**Effects of oregano essential oil in poultry**

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1. **Τίτλος μελέτης: *The usefulness of oregano and its derivatives in poultry nutrition***

*(Published: September 2018)*

***World's Poultry Science Journal, Vol. 74***

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**Περίληψη:** Η επίδραση του εκχυλίσματος ριγανελαίου οφείλεται στα **βιοενεργά συστατικά** του, όπως η θυμόλη και η καρβακρόλη, τα οποία δρουν συνεργιστικά. Το ριγανέλαιο έχει πολλαπλές επιδράσεις στα πουλερικά: Δρα ως **αντισπασμωδικός, διουρητικός, αντιμικροβιακός (βακτηριοκτόνο, μυκητοκτόνο και ιοκτόνο), αντιπαρασιτικός και ανοσοδιαμορφωτικός παράγοντας** όταν συμπεριλαμβάνεται στην τροφή τους. Η σωστή χρήση εκχυλίσματος οριγανελαίου συμβάλει στην **καλύτερη ανάπτυξη και υγεία** των πουλερικών.

**Abstract:** *Origanum vulgare* is a natural, less toxic, residue free feed supplement for poultry when compared to other synthetic ingredients. It contains key bioactive components, including as thymol and carvacrol. *O. vulgare* as a poultry feed supplement has had an antimicrobial, antioxidant, antiviral, immunomodulatory and antiparasitic effect. The potential advantages of utilising oregano extracts, in poultry diets include improved feed intake and feed conversion, enhanced digestion, expanded productive performance, down-regulated disease incidence and economic losses. From the available literature, average inclusions of oregano essential oil up to 600 mg/kg in broiler diets increased body weight gain. Using 1% oregano oil in broiler diets improved feed conversion ratio and feed utilisation. Moreover, oregano can induce a marked improvement on the intestinal microbiota and ileal villus height of broilers when combine with attapulgite by ratio 15 mg/kg of oregano. Broilers fed 300 ppm oregano oil in their diet display higher IgG titres relative to those reared on control (without supplementation) diet. Including 240 mg oregano supplementation per kg diet appears to give an optimum level for protecting broiler chickens from *C. perfringens* infections. Bioactive components extracted from *O. vulgare* parts could be used in poultry diets levels of 10 to 30 g/kg. This review includes information on the use of *O. vulgare* and its derivatives in poultry nutrition. To maximise the overall productivity of poultry, oregano may be used as a natural alternative to antibiotics and drugs due to the absence of side effects and residues.

**Conclusions:** The reviewed trials demonstrated overall that oregano extracts used as feed supplements can be used as an effective growth promoter as a natural alternative to drugs. In addition, oregano and its derivatives have antioxidant, growth promoting, antimicrobial, and immunostimulant impacts in poultry production. The antioxidant benefits of oregano and its bioactive components may protect the quality of meat and its derivatives. These effects showed that oregano extracts could enhance efficient growth and health in poultry. Overall, oregano can be supplemented from 10-30 g/kg diet, while its essential oils should be limited to 500 mg/kg diet for best performance and health.

# **Τίτλος μελέτης: *Antioxidative effect of oregano supplemented to broilers in oxidative stability of poultry meat***

*(Published: 28 April 2008)*

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**Περίληψη μελέτης:** Τα αποτελέσματα της μελέτης έδειξαν **αυξημένο βάρος σφαγίου**, στο δείγμα που είχε τραφεί με πρόσθετο ριγανελαίου (0.05% οριγαν./kg τροφής).Ακόμη, η προσθήκη εκχυλίσματος ριγανελαίου είχε **θετική επίδραση στην καθυστέρηση της οξείδωσης των λιπών** σε σχέση με το δείγμα ελέγχου (μάρτυρας) (P < 0.05). Η μελέτη έρχεται σε συμφωνία με άλλες παρόμοιες ( Florou-Paneri et al., Govaris et al.), που δείχνουν ότι η προσθήκη ελαίου ρίγανης σε ζωοτροφές γαλοπούλας και, μετά τη σφαγή, σε αλεσμένο κρέας, **αυξάνει τη σταθερότητα της οξείδωσης των λιπών**. Τέλος, το αιθέριο έλαιο ρίγανης **καθυστερεί την οξείδωση των λιπιδίων** σε μέρη των πουλερικών, όπως ο μαστός και ο μηρός, κατά τη διάρκεια της αποθήκευσης σε συνθήκες ψύξης.

