Chapter 20

Effect of Essential Oils as Natural Alternatives and Antioxidants for the Growth of Poultry Broilers

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ABSTRACT

Poultry farming is important in today's food security issues and is crucial for economic development. Intensive production methods in the poultry industry necessitate the use of antibiotics, raising concerns about animal welfare. In this study, we investigate the potential of essential oils (EOs) as natural substitutes for antibiotic growth promoters (AGPs) in broiler production. This exploration aims to harness the power of EOs as a potentially transformative solution, moving beyond antibiotics towards a more sustainable and ethical approach to broiler growth. We also read about the essential oil extraction techniques and their different disadvantages. We explore the various applications of EOs, such as their antifungal, antiviral, antioxidant, and antibacterial activities. We discuss how these characteristics help broilers' immune systems, intestinal health, and disease resistance. Furthermore, we examine the impact of EOs on growth performance parameters like feed conversion ratio, body weight, and meat quality. Finally, we'll see about the urgent research needed to refine the use of EOs in poultry diets. This will optimize their effectiveness and ensure the safety of this promising alternative to antibiotics.

KEYWORDS
Growth promoters, Extraction, Growth, Promoters, Antioxidant, Poultry

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INTRODUCTION

Poultry farming is a critical driver of livestock worldwide, enhancing the GDP of developing countries like Pakistan. It also leads to the fulfillment of nutrition and economic growth of a country (Gulilat et al., 2021). Poultry farming, as a cornerstone of animal husbandry, is necessary for economic development. It is a source of increased income for farmers in the agriculture sector (Wu et al., 2022). Poultry products are nutritious and appetizing at the same time (Tajima et al., 2023). The poultry industry has grown tremendously because of increased prepared chicken products catering to the demand of working individuals (Barbut et al., 2022). A huge number of birds are killed and consumed annually to meet their high demands of consumption (Ayalew et al., 2022). Poultry meat is also the cheapest halal protein source preferred by people (Paputunganet al., 2020). Broiler farming delivers chicken meat production requirements to large consumer populations Wilcox et al., 2023). Broiler meat is the most favored white meat, liked by every culture and religion, is low in fat, and is an economical source of protein (Ramukhithi et al, 2023). The quality of the broiler meat is judged based on its parts, such as breasts, thighs, and drumsticks (Kuźniacka et al., 2014).

Being one of the largest industries in the world, in itself comes with a lot of challenges. The most significant challenges facing poultry are health and environmental hazards in large intensive production systems (DR Korver, 2023). The root of the problem lies in the high bird density and intensive nature of production (Gržnić et al., 2023). The unique gut system of chickens and their microbes demand close attention to gut health for maximum and optimal nutrient absorption (Wickramasuriya et al., 2022). Many chemicals are used to improve gut health, increase the growth rates in poultry, and prevent infections. Antibiotics are the most used worldwide to improve feed conversion efficiency (Samad, 2022).

Antibiotic Growth Promoters (AGPs)

Antibiotic growth promoters have been tremendously used in the poultry industry generating a wealth of associated literature. Its use has mounted public concern (Cardinal et al., 2020). AGPs used at the sub-therapeutic level are used for bird productivity rather than for treating some diseases (Abd El-Hack et al., 2022). Feed and meat residues of AGP are the greatest threat to humans (Sapsuha et al., 2021) but AGPs have also helped in the growth of animals by 4 mechanisms: (1) decline sub-clinical infections (2) enhanced nutrient availability (3) improved nutrient uptake (4) improvement in the intestinal environment (Rahman et al., 2022) but antibiotic resistance has been a significant issue regarding AGP use.

AGP Alternatives Used in Poultry

There has been a growing application of AGP alternatives such as pre-biotics, pro-biotics plant extracts, and organic acids as part of the trend towards natural solutions (Oluwafemi et al., 2020). The demand for poultry products raised without antibiotics is increasing. Producers have to follow the demand and ensure that they address animal welfare concerns by using AGP alternatives (Rahman et al., 2022).

Organic acids have no residue problems and improve the digestibility of nutrients and minerals in poultry. Examples include short and medium-chain fatty acids (Aljumaah et al., 2020). OAs decrease the pathogen population by reducing the pH of the gut (Scicutella et al., 2021). OAs also require a lot of research in application in poultry as different conditions need to be assessed for their application (Melaku et al., 2021).

