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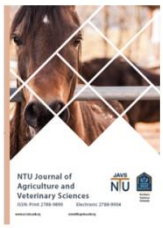

The Effect Of Adding Some Plants To The Feed On The Productive Performance and Some Qualitative Characteristics Of Laying Hen eggs

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A B S T R A C T

This study aims to try to improve the production and quality of laying hens' eggs in the late stages of their productive life by adding some herbal plants to the fodder. 288 laying hens at 64 weeks old were used and it was distributed into four treatments, with three replicates for each treatment, and each replicate had 24 laying hens. The first treatment was a control free of the addition, The second treatment included adding 1% of rosemary, the third treatment included adding 2% of thyme, and the fourth treatment adding 1% of garlic. The statistical analysis results showed that there was a significant superiority of the rosemary treatment in the average egg weight, while the thyme addition treatment was superior in the average egg mass, feed conversion factor, and egg production percentage. The additives also led to an increase in feed consumption compared to the control treatment

Introduction

chicken table eggs are a necessary part of the human diet due to a lot of high-quality amino and fatty acids as well as sufficient natural vitamins and minerals [1]. In the layer poultry industry, the late stages of production usually face various stresses, such as excessive accumulation of reactive oxygen species and redox imbalance [2] These things lead to a weakening of the function of the reproductive system of chickens, accompanied by a dilution of egg albumen and a decrease in Haugh unit [3].

Therefore, recent studies related to poultry nutrition have revealed the importance of adding medicinal herbs as safe alternatives to antibiotics manufactured in poultry diets and considering them as natural additives that contain biologically active substances that affect many unwanted microorganisms In addition, it is considered one of the natural antioxidants that enhance the immune system and can be used to improve growth and health of poultry [4]. Based on the results of many researchers, the essential oils of herbaceous plants affect feed consumption, weight gain, and nutrient utilization efficiency in poultry [5], egg weight [6], egg production, and body weight of laying hens [7]. and [8].

Rosmarinus Officinalis L. is an aromatic plant that improves birds' performance and eggshell quality. Many studies have concluded that adding rosemary leaves to the diet of laying hens has a positive effect on egg production and raising the immune system's efficiency [9]. In addition, rosemary improves the digestion of nutrients, delays fat oxidation, and is used as an alternative to antioxidants and antimicrobials in feed [10].

Garlic [11] is considered an important medicinal plant because of its vital role as a treatment for many diseases as it has been scientifically proven that garlic has antioxidant properties, antimicrobial, antiparasitic, and other immune activities in poultry [12]. Adding garlic powder to poultry food improved some blood values and total immunoglobulin, which could contribute to improving blood circulation and immunity in white Leghorn chickens [13].

As for the thyme (Thymus vulgaris), it is an aromatic plant with antifungal, antioxidant, and antimicrobial properties [14]. Thyme oil or its extract improves the digestion of nutrients by increasing the activity of digestive enzymes and reducing cholesterol in the serum and yolk [15]. Carvacrol is one of the main active compounds in the thyme plant, as it improves feed conversion efficiency and egg quality standards [16].

Materials &Methods

This study was conducted on a poultry farm of the Department of Animal Production at the College of Agriculture and Forestry - University of Mosul for 12 weeks, from 2/16/2024 until 5/16/2024 and it included three productive age periods.

Experimental design

In this research,288 laying hens of the Mezo type were used at the end of their productive age (at 64 weeks old). It was distributed into four treatments, with three replicates for each treatment, and each replicate had 24 laying hens. Astandard feed was used, which in cluded the addition of different levels of herbal plants as follows: The first treatment was a standard feed without additives, the second treatment was a standard feed with the addition of 1% rosemary, the third treatment was a standard feed with the addition of 2% thyme, and finally the fourth treatment was a standard feed with the addition of 1% garlic.

Cages and housing conditions

All hens were housed in a ground-based breeding hall designated for this purpose, consisting of 24 rooms with dimensions of (1.5 x 3.25) meters. The hall was well insulated and equipped with feeders, automatic manholes, and two-story metal nests with four holes containing hay to prevent the eggs from being broken and contaminated. Housing conditions, including light, temperature, and ventilation, humidity were maintained to provide all standard administrative conditions It contains electronic mercury thermometers distributed between the rooms and at the bird level to monitor temperature and humidity. The photoperiod is 16 hours of light and 8 hours of darkness, with a room temperature between 18-22 degrees Celsius. The chickens underwent the necessary preventive program and were given vitamin AD3E at a rate of 1 ml/2 liters once every two weeks throughout the experiment.