**Summary:** Effect of oil extract of oregano supplemented in diet, on growth and oxidative stability of poultry meat was studied. Broiler chickens fed with addition of oregano achieved higher weight (2563 ± 140 g) in comparison with control group (2462 ± 195 g). Oxidative processes were investigated as changes of malondialdehyde content in breast and thigh meat after 0, 3, 6, and 12 months of storage at -21 °C. Partition of defrost samples was stored at chilling conditions (4 °C) during 12 hours, ground and thermally treated at 80 °C during 15 minutes, to observe antioxidative effect of added oregano oil in poultry meat after thermal treatment. Results showed that oregano essential oil was more effective in delaying lipid oxidation compared to the control diet at all time points. Thigh meat was more susceptible to lipid oxidation compared to breast meat (P < 0.05). Same effects of oregano extract were observed in meat after warm heating (P < 0.05).

# **Τίτλος μελέτης: *Essential oils in poultry nutrition: Main effects and modes of action***

*(Published: 9 March 2010)*

***Animal Feed Science and Technology***

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**Περίληψη μελέτης:** Η παρούσα μελέτη αφορά τη συλλογή, αξιολόγηση και παρουσίαση των επιστημονικών πληροφοριών σχετικά με τη χρήση των αιθέριων ελαίων, συμπεριλαμβανομένου και του ελαίου ρίγανης, ως πρόσθετα στην τροφή των πουλερικών και τις επιδράσεις αυτών. Μεταξύ άλλων, αναφέρει πως το Origanum vulgare είναι γνωστό για τις **αντιοξειδωτικές** του **ιδιότητες** και συμβάλει δραστικά στην **καθυστέρηση της οξείδωσης του λαρδιού**. Υπεύθυνοι παράγοντες για τη δράση αυτή είναι η καρβακρόλη και η θυμόλη. Ο συγγραφέας παραθέτει πολλαπλές έρευνες (Cervato et al., 2000; Abdalla and Roozen, 2001; Damechki et al., 2001; Martinez-Tomé et al., 2001; Vichi et al., 2001; Bendini et al., 2002) που παρουσίασαν το ριγανέλαιο ως **αντιοξειδωτικό παράγοντα**. Η χρήση του σε ζωοτροφές πουλερικών έδωσε δείγματα κρέατος με **μεγαλύτερη οξειδωτική σταθερότητα** συγκριτικά με τα δείγματα ελέγχου (μάρτυρες).

**Abstract:** Antimicrobial compounds produced bymicroorganisms have been used for decades in poultry diets to increase performance and decrease morbidity particularly in broiler chickens. However, consumer pressure related to the potential development of antibiotic-resistant bacteria has resulted in the development of non-antibiotic feed additives that may also improve broiler performance. In recent years, aromatic plants and their extracts have received attention as growth and health promoters. It is known that most of their properties are due to the essential oils (EOs) and other secondary plant metabolites. EOs enhance production of digestive secretions, stimulate blood circulation, exert antioxidant properties, reduce levels of pathogenic bacteria and may enhance immune status. The purpose of this paper is to provide an overview of the published data on the potential of EOs and their components in poultry nutrition, and to describe their possible modes of action. The current knowledge on potential antagonistic and synergistic effects is presented and areas for future research are proposed.

**Conclusions:** The increasing pressure on the livestock industry to reduce or eliminate feed-antibiotics as growth enhancers has initiated new research to find safe and efficient alternatives. This new generation of feed additives includes herbs and EOs. The beneficial effects of most herbs, spices and their bioactive compounds have been recognised since antiquity and their properties reported in foods and experimental animals. A wide range of plants contain bioactive compounds which have the potential to act as multifunctional feed supplements for animals. Some extracts from common herbs and spices are reported to have multiple actions in monogastric animals including effects on performance, the oronasal somatosensing and the digestive systems, lipid metabolism, prevention of tissue oxidation and modulating microbial populations. Therefore the effect of EOs may not only be confined to the microbiota, but may extend to peripheral chemosensing and animal metabolism. A better knowledge of the mechanism of action and effects of individual compounds would be useful to formulate mixtures of compounds to optimize efficacy.

# **Τίτλος μελέτης: *Potential of essential oils for poultry and pigs***

*(Published: 10 January 2018)*

***Animal Nutrition***

**Ίδρυμα:** DSM (China) Animal Nutrition Research Center, Bazhou 065799, China

**Μελετητές:** Zhai, H., et al.

**Περίληψη μελέτης:** Σύμφωνα με τους μελετητές, η αυξανόμενη πίεση για μείωση της χρήσης των αντιβιοτικών, μπορούν να οδηγήσουν σε αυξανόμενη χρήση αιθέριων ελαίων στον τομέα της ζωικής παραγωγής. Στο άρθρο, μεταξύ άλλων παρουσιάζεται και το αιθέριο έλαιο ρίγανης. Οι φαινόλες (καρβακρόλη και φαινόλη) συνιστούν το 80% της περιεκτικότητας του ριγανελαίου και είναι γνωστές για τις **αντιοξειδωτικές** τους **ιδιότητες**. Τέλος, οι μελετητές προτείνουν πεδία έρευνας σχετικά με τα αιθέρια έλαια, καθώς θεωρούν πως οι ενδείξεις για τα οφέλη υπάρχουν αλλά η αποτελεσματικότητα τους δεν έχει αποδειχθεί πλήρως ακόμα.

