Efficacy of peppermint (*Mentha pipreitae*), basil (*Ocimum basilicum*) and their combination on growth performance and meat quality of broilers

Payam S. Sabir [1], Rebin A. Mirza [2], Ahmed E. Hamedmin [3], Hemn S. Abdulla [4]

[1,2]Department of Animal Resource, College of Agricultural Engineering Sciences, Salahaddin University, Erbil, Kurdistan, Iraq.
[3,4]Directorate of Agriculture Research, Erbil, Ministry of Agriculture and Water Resources, Kurdistan, Iraq.

[2]Corresponding author: rebin.mirza@su.edu.krd

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Abstract

The efficacy of peppermint (*Mentha pipreitae*), basil (*Ocimum basilicum*) and their combination as natural feed additives was the goal of the current investigation on the broiler performance and meet quality. A number of 600 days old broiler chicks (Ross 308 strain) were randomly distributed into four treatments with five replicates which contained 30 chicks in each replicate for forty-nine days of the experimental period. The dietary treatments were designed as follows; control (T1) standard diet, 1% of peppermint in the standard diet (T2) and 1% of basil standard diet (T3) and their combination 0.5% peppermint + 0.5% basil (T4). The results of this research were showed that the best live body weight and weight gain were recorded for basil and combination between of two additives compared with the control group. Also, there were no significant differences on the feed intake, feed conversion ratio carcass weight and meat quality of the boiler at the end of the experimental period. The investigations of the current study found that feeding broilers on peppermint, basil and their combination tend to improve their growth performance and feed conversion ratio but not statistically.

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Introduction

Plant-based feed additives, are often known as phytogenic or phytobiotic substances. AGPs could be replaced with herbs in poultry diet because of their antibacterial properties. A wide range of plants' bioactive components have antibacterial properties (Cross *et al*., 2007; Lewis *et al*., 2003). Windisch and Kroismayr (2006) were redefined phytobiotics as plant derived products from plants that added to the diet of livestock in order to improve productivity. The use of medicinal and aromatic plants (MAP) in broiler diets has been associated with improvements in body weight, weight gain, feed conversion efficiency, and feed costs, according to several researchers (Azouz, 2001; Alcicek *et al*., 2004; Abdel-Azeem, 2006).

Since the 1970s, antibiotics have been added to chicken feed as a supplement to promote growth and preserve the birds against the harmful effects of pathogenic bacteria. In response to worries about the development of widespread antibiotic resistance in human diseases, the European Union prohibited antibiotics in 2006. To sustain the best chicken production, producers of poultry are looking for alternatives. Therefore, these herbs have the potential effects to reduce the enteric pathogen bacteria and ability to enhance growth performance in birds and finally reduce contamination of poultry meat (Ocak *et al*., 2008). Increasing concerns about the

negative impact of AGPs have led to research on the use of natural feed additives in poultry feed to ascertain better performance and safety in the food chain. Herbs and substances of plant origin (garlic, oregano, thyme, anise, rosemary, and cinnamon) are defined as photobiotic or botanical natural feed additives. Numerous studies on such substances in poultry production have shown more beneficial effects such as antimicrobial, antiviral, antioxidant, and enhancing gut function (Mohamed and Hassan, 2023).

One of the oldest medicinal plants in the world and a member of the Labiatae family, peppermint (*Mentha piperita*) is consumed in both Eastern and Western cultures. It is frequently utilized in the herbal treatment and is thought to be very helpful in boosting immunity and battling secondary infections (Nanekarani *et al*., 2012). The main treatment properties of mint's leaves derive from the plentiful menthol, which is the primary phenolic compound with antibacterial properties (Schuhmacher *et al*., 2003). Peppermint contains polyphenolic compounds and hence could possess strong antioxidant properties (Dorman *et al*., 2003). Basil (*Ocimum basilicum* L.), also known as sweet and garden basil, is a plant that is widely grown in the Mediterranean region (Abbas, 2010). Basil, also known as Rehan in Arabic, is a member of the Lamiaceae plant family and contains essential oils that are high in phenolic compounds, polyphenols like flavonoids, and anthocyanins (Phippen and Simon, 2000).

Chemical analysis that an investigated peppermint and basil leaf contains different active compounds, such as tannins, flavonoids, glycosides, saponin, steroids and terpenes (Pattnaik *et al*., 1997). The research conducted by Hussein (2021) showed that peppermint has high protective efficacy against declining performance and gut health of coccidiosis infected broilers. Consequently, the goal of this study was to investigate the possible effects of different herbal plants as feed additives on the performance and quality of meat of broilers.

Materials and Methods

Ethic Approval

The Scientific Ethical Committee of the Animal Resources Department, College of Agricultural Engineering Sciences, Salahaddin University, Erbil, approved this study (No.: 3/1/7811 at 30/6/2022).