Composition of the ration

The additives were obtained from reliable sources and were very pure and free of impurities and dust. As for the raw materials for the feed, they were purchased from the local market, ground, then mixed well in the feed laboratory of the Animal Production Department at the College of Agriculture and Forestry at the University of Mosul. All laying hens used in the experiment were fed a standard diet containing a representative energy of 2800.1 kilocalories/kg and a protein of 17.01%. The amount of feed for each replicate was calculated based on what is recommended in the breeding manual: 115 gm feed/chicken/day throughout the experiment. As for water, it was freely available around the clock. Medicinal plants were added in crushed form according to a certain proportion to the diets of the various treatments using a sensitive balance as presented in Table 1. They were mixed with a small amount of feed (1) kg, then mixed with a larger amount of feed in a good manner, and so on to

ensure homogeneity of the mixture. Table 2 shows the ratio of feed components and the calculated chemical composition of the diet.

Table 1. Shows the chemical composition of the additives used

Ingredients	Garlic *	Rosemary **	Thyme ***
Moisture	64.58	8.62	6.6
Crude protein	7.87	5.08	14.46
Crude fat	0.52	16	3.48
Crude fibre	2.3	18.94	25.84
Ash	2.46	7.52	2.92
Carbohydrates	22.27	43.84	45.09

* [17] ** [18]*** [19]

Table 2. The ratios of feed components and chemical composition. (NRC,1994).

Ingredients feed	Percentage (%)
maize	47.5
Wheat	15.5
Soybeans (44%)	24
Sunflower oil	1 L
Dicalcium phosphate	1 kg
Limestone (ca 36%)	8.25
Enzymatic mixture	0.025
Salt	0.225
the total	100
Calculated chemical analysis	
Protein	17.01
Energy	2800.1
Raw fiber	3.19
Lysine	0.874
Methionine	0.470
Methionine + cysteine	0.535
Calcium	3.325
Available phosphorus	0.373
linolenic	1.381

Parameters evaluated

The egg production percentage

The eggs were collected manually twice a day, at 10:00 am and 2:00 pm, to prevent the eggs from being broken or contaminated, for a period of one week, collectively from each replicate throught the experiment. The egg production percentage was calculated based on the number of chickens in the replicate according to the following equation [20].

$$\text{day prodution \%} = \frac{\text{Number of the egg laid} \times 100}{\text{Number of hen} \times \text{days}}$$

Feed consumption

The average amount of feed consumed per week was calculated by weighing the amount of remaining feed at the end of the period and subtracting it from the amount of feed provided to it at the beginning of the week (which was calculated by multiplying 115 g/chicken/day by the number of replicated chickens and the number of days of the week, Considering that there were no instances of bird death during the experiment period As in the following equation, [21] The formula= Weight of feed provided at the beginning of the week (gm/replicate) - Feed weight at the end of the week(gm/replicate))/ Number of hens per replicate

Feed Conversion ratio

Calculate the average feed conversion factor for eggs for each replicate based on the amount of feed consumed in grams required to produce one gram of eggs according to the following equation: [20]
Average feed conversion factor per egg production period= Average weekly feed consumption/ Average total egg mass

Average egg weight in grams

Eggs were collected and weighed twice daily, in the morning and afternoon, regularly from each replicate. Then the average egg weight/replicate was calculated by dividing the total egg weights per day during the week and dividing it by the number of eggs replicated.