The use of probiotics in poultry production, for example, involves mechanisms of very complicated reactions (Hassan et al., 2018). Probiotics are the normal intestinal micro-flora given in proper concentrations exogenously. It doesn't have as much negative impact as antibiotics (Krysiak et al., 2021). Several studies reveal that probiotics are thought to increase body weight by reducing FCR, and can ward off necrotic enteritis. Peng et al. (2016) claimed that *L. plantarum* supplementation improved the growth of broiler chickens previously colonized with *E. coli* in the cecum. Therefore, *L. plantarum* supplementation increased populations of lactic acid bacteria in the cecum (Sapsuha et al., 2021). Another experiment carried out by Ferdous et al. in 2021 shows that probiotics increase body weight by stimulating gut bacteria, better digestibility, and feed intake. They improve the production rates and health of broilers, *B. subtilis* is a great example as it is resistant to temperature change (Rivera-Pérez et al., 2021). Probiotics don't play a larger or clearer role in growth performance but do reduce the chances of infections (Yaqoob et al., 2022).

Prebiotics are indigestible food ingredients that enhance the growth of one or more beneficial bacteria (Ricke, 2021). Most of them consist of carbohydrates and associated products that the healthy gut microbiota can digest. Bacteria ingest the goods to enhance gut health and counteract the activities induced by harmful bacteria (Abd El-Hack et al., 2022). By improving intestinal characteristics (longer villi, more goblet cells) that promote beneficial bacteria like *lactobacilli* and *bifidobacteria*, prebiotics increase the feed conversion ratio in broilers (Thora et al., 2015). In an experiment done by Murshed and Abudabos, (2015) prebiotics (mannan oligosaccharides) are known to be an alternative to antibiotics and improve the FCR and broiler performance. In another experiment carried out by Rehman at al., 2020 importance of mannan oligosaccharide was highlighted that it causes the growth of beneficial bacteria (*Lactobacilli* and *Bifidobacteria*) and reduces pathogenic bacteria (*E. coli* and *Salmonella*). Prebiotics are used in combination with probiotics to have better efficacy but a great deal of research is necessary to prove the effective growth effects on poultry (Khomayezi and Adewole, 2022). A rise in the immune system, performance, and meat quality of the broiler chicken was seen when prebiotics were used in an experiment conducted by Al-Khalifa et al., 2019. In an examination prebiotics like oligofructose were known to improve the weight gain, breast weight, and percentage of the carcass (Al-Khalaifah, 2018).

Plant extracts are very beneficial in promoting poultry health. They may improve feed intake, increase body weight, and improve the feed conversion rate (Oluwafemi et al., 2020). For instance, whereas it is indicated that the Moringa plant, due to its high nutritional value, happens to be one among these herbal plants that have the potential to work as a supplement in chicken feed, there is still a controversy surrounding the best dosage and its resultant effect on performance (Mahfuz and Piao, 2019). As far as environmentally friendly and improvement of performance are concerned, the application of phytogenic derivatives has been on the rise in animal feeds (da Silveira Deminicis et al., 2021). Phytogenic feed additives (PFAs) are now being used as replacements in poultry feed due to their different complex activities that lead to disease prevention and increase in production (Stevanović et al., 2018). The use of Essential Oils as PFAs in monogastric like poultry as an alternative to AGPs is an emerging topic (Mucha and Witkowska, 2021). The addition of phytobiotic additives can enhance the appetite, boost the production of digestive enzymes, strengthen the immune system, and also amplify the quality of animal products (Krauze et al., 2021).

Essential Oils are secondary metabolites produced by different plant parts and oil glands, extracted by different techniques (Herman et al., 2019). They are hydrophobic and volatile chemical compounds. They have been used for clinical and medicinal uses along with their aromatic properties in food (Wińska et al., 2019).

Essential Oils: Potential Natural Alternatives for AGPs

Essential oils are safe to use but toxicities can result in some cases (De Groot and Schmidt, 2016). EOs consist of many components in different ratios but only two to three components constitute 20-70% of the total concentration. These major components are responsible for the biological properties of the EO (de Sousa et al., 2023). EOs are also bio-active substitutes for different antimicrobial, antiviral, nematicidal, antifungal, and antioxidant drugs and compounds (Turek and Stintzing, 2013). Essential Oils are also used to improve drug penetration through the skin (Adorjan and Buchbauer, 2010) and also for nematicidal and larvicidal activities in some parts of the world (Lahlou, 2004). EOs are also used as repellents against arthropod species, for example, *Cymbopogon* species are used to repel mosquitoes in Amazon areas (Nerio et al., 2010).