**Abstract:** The increasing pressure of abolishing and/or decreasing the use of antibiotics as antimicrobial growth promoters for livestock calls for alternative solutions to sustain the efficiency of current livestock production. Among the alternatives, essential oils have a great potential and are generally considered natural, less toxic, and free from residues. Essential oils have been proven in numerous in vitro studies to exert antimicrobial effects on various pathogens. The current review touched on the basics of essential oils, and the in vivo effects of essential oils on growth, intestinal microflora, anti-oxidation, immune functionality, meat qualities as well as the possible modes of action in poultry and pigs, and the future research areas were proposed.

**Conclusions:** The success of essential oils depends on whether our knowledge of their actions is based on a solid scientific ground. This review shows that the positive effects of essential oils on the growth performance of poultry and pigs exist both abundantly and controversially, which makes the speculated underlying mechanisms further questionable. Firstly, more attention should be paid to dietary characteristics and experimental environments, and the description of the tested essential oils should be stricter. The description of the starting materials and extraction methods cannot guarantee the stable chemical composition of essential oils in animal trials, which should be further disclosed by analytical methods. These analytical results are essential for congregating the animal trial results and reconciling the conclusions. Secondly, the metabolism of essential oils should be better understood, which could cast light on the chemical forms and the locales in the animal body for the essential oils per se or their derivative metabolites to present themselves, and consequently to connect to their declared benefits. Lastly, the evidence for the link between essential oils and animal health is not robust yet. Anecdotal evidence and in vitro studies could not warrant the in vivo effects of essential oils. The direct effects on gut microflora and the indirect effects via the gutassociated immune system should be further explored.

# **Τίτλος μελέτης: *Essential Oils as a Feed Additive in Poultry Nutrition***

*(Published: 31 October 2013)*

***Advances in Animal and Veterinary Sciences .2***

**Ίδρυμα:** Division of Animal Nutrition, Division of Bacteriology and Mycology, Division of Parasitology, Division of Veterinary Surgery and Radiology, Division of Veterinary Pharmacology and Toxicology, Division of Veterinary Virology, Division of Extension Education, IVRI, Izatnagar, Department of Animal Nutrition, Veterinary College and Research Institute, Namakkal, India

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**Περίληψη μελέτης:** Οι μελετητές, στην παρούσα εργασία, εκτιμούν πως στο εγγύς μέλλον τα αιθέρια έλαια θα έχουν καθοριστικό ρόλο στη διατροφή των πουλερικών, αντικαθιστώντας τη χρήση αντιβιοτικών, ως φυσικά πρόσθετα. Η έρευνα των Hernadez et al. (2003) σε ζωντανά κοτόπουλα, έδειξε ότι ένα μείγμα αιθέριων ελαίων κανέλας, πιπεριού και ρίγανης **βελτίωσε την πεπτικότητα** στα κοτόπουλα που έλαβαν συμπληρωματική τροφή σε σύγκριση με τα κοτόπουλα που τράφηκαν με τροφή ελέγχου χωρίς το μείγμα. Επιπροσθέτως, το αιθέριο έλαιο ρίγανης έχει **υψηλή αντιοξειδωτική δράση** (Cervato et al., 2000, Dorman et al., 2003) και ενισχύει την οξειδωτική σταθερότητα ζωικών προϊόντων που περιέχουν λίπος όπως το κρέας και τα αυγά. Τέλος, οι συγγραφείς παραθέτουν πως, σύμφωνα με τους Lee and Ahn (1998), η καρβακρόλη της ρίγανης έχει **αντιμικροβιακές**, **αντιοξειδωτικές** και **αντισηπτικές ιδιότητες**.

**Abstract:** The increased awareness and concern over the antibiotic residues in animal and poultry products among the consumers made the hour a prime time to find an alternative to antibiotic growth promoters (AGPs) and it have increased a lot over the past decade. One such alternative is the essential oils (EOs) which are derived from various plants as secondary metabolites. Essential oil usage in animal feeding has been practiced for their role as antibacterial, antiviral, antifungal, antioxidant, digestive stimulant, immunomodulator, hypolipidemic agent and also heat stress alleviator. They had been successfully used as a dietary antibiotic replacer without residues. They not only act as an in vivo anti-oxidant for the animal but also exert its anti-oxidant action to prolong the shelf life of the feed in which it is incorporated and the meat which is obtained from the animal fed with essential oils. The lean meat produced by essential oil supplementation through the poultry diet reduces the risk of hyperlipidemia in the consumers. The results being favorable as an alternative to antibiotics, spur the researchers to exploit the role of essential oil mixtures as a feed additive. Nowadays, essential oils are used in the ruminant experiments as an agent to reduce the rate of methanogenesis thereby traffics the organic molecules for efficient energy synthesis. Hence, various studies have been carried out across the globe with possible combinations and cocktail of these oils or the crude extracts of their active principles to explore the multifaceted caliber of these feed additives. The expanding horizons in the research on essential oils are expected to pull the curtain down for the extensive use of antibiotics as feed additives. In the near future the role of essential oils in the poultry feeding will play a huge role in the industry development.