Egg mass/female in grams

The egg mass was calculated according to what was stated by the researcher's equation [22] and as follows:

$$\text{Egg mass (g)} = \frac{cumulative\ egg\ weight\ (g)}{number\ of\ females\ in\ the\ replicates}$$

a. The relative weight of the albumen:

The relative weight of the albumen was calculated after subtracting the weight of the yolk and the weight of the shell with the membranes from the total weight of the egg according to the following equation given by the researchers [20] and as follows:

The relative weight of the albumen = the weight of the albumen × 100 / the weight of the egg

b. Relative weight of the yolk:

After accurately separating the yolk from the albumen, it was weighed using a sensitive balance (0.01). The relative weight of the yolk was calculated according to the equation given by the researchers [23] as follows:

Relative weight of the yolk = weight of the yolk × 100 / weight of the egg

c. The relative weight of the shell:

After separating the eggshell and its membranes, it was weighed using a sensitive digital balance (0.01), and the relative weight of the shell was calculated according to the following equation:

Relative weight of the shell = weight of the shell(g)×100/ weight of the egg(g)

d. Shell thickness:

The shell thickness of each egg was measured using a digital caliper (Vernier with an accuracy of 0.01 mm) from three locations, and the average shell thickness was calculated by dividing the sum of the readings by three.

e. The egg shape index:

Nine eggs were taken from each treatment to measure their length and width using a digital caliper (vernier with an accuracy of 0.01 mm), by placing them longitudinally and then horizontally between the two heads of the device, adjusting the reading, and recording the length and width, then the egg-shape index was calculated by applying the following equation:

egg shape index % = egg width mm × 100/ egg length mm

f. Yolk index:

The yolk shape index was calculated by applying the following equation:

Yolk index= Yolk height mm / Yolk diameter mm

g. Yolk color:

Yolk color was measured by visual comparison using a printed yolk color fan

h. Haugh unit

The Haugh unit was calculated from the relationship between the egg's weight and the egg's height by applying the researcher's equation [23].

$$H.U = 100 \text{ Log } (H + 7.57 - 1.7 W^{0.37})$$

Where : H = height of the egg(mm), W = weight of the egg (g)

Statistical analysis

A complete Randomized Design (C.R.D.) was applied. The results were analyzed using the statistical software suite Statistical Analysis System (SAS, 2012) in a one-way analysis method. Significant differences between means were compared by applying Duncan's multinomial test [24]. At a significant level (a≥0.05)

RESULTS AND DISCUSSIONS

Table (3) indicates the effect of adding some plants to the feed on the average egg weight of laying hens for the three periods and for the total duration of the experiment from 65 to 76 weeks of age. It is noted from the first period of the experiment that T2 (rosemary 1%) was superior to the control treatment in the average egg weight, which reached 65.91g, compared to the control treatment, which reached 63.72g, while no significant differences appeared between all treatments in the second and third periods and the total duration of the experiment. The improvement in egg weight gain can be attributed to the presence of bioactive components in rosemary which can have a beneficial effect on digestion by improving the bacteria in the digestive tract. Bioactive components in rosemary such as flavonoids, phenolic acids, and terpenoids [25] directly influence some digestive enzymes such as amylase and protease [26] and improve poultry growth through improving absorptive cells in the intestine [27] . It could also be due to the effects of biological activity of phenolic compounds such as carnosol and carbolic acids present in rosemary, which can lead to increased feed efficiency and conversion resulting in improved production performance [28] and this result is consistent with [29, 30, 31].

Table 3. The effect of adding some plants to the feed on the average egg weight for laying hens for 65-76 weeks of age (± standard error)

Periods	Egg weight(g)			
	T1	T2	T3	T4
65-68 wk	63.72 b ± 0.18	64.91 a ± 0.40	63.81 b ± 0.06	64.48 ab ± 0.06
69-72 wk	64.66 ± 0.07	65.04 ± 0.50	64.11 ± 0.26	64.66 ± 0.53
73-76 wk	64.78 ± 0.31	65.61 ± 0.35	64.64 ± 0.29	65.54 ± 0.27
65-76 wk	64.39 ab ± 0.17	65.19 a ± 0.41	64.18 ab ± 0.20	64.89 ab ± 0.21

Parameters: T1 = standard diet without adding T2 = adding 1% rosemary T3 = adding 2% thyme T4 = adding 1% garlic

Table (4) shows the effect of adding some plants to the feed on the average egg mass of laying hens for the three periods and the total duration of the experiment from 65 to 76 weeks of age. It is noted that in the first period of the experiment, the T2 treatment outperformed the control treatment in the average egg mass. In the second period of the experiment, the T2 and T3 treatments outperformed the control treatment in average egg mass. While in the third period and the total duration of the experiment, it is observed that the T3 treatment outperformed the control treatment and the T4 treatment The significant effect on egg mass could be due to the positive effects of thyme in improving digestion and absorption of nutrients as well as the overall health of the digestive system [32] . Thyme is known for its antioxidant and antibacterial properties mainly due to its active ingredients such as thymol and carvacrol [33] . The reason for the increase in egg mass may also be due to thyme containing the enzymes lipase, amylase, and protease, which have an important role in the process of digestion and absorption by decomposing the carbohydrate, protein, and fatty food components, which contribute to compensating for

the deficiency in the represented nutritional elements and thus increasing the mass of eggs. Al-Baidh [34]. These results are consistent with [35, 19].