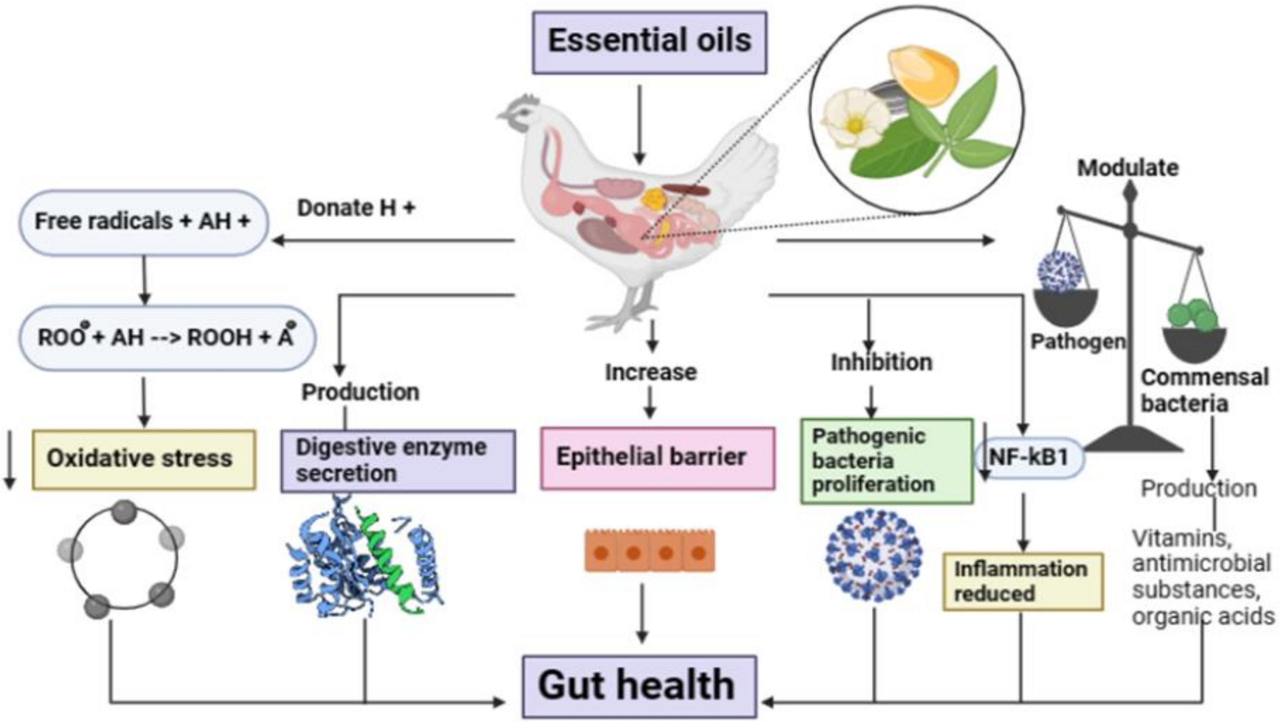

Fig. 1: Essential oils and their effects on broiler chicken

Extraction of Essential Oils

Extraction of EOs can be carried out by several techniques but the most common ones are Hydro-distillation (HD), steam distillation, cold pressing (CP), solvent extraction (Reyes-Jurado et al., 2015), and Enzyme assisted extraction (Ferrentino et al., 2020). These conventional methods are simple but take time and produce low amounts of EOs. Ultrasound and microwaves are new approaches that offer faster extraction and higher yields. Less energy is consumed and a higher quality product is obtained (Lainez-Cerón et al., 2022).

Conventional Methods of Extraction

Hydro-distillation

Distillation extracts the plant essential oils through differential pressure aimed at evaporation and condensation of the mixture components. Hydro-distillation method, which is widely applied for extracting essential oils, is easy and cheap (Drinic et al., 2021). It involves immersion of the plant matter in water, after which the mixture is boiled and then the vapor is condensed, separating the oil from the water. However, heat and water may destroy sensitive compounds while preventing the recovery of water-soluble oils (Ghasemy-Piranloo et al., 2022).