Design of Experiment

This experiment is designed in the Erbil Directorate of Agriculture Research, Ministry of Agriculture and Water Resources, Kurdistan, Iraq. The research was done to investigate the influence of peppermint (*Mentha pipreitae*), basil (*Ocimum basilicum*) and their combination on broiler performance and meet quality. A number of 600 days old broiler chicks (Ross 308 strain) were randomly distributed into four treatments with five replicates per each treatment for forty-nine days of trial. The dietary treatments were designed as follows; control (T1) standard diet, 1% of peppermint in standard diet (T2) and 1% of basil in the standard diet (T3) and their combination 0.5% peppermint + 0.5% basil (T4). The chicks had free to obtain diet and water *ad libitum*. The composition of the control diet is presented in table 1.

Table 1. The composition of the standard diet for all trials (%)

Ingredients	Composition (%)	
	Starter (1-21 Days)	Grower (22-49 Days)
Maize	19.5	11.8
Soybean meal	34.1	25.0
Wheat	40.0	55.8

Limestone	1.5	1.4
Premix[1]	2.5	2.5
Di calcium phosphate	0.6	0.3
Enzyme	0.1	0.1
Anti-oxidant	0.1	0.1
Oil	1.6	3.0
Total	100	100
Calculated values[2]		
ME (kcal/kg)	3000	3150
Crude Protein %	23	20
Lysine %	1.19	0.99
Methionine %	0.47	0.44
Calcium %	0.81	0.71
Available phosphate %	0.45	0.39

[1]Premix: each 1 kg contain: Crude protein 15%. Crude fat 2%. Crud fiber 4%. Calicium 4% Phosphorus(Av.) 8.6%. Methionine 5.2%. Methionine+cystine 5.4%. Lysine 2.5%. sodum 5%. VitA 480.000IU. VitD 3120.000 IU. VitE 1000 mg. Vit K 80 mg. Vit B 180 mg. Vit B 240 mg. Vit B3,600 mg. Vit B 6,120 mg. Vit B12 1 mg. Niacin1.200 mg. Folic acid, 40 mg. Biotin,6 mg. CholinChlorid 12.000 mg. Iron,2.800 mg. Zinc 2.400 mg. Copper 320 mg. Manganese 3.000 mg. Iodine 1100 mg. Selenium 8 mg.
[2] Food requirements were estimated according to (NRC, 1994)

Growth Performance

The chick's one-day-old and final weight of the birds were weighted using a digital balance and feed intake were recorded during all experimental period and FCR was calculated by using the equation of feed intake per unit divided by weight gain. Carcass weight was also measured. The growth performance was analyzed by the following formulas:

Weight gain (g) = BW at the end of the experiment - BW at the beginning of the experiment

Feed conversion ratio (FCR) = Final Feed intake / Final weight gain

Calculated using the following equation according to (Wasman, 2022).

Meat Quality

According to the researcher Mirza (2015), the colour [redness a*, yellowness b* and lightness L*] of male and female breast muscles were evaluated using a Minolta CR-400 (Konica Minolta Sensing Americas Inc., Ramsey, NJ). Prior to taking measurements, a standardized calibration was conducted with black and white tiles. Individual breast fillets' surface colors were measured in a region free of evident color flaws (bruises, blood spots, or surface discolorations). Five birds per treatment conducted measurements of the color of their breast meat in various positions on each sample. Also, dripping loss, cooking loss and pH of meat were measured.

Statistical Analysis

Using the SPSS program, a one-way ANOVA analysis was performed on the data (SPSS 26, 2019). The results include means and standard error, using descriptive statistics. Duncan's test was performed to identify significant differences between the various parameters at 0.05 levels (Duncan, 1955).

Result and Discussion

The findings of this study demonstrated that supplementation with additional plant additives had no positive effect on the growth performance of broilers. The best live body weight and weight gain were recorded for basil and a combination of two additives compared with all control groups.

Also, there were no significant differences on the carcass weight of the boiler at the end of the experimental period (Table 2).

Phytogenic compounds are an alternative to antibiotic growth promoters. The mode of action of phytogenic materials is to achieve better performance of animals. The present study indicates that the addition of peppermint, basil leaves and their interactionwith diets improves the growth, FCR, of broiler compared to the control group but not significantly. According to the research, adding peppermint and basil leaves to the diet had a positive impact on feed conversion ratio and body weight gain. It also shows that these leaves, acting as both active ingredients and enhancers,lessening the negative effects of heat stress on broiler performance and viability. (Abbas, 2010; Beigi *et al*., 2018; Bupesh *et al*., 2007; Grigoleit and Grigoleit, 2005; Osman *et al*., 2010).

Abdel-Wareth *et al.* (2019) conducted an experiment using supplementations of peppermint leaves in different concentrations for a broiler diet. The results showed that significantly increased body weight and daily-body weight gain compared to control groups, proving that peppermint has an imperative effect on the conversion of digested feed into body gain. In addition, the antimicrobial, antioxidant, antifungal and anti-inflammatory influences of peppermint and basil were also observed by many researchers (Ali, 1999; Uma-devi, 2001). Similarly, the supplementation of poultry diets with aromatic plants have stimulating effects on digestive system of the animals through the increasing the production of digestive enzymes and by improving the utilization of digestive products through enhanced liver function (Hernandez *et al*., 2004).