Table 4. The effect of adding some plants to the feed on the average egg mass for laying hens for the period from 65-76 weeks of age (± standard error)

Periods	Egg mass(g) T1	T2	T3	T4
65-68	53.66 b	57.99 a	57.46 ab	53.59 b
wk	± 1.71	± 1.43	± 0.81	± 0.77
69-72	53.63 b	57.87 a	58.12 a	55.29 ab
wk	± 1.58	± 0.95	± 0.52	± 1.00
73-76	52.95 b	56.87 ab	59.16 a	52.59 b
wk	± 1.67	± 1.17	± 0.96	± 1.96
65-76	53.42 c	57.58 ab	58.25 a	53.83 bc
wk	±1.63	± 1.14	± 0.66	± 1.05

Parameters: T1 = standard diet without adding T2 = adding 1% rosemary T3 = adding 2% thyme T4 = adding 1% garlic

Table (5) shows the effect of adding some plants to the feed on the average feed consumption of laying hens in the three periods and the total duration of the experiment from 65 to 76 weeks of age. It is noted that in the first period of the experiment, the T3 treatment was superior in feed consumption over the control and T4 treatments while at the end of the second period of the experiment at the age of 69 to 72 weeks, it became clear that the T2 treatment was superior to the control treatment in feed consumption. It was also noted that at the end of the third period from 73 to 76 weeks of age and the total period from 65 to 76 weeks of age, there was a significant decrease in feed consumption in the control treatment compared to the addition treatments. The reason for the increased consumption of feed containing thyme is that thyme stimulates the appetite, stimulates the stomach expels gases, prevents fermentation and helps digestion and absorption of nutrients because it contains digestive enzymes (protease, amylase, and lipase) that help in the decomposition of protein food components [36] . Thyme also has antibacterial activity [37] . This may also be due to the vital role of phenolic molecules such as carnosol, carnosic acid, rosmarinic acid, and thymol found in rosemary and thyme, which lead to increased feed efficiency, leading to improved performance indicators [38]. Garlic also contains active compounds, including flavonoids, saponins, and some sulfur compounds, which have a structure and action similar to steroid hormones [39], which leads to improved performance indicators. This result is consistent with [19 ,29] while it differs with [11,40,17].

Table 5. The effect of adding some plants to the feed on the average feed consumption (g) of laying hens for 65-76 weeks of age (± standard error).

Periods	Feed intake(g) T1	T2	T3	T4
65-68	113.23 bc	113.82ab	113.96 a	112.65 c
wk	± 0.21	± 0.21	± 0.19	± 0.22
69-72	112.25 b	114.33 a	113.99ab	113.69ab
wk	± 0.96	± 0.31	± 0.41	± 0.411
73-76	111.60 b	113.55 a	113.51 a	113.61 a
wk	± 0.06	± 0.41	± 0.13	± 0.24
65-76	112.36 b	113.9 a	113.82 a	113.31 a
wk	± 0.34	± 0.31	± 0.23	± 0.25

Parameters: T1 = standard diet without adding T2 = adding 1% rosemary T3 = adding 2% thyme T4 = adding 1% garlic

Table (6) indicates the effect of adding some plants to the diet on the average feed conversion factor for laying hens for the three periods and the total duration of the experiment from 65 to 76 weeks of age. It is noted that in the first period, at the age of 65 to 68 weeks, there are no significant differences between all treatments while the T3 treatment outperformed all treatments and the control treatment at the end of the second and third periods and the total duration of the experiment.