Steam Distillation

The steam is above boiling water and the plant material is not submerged in this boiling water. In this process, the plant material comes into contact only with the steam of the boiling water, not with the water itself (Oktavianawati, 2020). This method requires simple instruments and hence is simple without complexities, therefore having many advantages as indicated by Saldaña-Mendoza et al. 2022. Water- Steam distillation which as explained earlier involves placing plant material above boiling water while Steam distillation involves the use of external sources of steam (Ghasemy-Piranloo et al., 2022).

Cold Pressing

Due to the absence of a chemical refining stage, cold-pressed oils (CPOs) provide pure mechanically derived oils hence securing naturally occurring beneficial nutrients, including vitamins, minerals, and antioxidants, from the product (Rabiej-Kozioł et al., 2023). It is more economical and safer both for the consumer and their environment because it doesn’t require chemicals (Kabutey et al., 2023). The method ensures that antioxidants are present in the oil, making it stable throughout a long shelf life (Prescha et al., 2014).

Table 1: Constituents and roles of important essential oils used in the poultry industry

Essential Oil Name	Common Name	Family Name	Major Compounds	Amount Used	Growth Promoters	References
Oregano Essential Oil (OEO) from *Origanum* genus	Oregano essential oil	*Labiatae*	carvacrol and thymol	01%, 1% w/w	Have antioxidant effect, inhibiting hydroperoxide and phenols, influence gene expression	[Peng et al., 2016] [Pontes-Quero et al., 2021] [Puvača et al., 2022] [Pateiro et al., 2018]
Basil leaves from *Ocimum basilicum*	Basil	*Lamiaceae*	Estragole, limonene and p-cymene	0.062, 0.125 and 0.25%	Have antioxidant effects, improve growth, feed conversion, immune response and general health. Also reduce harmful bacterial counts and influence beneficial bacteria.	[VLAICU et al., 2022] [Mkaddem Mounira et al., 2022] [Oliveira et al., 2024] [Pateiro et al., 2018]
Thymus vulgaris	Thyme	*Lamiaceae*	O-Thymol, Tetra hydro-3-methylfuran, thymol	0.5%	Play important antioxidant, antigenotoxic and antimicrobial effects, improve immune response, kidney and liver function. Also improves nutrient digestibility.	[HOSSAİN et al., 2022] [Chbel et al., 2022] [Fawaz et al., 2021] [Pateiro et al., 2018]
Cinnamon (species Cinnamomum)	Cinnamon	*Lauraceae*	*Trans-cinnamaldehyde*, δ-cadinene and β-cubebene	200 mg/kg	Has antiinflammatory, antimicrobial and antioxidant properties improving health, immunity metabolism, carcass traits, and meat quality.	[Dahmani et al., 2021] (Alizadeh Behbahani et al., 2020) [Ali et al., 2021] [Hippenstiel et al., 2011]
Garlic (Allium sativum)	Garlic	*Amaryllidaceae*	Diallyl disulfide, Diallyl trisulfide	300 mg/kg	Act as antioxidants, boost immunity and gut health of poultry and maintain blood parameters.	[Ezeorba et al., 2022] [El-Saber Batiha et al., 2020] [Abd El-Ghany, 2024] [[Hippenstiel et al., 2011]
Black cumin seed oil (*Nigella sativa L.*)	Black cumin seed / black seed	*Ranunculaceae*	thymoquinone, thymohydroquinone, dithymoquinone, thymol and nigellone	2-3%	It has a good antioxidant effect, improves growth and egg production, and also reduces harmful bacteria in the gut.	[Elnour and Abdelsalam, 2018] [Hannan et al., 2021] [Seidavi et al., 2020]
Ginger (*Zingiber officinale)*	Ginger	Zingiberaceae	zingiberene, camphene, Curcumene and β-phellandrene	0.2%	Promote the functioning of antioxidant defense systems, improve reproductive performance, and prevent harmful bacterial colonization by acting as an antimicrobial.	(Mao et al., 2019) [Abd El-Hack et al., 2020] [Pateiro et al., 2018]
Rosmarinus officinalis	Rosemary Essential Oil	*Lamiaceae*	α-Pinene, Bornyl acetate, Camphor, 1,8-Cineole	0.15, 0.3 g/kg	Regulates host immunity, and intestinal microflora and also has a beneficial antioxidant role. Has potential anticoccidial activity.	[Lahlou et al., 2021] [Hippenstiel et al., 2011]

