IMPROVING EGGS PRODUCTION AND QUALITY FOR LAYER BY STOCKING DENSITY AND MEDICINAL PLANTS

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ABSTRACT

This study was aimed to increasing egg production by supplementing medicinal plants *Salvia officinalis L* and *Lavandula angustifolia L* powders as antistressors in hen layer diet under high stocking density during different conditions. 240 two hundred and forty 31 weeks old hens layer were randomly divided into seven treatments with three replicates in each, reared for 16 weeks as folowings; T0 negative control normal density 24 layers, 8 layers/1.20 m^2 in each replicate (7 hens/m^2) fed a basal diet. T1 positive control basal diet, T2 basal diet+ 0.7% salvia, T3 basal diet+ 0.9% salvia, T4 basal diet+ 0.7% lavender, T5 basal diet+ 0.9% lavender and T6 basal diet+ 0.7% mix (0.35% salvia+0.35% lavender). From T1-T6, the stock density is 36 layers in each treatments, 12 layers/1.30 m^2 (9 hens/m^2). All layers were exposed in hot, normal, semi-cold conditions. The results showed productivity, hematology and immunity traits significantly improved by adding the two plants 9% lavender, 0.7% lavender, and 0.7% mixed, respectively, under stocking density led to significantly increase hen day egg production HD%, egg mass g, egg weight g, FCR for feed/1g egg, and feed/1egg were improved by 0.9% lavender and 0.7% mixed. Moreover, egg quality improved by adding the medical herbals. The yolk color was also improved colorful, particularly in 0.9% lavender. Red blood cells RBC 106 cells/mm^3, PCV %, HGB g/dL, lymphocyte%, and total protein mg/dL were significantly increased by 0.9% salvia, 0.7% lavender, 0.9% lavender, and 0.7% mixed, while heterophil %,and the stress indicators H/L ratio and glucose mg/dL decreased. It was concluded that it's possible to increase the number of hens per m^2 area to increase number of egg production by supplementing medical herbals salvia and lavender without any adverse effect.

Keywords: Stocking density-stress, salvia, lavender, hen-day egg production, antistressors.
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تحسين إنتاج البيض والصفات النوعية دجاج البياض بزيادة كثافة الطيور وإضافة النباتات الطبية

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المستخلص

هدفت الدراسة إلى زيادة إنتاجية البيض من خلال إضافة مساحيق نباتات طبية الميرمية *Salvia officinalis L* والخزامي *Lavandulaangustifolia L* كمضادات للإجهاد في دجاج البياض الكثافات العالية للطيور تحت ظروف التربية المختلفة. أستخدم في البحث240 دجاجة بياضة بعمر 31 أسبوع تم توزيعها عشوائيا على (7) معاملات بواقع ثلاث مكررات لكل معاملة، تم تربيتها لمدة (16) أسبوعا تحت ظروف تربية مختلفة وبكثافات عالية. T0: السيطرة السالبة (كثافة طيورعادية) 24طير، 8 طير/1.2 م^2 لكل مكرر في المعاملة أي (7 طير /1م^2) التغذية على العليقة القياسية، T1:التغذية على عليقة قياسية، T2: التغذية على عليقة قياسية+ 0.7% ميرمية، T3: التغذية على عليقة قياسية+ 0.9% ميرمية، T4: التغذية على عليقة قياسية+ 0.7% خزامي، T5: التغذية على عليقة قياسية+0.9% خزامي، T6: التغذية على عليقة قياسية+ خليط 0.7%(0.35% ميرمية+0.35% خزامي)، من المعاملة الأولى وإلى السادسة كثافة الطيور 36 طير / معاملة أي 12طير/ 1.2م^2 (9 طير / 1م^2). تم تعريض جميع الطيور إلى حرارة عالية، معتدلة وباردة. اظهرت النتائج، بأن الصفات الإنتاجية والدم والمناعية قد تحسنت معنويا بإضافة نبات الخزامي 0.9% و0.7% و 0.7% خليط . تحت الكثافة العالية للطيور أدى إلى زيادة معنوية في إنتاج البيض HD، كتلة البيض ووزن البيض وتحسنت كفاءة التحويل الغذائي بإضافة الخزامي 0.9% وخليط من الميرمية والخزامي. ، تحسنت جودة البيض بإضافة الأعشاب الطبية. وكذلك تحسنت لون الصفار بإضافة 0.9% من الخزامي. كل من خلايا الدم الحمراء ملم^3/10^6, هيموغلوبين الدم %, خلايا المرصوصة للدم % , خلايا ليمفوسايت % مع بروتين الكلي للدم ملغم/ديسي لتر ازدادت معنويا في معاملات 0.9% ميرمية, 0.7% خزامي, 0.9% خزامي و الخليط. ولكن بالنسبة لخلايا المتغايرة% ومؤشر الإجهاد نسبة خلايا المتغايرة/ الليمفوسايت و نسبة غلوكوز الدم ملغم/ديسي لتر انخفضت معنويا. يمكن استنتاج بان يجوز زيادة عدد الدجاج البياض في متر مربع الواحد لغرض زيادة انتاج البيض باستخدام النباتات الطبية الميرمية والخزامي كمكملات الغذائية دون تأثير السلبي علي الدجاجات.