**Conclusions:** The antimicrobial activities of essential oils have been well documented while its toxicological effects are seen only at very high doses. The antioxidant and hypocholesterolemic effects have been studied in chickens. The characteristic flavour and stimulation of digestive process of essential oils might play role in poultry performance, however, it requires further studies. The hypolipidemic and immunomodulatory properties of these oils are gaining more interest among the poultry industrialists. The antioxidant property of these oils provides an effective protection against the drip loss during the prolonged low temperature storage which increases the acceptance among the consumers and reduces the loss for the meat processors. To conclude, the essential oils in the poultry diet could be used as an alternative to antibiotics, growth performance and value added products – low cholesterol meat, tenderness, green eggs, etc. Its role in improving the keeping quality and durability of raw as well as processed meat and nutraceutical property is also gaining importance. In the near future, it is expected that essential oils will play a huge role in the poultry industry development.

# **Τίτλος μελέτης: *The effect of oregano essential oil (Origanum vulgare L.) on broiler performance***

*(Published: 2010)*

***Lucrări Ştiinţifice - vol. 53, Seria Zootehnie***

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**Μελετητές:** Lenuţa Fotea, Elena Costăchescu, G. Hoha, Doina Leonte

**Περίληψη μελέτης:** Οι ερευνητές, μελέτησαν την επίδραση διαφορετικών ποσοτήτων αιθέριου ελαίου ρίγανης με ομαδοποίηση (groups) και διερεύνηση σε κρεατοπαραγωγικά κοτόπουλα. Παρατήρησαν ότιη χρήση ριγανελαίου είχε **θετική επίδραση σε κάθε δείγμα** κοτόπουλων, συγκριτικά με το δείγμα ελέγχου (μάρτυρας). Πιο συγκεκριμένα, η προσθήκη ποσότητας ριγανελαίου σε ποσοστό 1%, έδωσε **βελτιωμένο ημερήσιο βάρος** κατά 5% και 4% **αυξημένο λόγο μετατροπής ζωοτροφής** (κατά προσέγγιση), σε σύγκριση με το *group* ελέγχου. Η μελέτη, δείχνει ότι το αιθέριο έλαιο ρίγανης μπορεί να χρησιμοποιηθεί ως **«υποστηρικτής» φυσικής ανάπτυξης των πουλερικών**.

**Abstract:** Beneficial effects of botanical additives in farm animal may arise from activation on feed intake and digestive secretions, imune stimulation, antibacterial, coccidiostatical, antihelmintical, antiviral or antiinflamatory activity. This study was conducted in order to determine the use of oregano oil in broiler nutrition as a natural growth promoting substances instead of antibiotics. Different levels of oregano oil added to standard diet, to determine its effect on weight gain, daily weight gain, and feed conversion ratio compared to control group. Two hundred day-old broilers (Ross-308) were divided into groups of fifty chicken each, and randomly assigned to based diet. Experimental groups were as follow: LM control group without additive, L1 a 0.3% oregano oil group, L2 a 0.7% oregano oil group, L3 a 1% oregano oil group. The highest weight gain was observed on the L3 (2484 g), and followed by L2 (2463 g), L1 (2401 g) and LM (2365 g). The addition of oregano oil on the diets improved daily live weight by approximatley 1.5% (L1), 4.1% (L2) and 5% (L3) compared to the control group. As a general conclusion from all groups with oregano results were better than the group without, but the addition of 1% oregano oil to the diet improved feed conversion ratio by approximatley 4 % compared to the control group. In conclusion the results show that essential oil of Origanum vulgare L. culd be considered a potential natural growth promoter for poultry.

**Conclusions:** Studies carried out in the past 5 years on the use of aromatic and spicy medicinal herbs in broilers’ feed have extended. All groups that received oregano oil had better results than the control group. The main conclusion was that the use of these plants as powder and of the extracted essential oils determine a high growing performance and a very good feed conversion. The addition of 1% oregano oil to the diet was improved daily live weight by 5% and feed conversion ratio by approximatley 4 % compared to the control group. The research shows that the essential oregano oil may be considered a as a potential natural growth promoter for poultry.