Table 2. Influence of herbal plants administration on growth performance and carcass weight of broilers at seven weeks of age (Mean ± standard error)

Growth performance	Treatment				P. value
	CON	Mint	Bisal	Mixture	
Initial weight (g)	41.0±0.14	41.5±0.28	42.0±0.28	41.0±0.38	0.112
Final weight (g)	2910±56.69	2878±65.45	3170±63.12	3107±96.18	0.128
Weight gain (g/bird)	2869±56.69	2836±63.42	3128±48.55	3066±41.89	0.141
Feed intake (g/bird)	4788±170.79	4399±49.74	4818±82.34	4626±146.82	0.139
FCR*	1.66±0.03	1.55±0.04	1.48±0.03	1.57±0.04	0.243
Carcass weight%	76.62±0.81	76.27±1.24	75.66±0.69	77.92±1.35	0.527

* FCR: Feed conversion ratio.

The findings of L*, a*, and b* color determination are shown in table 3. The colour parameters lightness (L* value) of the male and female were not significantly (P>0.05) affected by additives supplementation compared with the control group. Also, there was no significant (P>0.05) differences were observed in meat male among treatments on redness (a* value) except mint additive compared with the control. While the a* value of the meat female were decreased in basil and mixture compared with control and mint groups. The colour parameter yellowness (b* value) of the meat male was decreased in basil supplements compared with control and both other additive supplementations. Also, there were no significant (P>0.05) variations that were observed in meat male between treatments on yellowness (b* value) except mint additive compared with the control group.

Table 3. Influence of herbal plants administration on meat color of broilers at seven weeks of age (Mean ± standard error)

Meat Colour[1]		Treatment				P. value
		CON	Mint	Bisal	Mixture	
Male	L*	58.25±1.39 a	57.69±1.29 a	61.60±0.64 a	59.94±1.06 a	0.142
	a*	8.43±0.54 a	6.82±0.32 b	8.66±0.01 a	7.98±0.4 ab	0.035
	b*	9.34±0.11 ab	8.39±0.19 b	6.47±0.64 c	9.77±0.34 a	0.001
Female	L*	54.39±2.19 a	54.79±2.80 a	59.01±0.74 a	57.95±3.07 a	0.471
	a*	7.45±0.44 ab	8.13±0.25 a	6.99±0.21 b	5.85±0.21 c	0.004
	b*	10.54±0.55 a	7.03±0.53 b	8.14±0.89 ab	9.25±1.30 ab	0.100

[abc] Data in the same row direction with different letters differ significantly (P<0.05).,
[1] L*: lightness, a*: redness, and b*: yellowness.

Influence of herbal plants administration on the meat quality of broilers at seven weeks of age is presented in table 4. The findings of the current study showed that addition of herbal plant additives had no significant (P>0.05) effect on meat quality of broilers at the end of the experimental period.

This result agrees with Rabia (2010), who reported that chicks fed basil diets had significantly heaviest body weights than those fed the control group. This could be attributed to the presence of essential oils in basil as additives in the diet. Also, the results of this study support the observations of Spirling and Daniels (2001) who reported that mint has a positive effect on digestion and can strongly affect feed intake.

Although not yet documented, peppermint and basil leaves had a significant impact on the way that broiler meat's qualitative traits changed. The experimental findings in the current study suggest that pH, drip loss and cooking loss of breast meat parts from both sexes fed peppermint leaves and basil leaves, and their interaction, were not significant differences as compared with the control group. These findings suggest that adding peppermint leaves or its active ingredient to broiler diets can reduce the cooking loss of breast meat and hence minimize tissue damage and cook loss of muscular tissues. These reductions in cook loss may be due to the antioxidant properties of peppermint and basil as dietary supplements, which may help protect chicken meat and increase its oxidative stability (Wenk, 2003). The results agreed with the finding of Abdel-Wareth *et al*. (2019) conducted an experiment using supplementations of peppermint leaves in different concentrations to broiler diet. The results showed no significant influence on meat quality compared to the control group.

Table 4. Influence of herbal plants administration on meat quality of broilers at seven weeks of age (Mean ± standard error)

Meat Quality		Treatment				P. value
		CON	Mint	Bisal	Mixture	
Male	Dripping Loss	24.90±0.37	24.56±0.66	25.26±0.56	25.00±0.52	0.836
	pH	5.65±0.03	5.48±0.09	5.45±0.05	5.56±0.02	0.138
	Cooking Loss	22.46±0.12	21.40±0.75	21.90±0.47	21.43±0.68	0.534
Female	Dripping Loss	25.30±0.35	24.50±0.05	24.50±0.05	24.76±0.41	0.213
	pH	5.50±0.04	5.50±0.04	5.41±0.03	5.48±0.03	0.413
	Cooking Loss	21.33±0.76	20.26±0.60	20.03±0.37	21.73±0.80	0.279

Conclusion

In conclusion, by improving the feed conversion ratio but not significantly, peppermint and basil leaves can be used as efficient feed addition to enhancing the growth performance of broilers. Higher economic efficiency in the production of broiler meat may occur from these impacts

Conflict of Interest

The authors declare that they have no competing interests

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