***الكلمات المفتاحية*: الإجهاد كثافة الطيور، الميرمية، الخزامي، إنتاج بيض الدجاجة، مضاد الإجهاد.**
وهذا جزء من أطروحة الدكتوراه يعود الي الباحث الأول

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INTRODUCTION

Profits in the commercial egg-type chicken sector are determined monthly by feed cost and nutritional value. Humans have always regarded eggs as a source of good protein (20). Many egg producers tend to increase the number of eggs per area by using housing facilities. Moreover, even though stocking density has been demonstrated to affect laying, disease, chronic stress, and reduced output are all on the rise (10). In addition, antibiotics as feed additives are dangerous since they can cause cross-resistance as well as multiple pathogen resistance. As a result, additions such as herbs and edible plants have been discovered to have unique features as growth promoters to substitute antibiotics over the previous two decades. Furthermore, medical herbal supplements are administered to animals and birds to help them function better physically and productively without causing any side effects (29;36 &10). Herbs and their essential oils have grown dramatically as a result of their many functions, traditional medicine as a therapy for various ailments are included in the *Lamiaceae* family (8). Salvia common name Sage, (*Salvia officinalis L*) and lavender (*Lavandulaangustifolia L*) plants belonging to the *Lamiaceae* family, and their active ingredients are used antioxidants, anticarcinogenic, antimicrobials, anti-inflammatory antidiabetics agents all of these act as immune-stimulating properties, can influence other physiological activities in layers and broilers, as well as help to maintain good health and welfare and boost performance (15). In addition, the effect of blood parameters, blood pressure, glucose, and cholesterol-lowering medicines would be beneficial in improving laying hen production (7& 38). Heterophils /lymphocytes ratio (H/L) ratio previously identified as a stress index. The effects of medicinal plants on the immune system of broiler chicken decreased H/L ratio(14). Phytochemicals such as flavonoids, polyphenols, alkaloids, lectins, terpenoids, polypeptides, carotenoids, and essential oils are included in the bioactive of the two plants, which improve egg production, egg weight, and feed conversion ratio in laying hens (10). In particular, hen-day egg production, feed conversion ratio, and eggshell % all improved once the *Lamiaceae* family was fed (5& 23). As a consequence, medicinal herbs including salvia and lavender have a positive impact on egg production and quality, as well as the color of egg yolk (35). Since there is no information on the use of salvia (*Salvia officinalis L*) and lavender (*Lavandula angustifolia L*) and mixture between them as supplementations in the diet of laying hens to reduce stocking density stress, this experiment was carried out the effect of using salvia and lavender as feed additives on productive performance traits, egg quality, and some physiological and immunity traits.

MATERIALS AND METHODS

Experiment site: From September-December 2020, the experiment was conducted in Gardarash, at poultry research farm, Animal Resource Department, College of Agriculture Sciences and Engineering, Salahaddin University, Erbil- Iraq.

Source of layer chicken and feed: The layers were brought from Al-Shimal company for a poultry commercial project in Erbil. However, the feed was especially for layers produced and manufactured in Erbil feed company.