# **Τίτλος μελέτης: *Essential oil and aromatic plants as feed additives in non-ruminant nutrition: a review***

*(Published: 2015)*

***Journal of Animal Science and Biotechnology***

**Ίδρυμα:** State Key Laboratory of Animal Nutrition, Ministry of Agriculture Feed Industry Centre, China Agricultural University, Beijing 100193, China

**Μελετητές:** Zhaikai Zeng, Sai Zhang, Hongliang Wang and Xiangshu Piao

**Περίληψη μελέτης:** Οι συγγραφείς, στην παρούσα εργασία, μελέτησαν την επίδραση των αιθέριων ελαίων ως πρόσθετα στην τροφή πουλερικών και χοίρων. Υπάρχουν σημαντικές ενδείξεις για την αποτελεσματικότητα του αιθέριου ελαίου ρίγανης. Με τη χρήση του παρατηρήθηκε **καλύτερη υγεία** σε κοτόπουλα, **μείωση του *E. Coli* και του *C. perfringens***, και **ισχυρή βακτηριοκτόνο δράση** έναντι του *Lactobacili* Μεγαλύτερη, ίσως, επίδραση μπορεί να εμφανιστεί με τον συνδυασμό του ριγανελαίου με άλλα πρόσθετα, όπως άλλα αιθέρια έλαια, προβιοτικά, πρεβιοτικά και οργανικά οξέα. Στο μέλλον, εικάζουν οι συγγραφείς, η συνεργιστική δράση των αιθέριων ελαίων με άλλα συστατικά μπορεί να αντικαταστήσει την, απαγορευμένη στην Ε.Ε., χρήση αντιβιοτικών κατά την παραγωγή πουλερικών.

**Abstract:** This paper summarizes the current knowledge regarding the possible modes of action and nutritional factors involved in the use of essential oils (EOs) for swine and poultry. EOs have recently attracted increased interest as feed additives to be fed to swine and poultry, possibly replacing the use of antibiotic growth promoters which have been prohibited in the European Union since 2006. In general, EOs enhance the production of digestive secretions and nutrient absorption, reduce pathogenic stress in the gut, exert antioxidant properties and reinforce the animal’s immune status, which help to explain the enhanced performance observed in swine and poultry. However, the mechanisms involved in causing this growth promotion are far from being elucidated, since data on the complex gut ecosystem, gut function, in vivo oxidative status and immune system are still lacking. In addition, limited information is available regarding the interaction between EOs and feed ingredients or other feed additives (especially pro- or prebiotics and organic acids). This knowledge may help feed formulators to better utilize EOs when they formulate diets for poultry and swine

**Conclusions:** The search for alternatives to antibiotics has generated considerable interest in recent years. The new generation of feed additives includes herbs and essential oils, and their beneficial effects for animal production have been well documented [2]. Although most of the latest research has noted the major components and original sources of EOs in vivo trials, only a few papers have identified the quantity of the principle components present. In addition, Brenes and Roura [41] argued that minor components present are critical to the activity of EOs and may have a synergistic influence. Sometimes the minor components may counteract the exerted effects. Therefore, in the future, the detailed constituents of EOs are needed to be determined in order to assess their different biological effects. In this way, it may be possible to compare different EO products and formulate mixtures that optimize their efficacy.

# **Τίτλος μελέτης: *Essential oils in broiler nutrition***

*(Published: 2002)*

***\*Dissertation\****

**Ίδρυμα: *Utrecht University Repository***

**Μελετητής:** Kyung-Woo Lee

**Περίληψη μελέτης:** Στην παρούσα διατριβή, ο ερευνητής, μελέτησε την επίδραση των αιθέριων ελαίων κατά την ανατροφή κρεατοπαραγωγικών κοτόπουλων. Το κύριο συστατικό, στο οποίο οφείλεται η αντιμικροβιακή δράση του ριγανελαίου είναι η καρβακρόλη. Αναφέρει, επίσης, πως υπάρχουν ενδείξεις για αντιοξειδωτική δράση του αιθέριου ελαίου ρίγανης. Ωστόσο, με την πλειονότητα των μελετών να είναι in-vitro, ο συγγραφέας θεωρεί πως τα αιθέρια έλαια είναι πιθανό να αντικαταστήσουν τη χρήση αντιβιοτικών και προτείνει να μελετηθεί η πιθανή συνεργιστική δράση αιθέριων ελαίων και η επίδραση τους στα ζώα.