Solvent Extraction

Another alternative process to achieve the extraction of essential oils from plants is solvent extraction. The technique aims to dissolve the oils from the plant components using different kinds of solvents, including ethanol, diethyl ether, and n-hexane (Ezeorba et al., 2022). Several factors affect the recovery by this method, such as the type of solvent, temperature, and particle size. The process is dependent on diffusion and concentration gradients which assist in the flow of oil from plant material to the solvent, which at the end should be easily separable from the oil, according to Ntalikwa, 2021. Solvent extraction is an extensive and widely employed oil extraction technique although it has drawbacks like undesirable residues and flavor changes (Khalil et al., 2017).

Modern Techniques of Essential Oil Extraction

Microwave-assisted Water Distillation

The process called microwave-assisted water distillation has huge potential for the extraction of essential oils. There are many advantages MAWD has over conventional techniques such as water distillation (Drinic et al., 2021). First, it reduces extraction time considerably; 30 minutes instead of the 4.5 hours it takes with conventional procedures for similar yields and quality (Guha and Zari, 2017). Second, the increased heating speed reduces thermal deterioration and may preserve the sensitive volatile substances. However, optimization of microwave power is needed for effective and superior extraction. Further investigation is required for MAWD to be applied to a more diversified range of plants, like thyme, to fulfill its potential (Akdağ and Öztürk, 2019).

Enzyme-Assisted Extraction (EAE)

These modern, green techniques involve the use of specialized enzymes to break down the components of the cell wall: lignin and cellulose (Lubek-Nguyen et al., 2022). EAE applies specific enzymes degrading those two elements of the cell wall, releasing the bound metabolites. The enzymes play their role naturally, just like keys. Enzymatic treatment facilitates the transfer of essential oils during extraction (Amudan et al., 2011; Hosni et al., 2013).

Ultrasound-Assisted Extraction (UAE)

UAE is a low-frequency sound wave technique below 16 kHz, improving oleoresins' plant extraction (Nora and Borges, 217). It creates acoustic cavitation in the cell walls of the plant material and eventually makes them release the essential oils (Mushtaq et al., 2020). Compared with other extraction procedures, some of the biggest edges associated with UAE include higher extraction rates, lower energy consumption, and a lower temperature at the time of extraction (Shen et al., 2023).

How do EOs act in poultry growth improvement?

Essential oils added as flavorings in poultry have been shown to have a range of physiological effects. These effects can be categorized into several groups, and there may still be more potential benefits waiting to be discovered

Role of Essential Oils as Antioxidants

The most widely studied physiological effects are the antioxidant activity of the EOs (Mutlu-Ingok et al., 2020). EOs directly neutralize free radicals in the gut and, up-regulate the expression of antioxidant enzymes in the gut and liver. They may down-regulate enzymes that produce reactive oxygen species (ROS), such as MPO, COX-2, and iNOS. MPO down-regulation diminishes oxidative stress and thus tissue damage. Down-regulation of COX-2 and iNOS can result in anti-inflammatory activities (Ezzat Abd El-Hack et al., 2016). They also scavenge free radicals like DPPH, ABTS, and also lipid peroxides. EOs protect from DNA oxidative damage, and they maintain β-carotene molecules without oxidation. Their activity depends upon the source of plant material, extraction method, and type of compound present, according to Valdivieso-Ugarte et al., (2019). The antioxidant activity of essential oils reduces lipid peroxidation in meat chicken muscles. This is highly useful for thigh muscles, which are more easily oxidized because of their higher content of polyunsaturated unsaturated fatty acids. The addition of essential oils to animal feed further aids in reducing rancidity in meat. Antioxidants play an important role in reducing lipid oxidation improving oxidative stability and removing stressors to chicken health (Adaszyńska-Skwirzyńska and Szczerbińska, 2017).