Experiment design: Two hundred and forty (240) ISA- Brown strain 31-week-old laying hens were randomly assigned to seven groups, each with three replicates, were reared in a floor system. The experiment was 16under stoking density S.D. and feed supplementations as the followings; T0 negative control normal S.D. 8 hens in 1.20 m^2 (7 hens in $1m^2$) the hens fed standard feed without feed supplementations, T1 positive control with S.D 12 hens in 1.30 m^2 (9 hens in 1 m^2) the hens fed standard feed without feed supplementations. The laying hens in T2, T3, T4, T5, and T6 were reared in the same density the hens fed standard feed + herbal supplementations salvia powder 0.7%, 0.9% lavender powder 0.7%, 0.9% and mix salvia+ lavender powders 0.7%. The feed was mash , every day in the morning the feed was given to the hens by weighing 120g feed per hen/ day, while water was given free. Eggs in all treatments were collected twice every day, in the morning and afternoon at the same time then counted. Light program; the light program was controlled by a timer of 16 hours light- 8 hours darkness. All the hens reared in

different conditions; normal and preparation (26°C), hot(30-29°C), normal(22-26°C) and semi-cold (under 16-13 °C) conditions, four weeks for each period.

Studied traits and data collection;

Egg production: the traits of hen-day egg production HD%, feed intake FI, feed conversion ratio FCR (g feed/ g egg) and FCR (g feed/ 1 egg)**.**

Egg quality measurements: every week, eggs from each treatment replicate are taken to the lab to calculate egg quality measurements:

Egg weight (g), egg mass (g).

Haug unit was calculated as: Haugh Unit = $100 \text{ Log } (H + 7.57 – 1.7 W^{0.37})$ (13)

As:H =albumin height (mm),W=eggweight (g)

Egg shape index, Egg strength (g /mm^2) was measured by (Egg Force Reader, OC-SPA, France Technical Services, and Supplies). Shell thickness (mm) was measured by a digital micrometer in three points of the shell after drying. Shell weight (g), yolk weight (g), and yolk color.

Blood and serum parameters; at the end of the experiment, the blood sample was collected from hens for each replicate of treatments and separated into two tubes. The first tube with anticoagulants (heparin) for blood cells measurements, and tube without anticoagulants for serum separation for biochemical and immunity tests. All the samples were brought to the laboratory.

Whole blood cells tests; Red blood cells (RBCs (10^6 cells/ mm^3)). Hemoglobin (Hb (g/dl)), white blood cells differentiation, lymphocyte% and heterophil% then heterophil/ lymphocyte H/L ratio were calculated.

Blood biochemical tests, serum tubes are taken to the laboratory to determine the range of cholesterol (mg/dl), Total protein (TP) (mg/dl), and glucose (mg/dl) by put the sample in Cobas Integrata400 plus.

Liver function tests, enzymes Aspartate aminotransferase AST(U/L) and alanine aminotransferase ALT(U/L) were calculated by Cobas 6000.

Tests diagnostic diseases, Newcastle disease (ND), and Infectious bronchitis disease (IBV) titer were determined by ELISA.

Table1.The two herbal chemical analyses

Components/100g	Salvia	Lavender
Fe mg	46	50
Co mg	2.3	2.4
Cu mg	22.4	15
Zn mg	81	41
Pb mg	3.9	4.6
K mg	30	20
Ca mg	460	1980
Na mg	60	13
Se mg	-	1.2
Carotene µg	903	690

Table2. Diet Ingredients and chemical compositions

Ingredients	Composition%
Yalow corn	25
Wheat	17.2
Soybean meal 48%	22
Flour	20
bran	3.5
Limestone	7.6
Vitamins- premix*	0.2
Minerals premix *	0.2
Salt	0.2
Mono-calcium phosphate	2.0
Calcium- Methionine	0.39
Lysine	0.74
Threonine	0.5
Phosphorus	0.47
Calculated analysis nutrient (%)	
Dry matter	89
Moisture	11
Crude protein	17.3
Metabolized energy(kcal/kg)	2775.0
Ash	6.1
Crude fat	3.4
Crude fiber	4.4

*Vitamins premix supplied per 1 kg of diet: Vit. D3 IU 2,500.26, Vit. E (alfatocopheryl) mg 50.26, Vit. K3 mg 2.76, Vit. B1 mg 2.26, Vit. B2 mg 5.00, Vit.B6 mg 5.00, Vit.B12 mcg 25.00, Biotin mg 0.10, Niacin mg 30.00, Folic acid mg 2.00.