The reason may be due to the beneficial effect of the Lamiaceae family (thyme and rosemary), resulting from phenolic compounds that show significant antimicrobial and antifungal activity, which has led to an improvement in the health status of birds and is reflected in the efficiency of protein conversion [38].This improvement can be attributed to its essential oil content, which contains active ingredients that possess antimicrobial, antifungal and antioxidant activities and thus can improve the birds' utilization of nutrients [30] . The result agreed with [31,41,42].

Table 6. The effect of adding some plants to the diet on the average feed conversion factor (gm) for laying hens for the period from 65-76 weeks of age (± standard error)

Periods	FCR T1	T2	T3	T4
65-68	2.11	1.97	1.98	2.1
wk	± 0.06	± 0.04	± 0.02	± 0.02
69-72	2.10 a	1.98 ab	1.96 b	2.06 ab
wk	± 0.05	± 0.02	± 0.01	± 0.04
73-76	2.11 ab	2.06 ab	1.92 b	2.17 a
wk	± 0.06	± 0.04	± 0.03	± 0.08
65-76	2.11 a	1.98 ab	1.95 b	2.11 a
wk	± 0.05	± 0.03	± 0.02	± 0.04

Parameters: T1 = standard diet without adding T2 = adding 1% rosemary T3 = adding 2% thyme T4 = adding 1% garlic

Table (7) indicates the effect of adding some plants to the feed on the egg production rate for the three periods and the total duration of the experiment from 65 to 76 weeks. It is noted that there are no significant differences between all treatments in the first period from 65 to 68 weeks of age, while it was

shown that there are significant differences between Treatments during the second and third period and the total duration of the experiment. Treatment T3 gave the highest percentage of egg production, reaching (90.67, 91.56, 90.77)% compared to the control treatment (82.93, 81.74, 82.96)%, respectively.

The significant improvement in the egg production rate in the diet to which thyme leaf powder was added may be attributed to the effectiveness of thyme in inhibiting Escherichia coli bacteria, which enhances the bird's health condition, reflected in its productive performance. Thyme also contains the enzymes lipase, amylase and protease, which have an important role in the process of digestion and absorption through their prominent role in decomposing fatty, carbohydrate and protein food components [35],that helps compensate for the deficiency in the representation of absorbed nutrients. This result agreed with [43, 42, 43, 19].

Table 7. The effect of adding some plants in the feed on the percentage of egg production in laying hens for the period from 65-76 weeks of age (± standard error)

	HD%			
Periods	T1	T2	T3	T4
65-68 wk	84.22 ± 2.86	89.39 ± 2.58	90.08 ± 1.33	83.13 ± 1.29
69-72 wk	82.93 b ± 2.43	88.99 ab ± 1.54	90.67 a ± 1.03	85.51 ab ± 1.85
73-76 wk	81.74 b ± 2.66	86.71 ab ± 2.17	91.56 a ± 1.89	80.26 b ± 3.3
65-76 wk	82.96 b ± 2.63	88.36 ab ± 2.06	90.77 a ± 1.29	82.96 b ± 1.85

Parameters: T1 = standard diet without adding T2 = adding 1% rosemary T3 = adding 2% thyme T4 = adding 1% garlic

The statistical analysis results in Table (8) show the effect of adding some plants to the feed on some qualitative characteristics of laying hen eggs for the period from 65-76 weeks of age. The results showed that there were no significant differences in adding plants in egg weight, yolk weight, albumin weight, shell weight, shell thickness, shape index, and Haugh unit.

As for the yolk index, adding 2% thyme gave the egg yolk index the highest significant value, which reached 0.38 compared to the control, which reached 0.35. As for the color of the yolk, the T2 treatment gave the lowest value, reaching 7.32 compared to the control, which amounted to 7.89. These results agreed with [42] who confirmed an improvement in the yolk index when plants were added to the feed. It also agreed with [29,44,45] who showed an improvement in the color of the yolk when using rosemary powder in the diet of laying hens.

Table 8. The effect of adding some plants to the feed on some qualitative characteristics of laying hen eggs for the period from 65-76 weeks of age (± standard error).

