	8.75
Median	2.78	5.10	1.92	5.32	0.61	6.11	105	94
Standard deviation	0.08	0.46	0.52	0.95	0.61	0.56	0.95	2.25

Also, studies have shown that extracts of plants such as thyme, rosemary, and sage have a reducing effect on the quality of egg yolk,³⁴ cholesterol and triglyceride levels in serum.^{35,36} Similarly, the extracts of thyme and garlic have been shown to reduce serum and yolk cholesterol in broilers.³⁷ Supplementation with thyme and rosemary extracts has been shown to contribute to the reduction in triglyceride levels, while cholesterol levels were reduced only by thyme-based supplementation.³⁸

The work of Saied *et al* and other scientists have shown the cholesterol-lowering effect of thyme oil and essential oils in broilers, quails and laying hens.³⁹⁻⁴¹

A reduction in total cholesterol and triacylglycerol concentrations was also observed in calves fed with diet supplemented with thyme or oregano essential oils.⁴² Similar results have been reported in poultry, such as quail⁴³ and broilers.⁴⁴

Lipid metabolism is mainly regulated by the active ingredients in thyme essential oil, thymol, and carvacrol. These substances have been shown to inhibit the activity of hydroxymethylglutaryl-coenzyme A reductase, a key enzyme that regulates the biosynthesis of endogenous cholesterol.⁴⁵ The ability of the active components of thyme to reduce serum triglycerides levels may be linked to the stimulation of lipoprotein lipase activity, as research using other plants has shown.⁴⁶

Effect of thyme essential oil on renal function in turkeys

The results of the analysis of biochemical parameters of renal function before the administration of thyme essential oil revealed a mean creatinine value of 6.45 ± 0.56 g/L and a mean urea value of 8.75 ± 2.25 g/L. However, after the administration of thyme essential oil, the mean creatinine level in the turkey population was found to decrease significantly to a value of 1.68 ± 0.61 g/L ($P < 0.05$), while the urea level also decreased significantly to 3.91 ± 0.95 g/L ($P < 0.05$) (Table 2).

The results of the renal function test suggest that the addition of thyme essential oil to turkey feed has a beneficial effect in reducing creatinine levels. Creatinine is a good marker of renal function, it is routinely tested by veterinary surgeons, particularly in the diagnosis, prognosis, and monitoring of renal failure. In renal failure, these two biochemical parameters (creatinine and urea) increase in parallel in a staggered fashion, with the increase in urea occurring earlier.⁴⁷

The isolated increase in urea is due to a decrease in renal perfusion and is often secondary to hypovolaemia.⁴⁷ Studies on broilers treated with thyme essential oil showed that in the 3rd and 5th weeks, the serum creatinine concentration did not change significantly.⁴⁸ In addition, studies on quail showed that in the groups given thyme essential oil, serum creatinine levels were low.⁴⁰ However, previous studies on broilers have shown that serum urea was not affected by thyme essential oil supplementation.⁴⁹⁻⁵¹

The observed reduction in renal function biomarkers, namely; creatinine and urea may be attributed mainly to the antioxidant properties of thyme which, like other plants in the Labiatae family, is a rich source of phenolic substances: phenolic acids (mainly rosmarinic acid) and flavonoids. The active compounds in thyme could have anti-inflammatory properties and increase the activity of phase I and phase II xenobiotic detoxification enzymes, which would also promote hepatoprotection.⁵²

In summary, to the best of our knowledge, this is the first study on the evaluation of the effect of thyme essential oil on the metabolic functions of turkeys. The results of the present study show that thyme essential oil has a beneficial effect on improving biochemical parameters in *Meleagris gallopavo* turkeys. Thus, our study suggested the possibility of including natural sources of antioxidants such as thyme in turkey feed to improve their health, productivity and nutritional value of their meat.

Conclusion

The results of the present study have shown that serum biochemical parameters, particularly lipid and renal function parameters were significantly reduced on supplementation of turkey feed with thyme essential oil. Lower serum levels of total cholesterol (2.76 ± 0.08 g/L), triglycerides (1.90 ± 0.52 g/L), urea (3.91 ± 0.95 g/L), and creatinine (1.68 ± 0.61 g/L) were observed in the treatment group compared to the control group, in which the serum biochemical parameters were higher: total cholesterol (5.15 ± 0.46 g/L), triglycerides (4.93 ± 0.95 g/L), urea (8.75 ± 2.25 g/L), and creatinine (6.45 ± 0.56 g/L). This therefore suggests that the addition of thyme essential oil to turkey feed has a positive effect in improving the metabolic functions and health of *Meleagris gallopavo* turkeys.

Conflict of Interest

The authors declare no conflict of interest.

Authors' Declaration

The authors hereby declare that the work presented in this article is original and that any liability for claims relating to the content of this article will be borne by them.

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