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Chemical Composition and Biological Activities of oregano (*Origanum vulgare*) Essential Oil

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Abstract: *Essential oils are increasingly investigated as phytogenic alternatives to conventional feed additives because they may simultaneously modulate microbial load, oxidative status, and intestinal health. In this study, oregano (Origanum vulgare) essential oil was chemically characterized and evaluated for its biological potential as a natural candidate for broiler nutrition. Gas chromatography–mass spectrometry revealed a carvacrol-dominant profile, with carvacrol (71.29%) as the major constituent, followed by o-cymol (5.84%), γ-terpinene (5.63%), β-caryophyllene (3.73%), β-linalool (3.16%), thymol (1.87%), eucalyptol (1.49%), and camphor (1.14%). Antimicrobial activity, assessed by broth microdilution against Escherichia coli, Salmonella Typhimurium, Listeria monocytogenes, and Clostridium perfringens, showed inhibitory activity at 7.5 µg/mL for all tested strains, indicating broad-spectrum antibacterial efficacy. Antioxidant evaluation by the DPPH assay demonstrated strong radical-scavenging capacity (78.17 ± 0.02% at 0.074 mg/mL). In contrast, anti-inflammatory screening based on erythrocyte membrane stabilization and inhibition of albumin denaturation suggested only limited protective activity under the tested conditions. In conclusion, oregano essential oil displayed a favorable functional profile driven mainly by its antimicrobial and antioxidant activities, supporting further investigation as a natural feed additive for poultry gut health and performance optimization.*

Keywords: antimicrobial activity; antioxidant capacity; carvacrol; enteric pathogens; phytobiotics.

• Introduction

Poultry production has been identified as a significant contributor to the emergence of antimicrobial-resistant (AMR) bacteria, leading to a global trend of banning or restricting antibiotic use in many countries .

• Material and method

The analysis of the OEO was performed by Gas Chromatography-Mass Spectrometer (GC-MS) with a Thermo Electron system.

The antimicrobial activity of OEO was evaluated *in vitro* using a broth microdilution method.

The antioxidant capacity of oregano essential oil a stock methanolic solution was prepared by dissolving 1ul of essential oil with 10 mL of methanol (Sigma–Aldrich; Merck KGaA, Darmstadt, Germany).

• Results and discussions

CHEMICAL PROFILE OF OEO

Carvacrol emerged as the most abundant constituent, representing 71% of its chemical content. This was followed by o-Cymol, which accounted for 5.84%, gamma-terpinene at 5.62%, beta- Caryophyllene at 3.73% and beta- Linalool 3.16 %.

Table 1. Main volatile constituents of OEO identified by GC-MS analysisd

Oregano EO	Mean (%)	sdv
o-Cymol	5.840	0.020
Eucalyptol	1.486	0.005
gamma.-Terpinene	5.627	0.023
beta.-Linalool	3.164	0.007
Thymol	1.867	0.009
Carvacrol	71.28	0.073
beta-Caryophyllene	3.734	0.005
Other compounds	7.002	0.007

ANTIMICROBIAL ACTIVITY OF OEO

OEO has potential antibacterial activity against all of the tested pathogens, with the strongest response observed against Gram-negative strains under the tested conditions.

The strongest inhibition was observed at higher OEO concentrations, particularly against *E. coli* and *S. Typhimurium*, whereas growth inhibition exceeded 90% at 2000-4000 µg/mL.

Table 2 Optical density and relative growth inhibition of bacterial pathogens exposed to OEO

OEO concentration (µg/mL)	*E. coli* OD540 / inhibition (%)	*S. Typhimurium* OD540 / inhibition (%)	*L. monocytogenes* OD540 / inhibition (%)	*C. perfringens* OD540 / inhibition (%)
4000	0.094 / 91.2	0.093 / 91.6	0.135 / 71.7	0.101 / 79.2
2000	0.101 / 90.6	0.108 / 90.2	0.146 / 69.4	0.110 / 77.3
1000	0.183 / 82.9	0.118 / 89.3	0.169 / 64.6	0.117 / 75.9
500	0.188 / 82.5	0.130 / 88.2	0.192 / 59.7	0.169 / 65.2
250	0.230 / 78.5	0.167 / 84.8	0.268 / 43.8	0.197 / 59.4
125	0.295 / 72.5	0.205 / 81.4	0.296 / 37.9	0.217 / 55.3
62.5	0.362 / 66.2	0.495 / 55.0	0.322 / 32.5	0.263 / 45.8
31	0.389 / 63.7	0.627 / 43.1	0.341 / 28.5	0.269 / 44.5
15	0.399 / 62.8	0.734 / 33.3	0.358 / 24.9	0.321 / 33.8
7.5	0.466 / 56.5	0.823 / 25.2	0.373 / 21.8	0.392 / 19.2
Positive control	1.072 / 0.0	1.101 / 0.0	0.477 / 0.0	0.485 / 0.0

ANTIOXIDANT CAPACITY

The antioxidant activity according to DPPH assay of OEO is represented in Table 3. Our results showed that OEO neutralized DPPH free radicals by 78.17 ± 0.02% at 0.074 mg/mL equivalent to 0.0074% w/v, while ascorbic acid, used as the positive control, showed 91.13 ± 0.06% inhibition at 0.016 mg/mL equivalent to 0.0016% w/v.

Table 3. Antioxidant activity of OEO

Sample	Concentration	DPPH free radical neutralization activity (%)
Oregano (*Origanum vulgare*)	0.074 mg/ml	78.17±0.02
Ascorbic acid	0.016 mg/ml	91.13 ± 0.06

• Conclusions

OEO effectively inhibited the growth of bacterial pathogens confirming his potential use as natural antimicrobials in broiler feed. Additionally, OEO demonstrated an efficient antioxidant capacity over suggesting an enhanced potential in combating oxidative stress in poultry.