Treatments	Egg weight (g)	yolk index %	shape index
T1	68.09 ± 1.32	0.35 b ± 0.06	73.74 ± 0.71
T2	68.9 ± 1.29	0.35 b ± 0.08	74.02 ± 0.72
T3	68.66 ± 1.59	0.38 a ± 0.04	74.85 ± 0.79
T4	67.14 ± 1.39	0.36 ab ± 0.06	75.25 ± 2.37
Treatments	shell weight %	shell thickness (mm)	Hough unit
T1	13.64 ± 0.36	0.42 ± 0.09	75.79 ± 1.08
T2	13.1 ± 0.46	0.41 ± 0.01	76.98 ± 1.21
T3	13.14 ± 0.44	0.42 ± 0.01	75.36 ± 1.72
T4	13.46 ± 0.32	0.4 ±0.07	78.04 ± 1.84
Treatments	yolk weight %	Albumen weight %	yolk color
T1	25.34 ± 0.76	61.02 ± 0.94	7.89 a ± 0.21
T2	27.09 ± 0.87	59.81 ± 1.09	7.32 b ± 0.16
T3	26.62 ± 0.99	60.23 ± 0.87	7.55 ab ± 0.15
T4	27.41 ± 1.11	59.13 ± 1.05	7.45 ab ± 0.12

Conclusions

It could be concluded that adding the herbaceous plants under study significantly positively affected some of the traits studied compared to the treatment without addition. The results of the statistical analysis showed a significant superiority of the second treatment (rosemary 1%) in the average weight of eggs compared to the control treatment. The third treatment (thyme 2%) also gave the highest percentage of egg production and egg mass and the best food conversion factor, and it also gave the highest index of egg yolk. The addition also led to an increase in feed consumption for all addition treatments compared to the control.

Conflict of interest: There is no conflict of interest.

References

[1] Czekajło-Kozłowska, A., Różańska, D., Zatońska, K., Szuba, A., & Regulska-Ilow, B. (2019). Association between egg consumption and elevated fasting glucose prevalence in relation to dietary patterns in selected group of Polish adults. Nutrition journal, 18, 1-11.

[2] Zhang, L., Ge, J., Gao, F., Yang, M., Li, H., Xia, F., ... & Shi, L. (2023). Rosemary extract improves egg quality by altering gut barrier function, intestinal microbiota and oviductal gene expressions in late-phase laying hens. Journal of Animal Science and Biotechnology, 14(1), 121.

[3] Wang, X. C., Wang, X. H., Wang, J., Wang, H., Zhang, H. J., Wu, S. G., & Qi, G. H. (2018). Dietary tea polyphenol supplementation improved egg production performance, albumen quality, and magnum morphology of Hy-Line Brown hens during the late laying period. Journal of Animal Science, 96(1), 225-235.

[4] Al-Hameed, S. A. (2019). Effect of dietary grounded fenugreek (Trigonella foenum graecum L.) seeds and ginger (Zingiber officinal) rhizomes powder on performance and some blood traits of layer hens. Plant Archives (09725210), 19(2).

[5] Amrik, B., & Bilkei, G. (2004). Influence of farm application of oregano on performances of sows. The Canadian Veterinary Journal, 45(8), 674.

[6] Abd El-Motaal, A. M., Ahmed, A. M. H., Bahakaim, A. S. A., & Fathi, M. M. (2008). Productive performance and immunocompetence of commercial laying hens given diets supplemented with eucalyptus. International Journal of Poultry Science, 7(5), 445-449.

[7] Yannakopoulos, A., Tserveni-Gousi, A., & Christaki, E. (2005). Enhanced egg production in practice: the case of bio-omega-3 egg. International Journal of Poultry Science, 4(8), 531-535.

[8] Arpášová, H., Gálik, B., Hrnčár, C., Fit, M., Herkeľ, R., & Pistová, V. (2015). The effect of essential oils on performance of laying hens. Scientific Papers Animal Science and Biotechnologies, 48(2), 8-8.

[9] Çufadar, Y. (2018). Effects of dietary different levels of rosemary essential oil on performance and eggshell quality parameters in laying hens. Selcuk Journal of Agriculture and Food Sciences, 32(3), 454-457.

[10] Batista, N. R., Garcia, E. R. M., Oliveira, C. A. L., Arguelo, N. N., & Souza, K. M. R. (2017). Trace mineral sources and rosemary oil in the diet of brown

[11] Ghasemi, R., Zarei, M., & Torki, M. (2010). Adding medicinal herbs including garlic (Allium sativum) and thyme (Thymus vulgaris) to diet of laying hens and evaluating productive performance and egg quality characteristics. Am J Anim Vet Sci, 5(2), 151-154.