For example, the antioxidant activity of thymol in various essential oils involves the scavenging of free radicals such as super-oxide and hydroxyl and the enhancement of endogenous antioxidant enzymes such as glutathione peroxidase and superoxide dismutase. Thymol chelates iron and copper, making them unavailable to catalyze free radical generation (Gholami-Ahangaran et al., 2022). Thymol is also transferred to the yolk via chicken tissues. This also protects the yolk along with the meat in poultry (Ezzat Abd El-Hack et al., 2016).

The Rosemary Essential Oil components, which are mainly composed of phenolic diterpenes, show antioxidant activity by scavenging free radicals by acting as electron donors and stabilizing them (Candan and Bağdatlı, 2017).

Tea tree oil is used in conjunction with other EOs for an enhanced antioxidant effect ((Puvača et al., 2022). Components of oregano (*Origanum vulgare*) EO have free radical neutralizing properties, although not as much as vitamin C, still acting in the vicinity of Vitamin E and BHT. Hens fed with a thymus-enriched diet produced eggs with longer refrigerator life because of the decreased level of oxidation in yolks (Nehme et al., 2021).

The antioxidant role of essential oils of plants is dependent upon the different activities of the constituent compounds (Mnisi et al., 2022). Although Oregano EO supplementation in broiler did reduce the malondialdehyde (MDA) serum levels, the result was even better when it was used in synergism with vitamin C supplementation. Total antioxidative capacity, TAC increased when oregano oil was given with vitamin C (Ghazi et al., 2015). Organosulfur bioactive compounds present in garlic essential oil exhibited good antioxidant activity against 2,2-diphenyl-1-picrylhydrazyl (DPPH). It decreases thiobarbituric acid reactive substances (TBARS), which is an indication of lipid oxidation in broiler meat (Rafeeq et al., 2022).

Essential oils can still, have toxic effects when taken in excess. These include problems in the respiratory tract, skin, and reproductive system, depending on the dose, time of exposure, and components of the oil, among other factors (Horky et al., 2019). Essential oils, when used alone, undergo oxidation. Terpenes oxidation also forms radicals, so microencapsulation of essential oils can help to provide safe antioxidant operation without the radicals oxidizing the terpenes since the terpenes are prone to oxidation due to the presence of unsaturated carbon bonds (Nehme et al., 2021).

Table 2: Some common essential oils and their antioxidant potential

Plant name	Utilized part	Major component	Performance effect on poultry	Antioxidant role	References
Thymus vulgaris	Whole plant	Thymol	Growth performance was enhanced	Remarkable antioxidant property	Oluwafemi et al., 2020 Kosakowska et al., 2021
Cinnamon (species Cinnamomum)	Leaf	Cinnamaldehyde	Improved the growth performance	Remarkable antioxidant activity	Oluwafemi et al., 2020 Alizadeh Behbahani et al., 2020
Garlic *(Allium sativum*)	Bulb	Allicin	Body weight and feed efficiency were improved	Good antioxidant role	Oluwafemi et al., 2020 Abd El-Ghany, 2023
Black cumin seed oil (*Nigella sativa L.*)	Seed	Cuminaldehyde	Body weight improved, feed efficiency was also enhanced	Has a great antioxidant capacity	Oluwafemi et al., 2020 Aydogan et al., 2020
Ginger (*Zingiber officinale*)	Rhizome	Zingerone	Improved carcass quality	Improved antioxidant effect	Oluwafemi et al., 2020 Abd El-Ghany, 2023 Gholami-Ahangaran et al., 2021
Rosemary *(Rosmarinus officinalis L.)*	Leaf	Cinneol	Increased average daily gain and feed conversion	Has a strong antioxidant activity	Oluwafemi et al., 2020 Petricevic et al., 2018 Hcini et al., 2023
Basil leaves from *Ocimum basilicum*	Leaves, stems	Methyl chavicol	Significantly improve body weight and feed conversion ratio.	Potentially beneficial antioxidant agent	Herman et al., 2019 Zweil et al., 2019