**Abstract:** Dietary antibiotics at low, subtherapeutic levels have been shown to improve growth performance in farm animals. However, there is a trend to look for alternatives to dietary antibiotics, due to occurrence of antibiotic-resistance bacteria. The present thesis explored the essential oils as the possible alternative to dietary antibiotics. An essential oil is a mixture of fragrant, volatile compounds derived from the aromatic plant. Dietary feed additives based on essential oil components are marketed to enhance growth performance and health. It is claimed that under practical conditions dietary essential oil components improve digestion and stimulate feed intake, and consequently raise growth performance. However, the effect of essential oils on animal performance has not been proved in a controlled study. The aim of this study was to evaluate the role of essential oils as the possible alternatives to antibiotics in poultry nutrition. Female broiler chickens were used as an animal model to study the effect of essential oils on growth performance, activities of digestive enzymes, macronutrient digestion and lipid metabolism. Furthermore, experiments were carried out to test whether dietary essential oil components could either counteract anti-nutrient effect of carboxymethylcellulose (CMC) or rye. Finally, the possible synergistic effects of individual essential oil components were tested in relation to growth performance when chickens were fed on a diet containing CMC. The literature review describes the general biological activities of essential oils. Dietary essential oils can have several useful biological properties, e.g., acting as antimicrobial substance and antioxidants, and being hypocholesterolemic, affecting flavor, and stimulating the digestion process. Their metabolic pathways have been well elucidated, and based on that observation, it was suggested that their side effects are unlikely. Due to a limited number of controlled studies on the effect of essential oil components on growth performance in broiler chickens, an experiment was conducted to describe the effect of thymol, cinnamaldehyde and a commercial preparation of essential oil components (CRINA® Poultry) on growth performance, digestive enzyme activities and macronutrient digestibilities. Corn-soybean meal based diet was used to prepare the experimental diets and chicks were housed in wire-bottomed cages. It was shown that no effect of essential oil components on any of parameters monitored in female broiler chickens was observed, but it can not be excluded that positive effects would have been observed under less hygienic environmental conditions or when using a less digestible diet. However, in this study dietary cinnamaldehyde significantly lowered water intake without affecting growth performance. Consequently, dry matter contents of excreta were higher in birds fed diet containing cinnamaldehyde. The observed cinnamaldehyde-induced reduction of spontaneous water intake could be commercially interesting. In subsequent studies, we further screened dietary carvacrol, and β-ionone as potential feed additives in female broiler chickens. Furthermore, we tested the alleged hypocholesterolemic effect of dietary essential oil components when the chickens were fed either cholesterol-free or cholesterol-rich diets. It was found that dietary carvacrol lowered feed intake and weight gain, but also lowered the feed:gain ratio. The carvacrol effect on feed:gain ratio could relate to increased efficiency of feed utilization and/or altered carcass composition. Unfortunately, carcass composition of the chickens was not analyzed. Carvacrol lowered plasma triglyceride concentrations, but did not affect plasma cholesterol. Dietary β-ionone failed to affect growth performance and the plasma lipid profile, irrespective of whether the diet was cholesterol free or rich in cholesterol. The question then addressed was whether dietary essential oils (thymol, cinnamaldehyde, CRINA® Poultry) could antagonize the negative effect of CMC on growth performance in broilers. Intestinal viscosity was increased by CMC inclusion, but was not lowered by dietary essential oils. However, addition of cinnamaldehyde and CRINA® Poultry to the CMC diet tended to counteract the negative effect on growth performance. Fat digestibility was reduced by CMC, but cinnamaldehyde and CRINA® Poultry partially relieved the CMC-induced inhibition of fat digestion. This study indicates that cinnamaldehyde and CRINA® Poultry, but not thymol, may antagonize the negative effect of CMC on growth performance which may relate to improving fat digestibility. In following study, we observed whether dietary essential oil components, i.e., thymol, cinnamaldehyde and CRINA® Poultry could have effects on growth performance, fat digestibility, and intestinal viscosity in female broiler chickens fed on rye. Feeding rye to chicken lowered weight gain, elevated intestinal viscosity and reduced fat digestibility. Addition of dietary cinnamaldehyde to rye diet partially counteracted rye-suppressed weight gain in female broiler chickens. However, intestinal viscosity and fat digestion were not modified by dietary cinnamaldehyde. The partial counteraction of dietary cinnamaldehyde on rye-induced growth depression seemed to be mediated by concomitant increase in feed intake, however underlying mechanisms remain unknown. It would expect that a mixture of essential oil components could act synergistically on growth performance. Carvacrol and cinnamaldehyde were selected based on earlier studies. In addition, CMC was included to enhance treatment contrasts. Individual components when supplemented to the CMC diet had no apparent effects on growth performance. On the other hand, a mixture of carvacrol and cinnamaldehyde added to CMC diet significantly impaired growth performance of the chickens. This latter study suggests that a certain combination of two or more essential oil components can impair growth performance of chickens when birds are fed a diet with the soluble fiber, CMC. It is generally concluded that dietary essential oil components have potential to improve performance of broiler chickens. However, the consistently alleged hypocholesterolemic effects of dietary essential oil components were not observed. Based on the present work, future studies with dietary essential oil components should focus on identifying synergistic effects of different essential oil components and their application to animal production.