[12] Rybak, M. E., Calvey, E. M., & Harnly, J. M. (2004). Quantitative determination of allicin in garlic: supercritical fluid extraction and standard addition of alliin. Journal of Agricultural and Food chemistry, 52(4), 682-687.

[13] Shoetan, A., Augusti, K. T., & Joseph, P. K. (1984). Hypolipidemic effects of garlic oil in rats fed ethanol and a high lipid diet. Experientia, 40, 261-263.

[14] Ünlü, M., Vardar-Ünlü, G., Vural, N., Dönmez, E., & Özbaş, Z. Y. (2009). Chemical composition, antibacterial and antifungal activity of the essential oil of Thymbra spicata L. from Turkey. Natural Product Research, 23(6), 572-579.

[15] Behnamifar, A., Rahimi, S., Torshizi, M. K., Hasanpor, S., & Mohamadzade, Z. (2015). Effect of thyme, garlic and caraway herbal extracts on blood parameters, productivity, egg quality, hatchability and intestinal bacterial population of laying Japanese quail.

[16] Beyazitoğlu, Ş. (2009). The effects of supplemented dietary of alfa-tocopherol acetat, carvacrol, carnosic acid in laying hens on egg production, egg quality and blood parameters and under high temperature.

[17] Mohammed, H. A., & Razaaq, S. R. (2020). Effect of additive garlic, black seeds and lettuce leaves in diet of local layers hen on performance, carcass qualities characteristic and chemical composition. Plant Arch, 20(Suppl 2), 1685-1690.

[18] Elnaggar, A. S. (2016). Productive, physiological and immunological effect rosemary leaves meal (Rosemarinus officinalis) supplementing to broiler diet. Egyptian Poultry Science Journal, 36(4), 859-573.

[19] Hamed, H. A., & Sadik, H. L. (2011). Effect of adding different levels of crushed leaves of thymus vulgaris to the diet on productive performance of white laying hens (Shever). Al-Anbar Journal of Veterinary Sciences, 4(2).

[20] Al-Fayyad, Hamdi Abdel Aziz and Naji, Saad Abdel Hussein. 1989. Poultry Products Technology. Higher Education Press - University of Baghdad.

[21] Al-Zubaidi, Suhaib Saeed Salwan. (1986). Poultry Management. Basra University Press - University of Basra.

[22] Rose, S. P. 1997. Principles of Poultry Sciences. CAB International, Walling

[23] Parmar,S.N.S.; M.S,Thakur, S.S.,Tomar and P.V.A,Pillai (2006) Evalualtion of egg quality traits indigenous kadaknath breed of poultry .Livistock Research for Rual, Development 18(9).

[24] Duncan, D. B. (1955). Multiple range and multiple F tests. biometrics, 11(1), 1-42.

[25] Sharma, A., Dhuria, R. K., & Dhuria, D. (2021). In vitro antibacterial potentials of various extracts of rosemary leaf powder and black cumin seed powder.

[26] Jang, I. S., Ko, Y. H., Kang, S. Y., & Lee, C. Y. (2007). Effect of a commercial essential oil on growth performance, digestive enzyme activity and intestinal microflora population in broiler chickens. Animal Feed Science and Technology, 134(3-4), 304-315.

[27] Jamroz, D., Wertelecki, T., Houszka, M., & Kamel, C. (2006). Influence of diet type on the inclusion of plant origin active substances on morphological and histochemical characteristics of the stomach and jejunum walls in chicken. Journal of Animal Physiology and Animal Nutrition, 90(5-6), 255-268.

[28] Bozin, B., Mimica-Dukic, N., Simin, N., & Anackov, G. (2006). Characterization of the volatile composition of essential oils of some Lamiaceae spices and the antimicrobial and antioxidant activities of the entire oils. Journal of agricultural and food chemistry, 54(5), 1822-1828.

[29] Kedir, S., Tamiru, M., Tadese, D. A., Takele, L., Mulugeta, M., Miresa, A., ... & Burton, E. (2023). Effect of rosemary (Rosmarinus officinalis) leaf meal supplementation on production performance and egg quality of laying hens. Heliyon, 9(8).