Essential Oils as Growth Promoters

Essential oils are also termed as very effective growth promoters. Growth performance improves due to the synergistic actions of the EO components used in the forms of blends or alone. When EO blends of thymol and cinnamaldehyde or carvacrol, cinnamaldehyde, and capsicum oleoresin were used, all caused an increased appetite, FCR (feed Conversion Ratio), and muscle mass, which meant an overall improved broiler performance (El-Ghany, 2020). They are involved in maintaining the growth rate and utilization of nutrients (Zhai et al., 2018). EOs are known to have a positive effect on the feed conversion ratio, body weight, feed intake, etc if used in an optimum amount. Mixtures of essential oils can also positively impact the growth rate of broilers (Adaszyńska-Skwirzyńska and Szczerbińska et al., 2017). Mixtures of essential oils can also positively affect the growth rate in broilers. Essential oils also increase the dry matter, crude protein, and ether extracts when raising an EO level from 0 to 400 mg/kg (Su et al., 2021). Apart from their role in increasing body weight gain and improving feed conversion ratio, EOs increase beneficial gut bacteria and reduce harmful ones. This shows their potential use as natural growth promoters with added health benefits (Irawan et al., 2021). Studies conducted on commercial blends such as CRINA (comprised of thymol, eugenol, and piperine) indicate that these blends enhance the activity of enzymes within the pancreas and gut lining in broilers. Birds supplemented with these blends have potentially better digestion of ingested feed. EOs like Heryumix TM and thyme oil improved the FCR and body weight gain of poultry (Micciche et al., 2019).

Oregano extracts can be used as alternatives to synthetic feed additives as they're less toxic, which most likely have potential benefits like improved growth, feed efficiency, gut health, disease resistance, and even immune responses. Positive effects were recorded at certain moderate inclusion levels; for example, 240 mg/kg for the protection against *C. perfringens* in poultry (Alagawany et al., 2018).

Supplementation of the fowl with thymol essential oil increased body weight, carcass breast weight, reduced count of total cholesterol and the population of harmful gut bacteria, and improved growth and function with better FCR. However, it decreased wing and thigh weight (Seidavi et al., 2021). Less prominent effects resulting in broilers' performance were seen when the feeds were supplemented with oregano, cinnamon, and pepper EOs (Oluwafemi et al., 2020).

Popović et al. (2019), evaluated that poultry raised on a mixture of thyme, oregano, and rosemary oil are nutritionally more valuable and low in fat/calories. According to an experiment stated by Barbarestani et al., 2020, antibiotics or feed alone were not able to result in an efficient increase in body weight gain as was seen when lavender essential oil was added in poultry ration. The feed conversion ratio was also reduced. In the study conducted by Thuekeaw et al.,, 2022, the effect of avilamycin, free basil oil, and modified basil oil was evaluated on the performance of conventionally raised broiler chickens. Avilamycin increases the average daily gain and feed conversion ratio in broiler chickens. Supplementation with 500 mg/kg of cinnamon oil improved weight gain and FCR, and reduced bad cholesterol in broilers, according to Saied et al., (2022).

The addition of some spice blends orEOs in chicken, such as *Lippia origanoides* + *Rosmarinus officinalis* with beetroot or natural betaine, improved growth, feed intake, and FCR, reducing the negative effects of heat stress as compared to the chicken that did not receive EOs. Dietary supplementation of 600 mg/kg lavender essential oil in broilers improved weight gain but showed undesirable interactions with its level on the levels of ileal *Lactobacillus* spp. in the gut that constitute part of the microbiota (Pilego et al., 2022).

The application of EOs in the food industry is an evolutionary change, but their intense aroma, reactivity, and reduced solubility have practically created limitations for the use of essential oils. It all requires the administration of EOs in modified forms like nanoencapsulation (Maurya et al., 2021). Much research and collection of information is still needed to understand the proper pharmacodynamics of EOs so that they may be administered in animal production precisely according to requirements (Simitsiz, 2017).

Conclusion

Antibiotics and other Alternative growth promoters have played a vital role in the growth of the poultry industry. They are still used in the industry but due to the concerns over antibiotic resistance and drug residues, their use has reduced or they are used in conjunction with other alternatives, such as essential oils. Essential oils show great promise to be used as AGPs and are a hope for ethical poultry farming. However further research is needed to understand their exact mechanisms and effects in specific target industries, in our case the poultry industry. This review has explored the functions of essential oils, including their antibacterial, antioxidant, antiviral, and antifungal features all of which contribute to the growth and health outcomes of broiler chickens. There is a need for further research on dosage, delivery methods, and potential side effects of EOs so they can be used for sustainable poultry practices. This requires the development of ethical approaches that prioritize both animal welfare and public health.

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