**Conclusions:** Dietary antibiotics at low, subtherapeutic levels have been shown to improve growth performance in farm animals. However, there is a trend to look for alternatives to dietary antibiotics, due to occurrence of antibiotic-resistance bacteria. The present thesis explored the essential oils as the possible alternative to dietary antibiotics. An essential oil is a mixture of fragrant, volatile compounds derived from the aromatic plant. Dietary feed additives based on essential oil components are marketed to enhance growth performance and health. It is claimed that under practical conditions dietary essential oil components improve digestion and stimulate feed intake, and consequently raise growth performance. However, the effect of essential oils on animal performance has not been proved in a controlled study. The aim of this study was to evaluate the role of essential oils as the possible alternatives to antibiotics in poultry nutrition. 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# **Τίτλος μελέτης: *Effect of dietary supplementation with oregano essential oil on performance of broilers after experimental infection with Eimeria tenella***

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**Περίληψη μελέτης:** Οι συγγραφείς μελέτησαν την επίδραση του αιθέριου ελαίου ρίγανης ως συμπλήρωμα στη διατροφή κοτόπουλων (ηλικία: 14 ημέρες), μετά την πειραματική τους μόλυνση με Eimeria tenella. Σύγκριναν την επίδραση του αιθέριου ελαίου με αυτή της αντικοκκιδιακής λασαλοσίδης. Η μελέτη έδειξε πως το ριγανέλαιο έχει **αντικοκκιδιακή δράση**, όταν συγκρίθηκε με το δείγμα ελέγχου. Ωστόσο, είχε μικρότερη δράση σε σχέση με τη λασαλοσίδη. Εν κατακλείδι, οι ερευνητές θεωρούν πως μπορεί, στο μέλλον, να υπάρξει διατροφή χωρίς κοκκιδιοστατικά συστατικά και προτείνουν περαιτέρω μελέτες για την επίδραση του ριγανελαίου στην αντιμετώπιση της κοκκιδίωσης.

**Abstract:** A study was carried out to examine the effect of dietary supplementation of oregano essential oil on performance of broiler chickens experimentally infected with Eimeria tenella at 14 days of age. A total of 120 day-old Cobb-500 chicks separated into 4 equal groups with three replicates each, were used in this study. Two groups, one infected with 5104 sporulated oocysts of E. tenella and the other not, were given a basal diet and served as controls. The other two groups also infected with E. tenella were administered diets supplemented with oregano essential oil at a level of 300 mg/kg, or with the anticoccidial lasalocid at 75 mg/kg. Following this infection, survival rate, bloody diarrhoea and oocysts excretion as well as lesion score were determined. Throughout the experimental period of 42 days, body weight gain and feed intake were recorded weekly, and feed conversion ratios were calculated. Two weeks after the infection with E. tenella supplementation with dietary oregano oil resulted in body weight gains and feed conversion ratios not differing from the noninfected group, but higher than those of the infected control group and lower than those of the lasalocid group. These parameters correspond with the extent of bloody diarrhoea, survival rate, lesion score and oocyst numbers and indicated that oregano essential oil exerted an anticoccidial effect against E. tenella, which was, however, lower than that exhibited by lasalocid.

**Conclusions:** The results of the present study suggest that oregano essential oil exerts an anticoccidial effect against E. tenella, but less than that exhibited by lasalocid. Under the trade name Ecodiar, oregano oil is an appetite enhancer for poultry and pigs and approved as feed additive by the European legislation. Until now, there is no restriction or advisable withdrawal time for Ecodiar in food producing animals. However, the bioavailablility of the major phenolic constituents of oregano oil deposited in broiler meat cannot be directly demonstrated, since currently no analytical methods have been developed for the quantification of such residues in meat. The hypothesis of rearing broilers without coccidiostats (Ekstrand et al., 1994) appears to be of promise for further investigations on a large scale. Further studies are needed to investigate the activity of different incorporation levels of oregano oil and its efficacy against different Eimeria species.