[30] Radwan Nadia, L., Hassan, R. A., Qota, E. M., & Fayek, H. M. (2008). Effect of natural antioxidant on oxidative stability of eggs and productive and reproductive performance of laying hens. International Journal of Poultry Science, 7(2), 134-150.

[31] Mohammed, A. B., Abdulwahid, A. S., & Raouf, S. M. (2022). Effect of Thymus vulgmus addition to the diet of laying hens on egg production, egg quality, biochemical and antioxidant parameters. Adv. Anim. Vet. Sci, 10(2), 427-433.

[32] Shahryar, H. A., Gholipoor, V., Ebrahimnezhad, Y., & Monirifar, H. (2011). Comparison of the effects of thyme and oregano on egg quality in laying Japanese quail. J. Basic Appl. Sci. Res, 1(11), 2063-2068.

[33] Abdel-Wareth, A. A. A. M. (2011). Effect of thyme, oregano and their major active components on performance and intestinal microbial populations of broilers (Doctoral dissertation, Universitäts-und Landesbibliothek Bonn).

[34] Al-Hadith, Silvana Tariq Shaaban. (2006). Qualitative characteristics of local and cultivated thyme and their use as an inhibitor of bacterial growth and an antioxidant for oils. Master's thesis in Food Technology, College of Agriculture, University of Baghdad.

[35] Vakili, R., & Heravi, R. M. (2016). Performance and egg quality of laying hens fed diets supplemented with herbal extracts and flaxseed.

[36] Scott, M. L., M.C. Nesheim and R. J. Young. 1982. Nutrition of the chicken. 3rd ed. Scott and associates company. Ltheca, New York.

[37] Dorman, H. D., & Deans, S. G. (2000). Antimicrobial agents from plants: antibacterial activity of plant volatile oils. Journal of applied microbiology, 88(2), 308-316.

[38] Abd El-Hack M E, Alagawany M, Farag M R, Tiwari R, Karthik K, Dhama K, Zorriehzahra J and Adel M. 2016a. Beneficial impacts of thymol essential oil on health and production of animals, fish and poultry: A review. Journal of Essential Oil Research 28: 365 - 82.

[39] Khodary, R. M., El-Azzawy, M. H., & Hamdy, I. R. (1997). Effect of Nigella sativa on egg production hatchability percentage and some biochemical values in laying hens with reference to fertility in cockerels.

[40] Ezenwosu, C., Ayuba, S. A., Anizoba, N. W., Linda, O. A., & ONYIMONYI, A. E. (2023). Laying Performance, Yolk Cholesterol, Serum Lipid Profile And Haematological Response Of Layer Hens Fed Diet Containing Moringa Leaf Meal And Garlic Powder As Feed Additive. Journal Of Agriculture, Food, Environment And Animal Sciences, 4(2), 259-275.

[41] Alagawany, M., Abd El-Hack, M. E., Saeed, M., Arain, M. A., Bhutto, Z. A., Fazlani, S. A., ... & Arif, M. (2017). Effect of some phytogenic additives as dietary supplements on performance, egg quality, serum biochemical parameters and oxidative status in laying hens. Indian J Anim Sci, 87(103), 100.

[42] Abdel-Wareth, A. A. A., Ismail, Z. S. H., & Südekum, K. H. (2013). Effects of thyme and oregano on performance and egg quality characteristics of laying hens. World's Poultry Sci. Journal, 1-6.

[43] Kamel, S. M. (2020). Effect of herbs on productive performance of laying hens, some blood constituents and antioxidant activityin egg yolk. Egyptian poultry science Journal, 40(2), 493-505.

[44] Bala, D. A., Matur, E. R. D. A. L., Ekiz, E. E., Akyazi, I., Eraslan, E., Ozcan, M., ... & Keten, M. (2021). Effects of dietary thyme on immune cells, the antioxidant defence system, cytokine cascade, productive performance and egg quality in laying hens.

[45] Park, S. B., Lee, K. J., Lee, W. H., & Ryu, K. S. (2012). Effect of feeding Thymus vulgaris powder on the productivity, egg quality and egg yolk fatty acid composition in laying hens. Korean Journal of Poultry Science, 39(2), 157-161.