# **Τίτλος μελέτης: *Oregano essential oil in the diet of broilers: performance, carcass characteristics, and blood parameters***

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**Περίληψη μελέτης:** Στην παρούσα εργασία, οι συγγραφείς μελέτησαν την επίδραση διαφορετικών ποσοτήτων αιθέριου ελαίου ρίγανης (300 mg OEO/kg, 600 mg OEO/kg, 900 mg OEO/kg) στα κρεατοπαραγωγικά κοτόπουλα. Παρατήρησαν ότι σε περιεκτικότητα 900 mg OEO/kg **το κοιλιακό λίπος μπορεί να αυξηθεί** **σε ανεπιθύμητα επίπεδα**. Επίσης, δεν παρατηρήθηκε αύξηση στο σωματικό βάρος μετά την πρόσθεση ριγανελαίου στη διατροφή των κοτόπουλων. Ωστόσο, τα αιθέρια έλαια μπορεί να έχουν **σημαντικό αντίκτυπο στον ρυθμό μετατροπής της ζωοτροφής** καιστη **σταθεροποίηση των μικροβιακών πληθυσμών**. Μπορεί, ακόμη, να **αυξήσει την απορρόφηση των θρεπτικών συστατικών**. Τέλος, σε συγκέντρωση 300 mg/kg, το ριγανέλαιο μπορεί να χρησιμοποιηθεί σε δίαιτες κρεατοπαραγωγής κοτόπουλων ως φυτογενές πρόσθετο, ειδικά **σε δίαιτες που δεν περιλαμβάνουν αντιμικροβιακές ουσίες**.

**Abstract:** Efficacy of the phytogenic feed additive oregano essential oil (OEO) (Origanum vulgare L.) was assessed as an alternative to an antibiotic as a growth promoter (AGP) in broiler diets. Three hundred male broiler chicks were assigned to five treatments, which consisted of diets with different levels of OEO (300, 600, and 900 mg/kg of diet), a negative control, and a positive control. Broiler performance was evaluated from 1 to 21 and 1 to 39 days old. From 1 to 39 days old, the broilers of the negative control group presented lower feed intake than those fed OEO300. No significant effect was observed on weight gain. The greatest feed conversion ratio occurred in the positive control group. Broilers treated with OEO300 had greater carcass yield than those in the positive control group. The haemogram, leukogram, and heterophil/lymphocyte ratio were positively influenced by OEO300. Red blood cell and leukocyte counts increased in a dose-dependent manner in broilers fed OEO-supplemented diets, while broilers in the positive control group had the lowest levels of haematocrit, mean corpuscular haemoglobin concentration, and plasma protein. Differential leukometry revealed lymphocyte numbers were increased with OEO treatment and reduced in the positive control group. For hepatic and renal metabolism, the broilers in the positive control group exhibited the greatest serum activities of aspartate aminotransferase, alanine aminotransferase, gamma-glutamyl transferase, and alkaline phosphatase. Although more studies on its efficacy are needed, OEO at 300 mg/kg may be used as a phytogenic additive in broiler diets, especially those without AGP.

**Conclusions:** Broilers treated with OEO displayed a stimulated immune system, while broilers treated with 300 mg OEO/kg of diet presented values within the reference range. The use of OEO in the diets did not harm the performance and carcass characteristics of broilers. At a concentration of 300 mg/kg, OEO can be used in broiler diets as a phytogenic additive, especially in diets without antimicrobial performance enhancers.

# **Βιβλιογραφία**

1. Alagawany, M., et al. "The usefulness of oregano and its derivatives in poultry nutrition." *World's Poultry Science Journal* 74.3 (2018): 463-474.
2. Marcinčák, Slavomír, et al. "Antioxidative effect of oregano supplemented to broilers on oxidative stability of poultry meat." *Slov Vet Res* 45.2 (2008): 61-66.
3. Brenes, Agustín, and E. Roura. "Essential oils in poultry nutrition: Main effects and modes of action." *Animal feed science and technology* 158.1-2 (2010): 1-14.
4. Zhai, Hengxiao, et al. "Potential of essential oils for poultry and pigs." *Animal Nutrition* 4.2 (2018): 179-186.
5. Gopi, Marappan, et al. "Essential oils as a feed additive in poultry nutrition." *Adv. Anim. Vet. Sci* 2.1 (2014): 1-7.
6. Fotea, Lenuţa, et al. "The effect of oregano essential oil (Origanum vulgare L) on broiler performance." *Lucrări Ştiinţifice Seria Zootehnie* 53 (2010): 253-256.
7. Zeng, Zhaikai, et al. "Essential oil and aromatic plants as feed additives in non-ruminant nutrition: a review." *Journal of animal science and biotechnology* 6.1 (2015): 1-10.
8. Lee, Kyung-Woo. *Essential oils in broiler nutrition. Diss. Uttrecht University, 2002*
9. Giannenas, Ilias, et al. "Effect of dietary supplementation with oregano essential oil on performance of broilers after experimental infection with Eimeria tenella." *Archives of Animal Nutrition* 57.2 (2003): 99-106.
10. Eler, G., et al. "Oregano essential oil in the diet of broilers: performance, carcass characteristics, and blood parameters." *South African Journal of Animal Science* 49.4 (2019): 753-762.