*Minerals premix supplied per 1 kg diet: Ca % 4.0000, P % 0.5373 Ca / P % 9.88, Na % 0.1668, K % 0.7149, Chloride % 0.2498, Ca % 4.0000, P (Av) Calc. % 0.4047 Mn mg 105.26, Zn mg 70.26, I mg 1.76, Cu mg 15.26, Se mg 0.51, Choline mg 944.76, Lysine % 0.7424, Meth + Cyst % 0.6807, Antioxidants 0.1%. Note; T2 until T6 medical plants supplemented on basal diet (28).

Statistical analysis: The collected data were subjected to variance analysis (ANOVA).

Statistical Analysis Software (34) was used to evaluate the data. Duncan's Multiple Range Test (11) was used to evaluate whether there were significant differences between the treatment means at P<0.01 and P<0.05. The statistical analysis' findings were given as mean ± Standard error of the mean (SEM).

Yij = μ + Ai + eij

RESULTS AND DISCUSSION

The present study illustrated that herbal supplementations salvia and lavender powders and the combination between them may reduce the stress caused by increasing the number of chickens in the same area in different conditions. lavender 0.9% significantly (P≤0.01)increased HD% to 82.46% led to reach negative control 82.75% normal density, then 0.9% salvia follow it the lowest egg production was recorded in the positive control (76.29%). The findings are similar to those that indicated that hen-day egg production was significantly (P<0.01) reduced by about 3% when the density of birds increased to10 birds/m^2 without supplementations (21;22& 39). Plants in the *Labiatae* family have been shown to promote stability in animal production, which has also been demonstrated in poultry meat and eggs (14). Furthermore, Manna oligo saccharide (MOS), n-3 polyunsaturated fatty acids, yeast cell wall extract, medicinal plants and natural herbs, and their essential oils have all been shown to have coccidiostat action and suppress the pathogen bacteria in the gut (19). The current results in this study agree with (41) when investigated that using 0.30, 0.45% of salvia powder significantly(p<0.05) increased quails egg production. As well, salvia contains the strongest antioxidant, flavonoids, and polyphenolic compounds such as rosmarinic acid, luteolin-glucoside, caffeic acid and nepetin related to antidepressant effects (2). Lavender's main bioactive compounds are linalool, linalyl acetate, and camphor in diets could improve laying performance, antioxidative status, and hormonal profile (33). Furthermore, the bioactive components in both herbal plants examined have antibacterial and antioxidant characteristics, and they play an important role in nutrient digestion and absorption, which could have improved laying hen performance measures (10). Recently, due to its effect of Gamma-aminobutyric acid (GABA) receptor modulation in the brain generate anxiolytic and antistressor activity, lavender has been used in insomnia therapy (6). Lavender is known as a great stress reliever, this is due to a variety of benefits of lavender such as antianxiety, antiviral, enhance blood circulation, aromatherapy, insect-repellent, could reduce stress and made the hens feel relax and affect the nervous system and stimulate gonads hormones (luteinizing hormone LH and follicle-stimulating hormone FSH) to secrete and ovulation and oviposition occur (24; 9& 37). On the other hand, medical plants stimulate the ovary to secretion estrogen and progesterone, as well as, simulate oviduct and tubules glands to manufacturing special proteins ovalbumin, conalbumin, lysosomes, and yolk proteins lipovitellin and phosvitinwith triglyceride lipids present in blood under monitoring liver and estrogen hormone increase egg production (41). Feed conversion ratio FCR defined in the laying hen's ability to convert feed consumption into egg production during the specific period under S.D represented in (Table 3) reveal that herbal supplementations improve overall FCR. The lower FCR (g feed/ 1g of egg) value was recorded in 0.9% lavender (2.33) and 0.7% mixed (2.38), as well as FCR (g feed/ 1egg) in lavender treatments 0.7% and 0.9% lavender were recorded the lowest value as compared with positive control. The findings are supported by those (39& 38) who found increasing stocking density significantly (p< 0.05) reduced FCR of laying hens and ducks. The results are in the line with (41;1&12) when showed medical herbals in *the Lamiaceae* family such as salvia, peppermint, and lavender improved FCR. The reason for improving the feed utilization and the growth performance due to supplementation of salvia and lavender may return to improvement exist in the metabolic system by balancing between beneficial and pathogenic bacteria cause increasing the enzymatic activity of digestion products by enhancing ring liver function, as well as the desired smell of lavender may effect of increasing palatability to eat more(12;25& 36). Furthermore, the existence good amount of antioxidants in salvia and lavender have

radical scavenging action during lipid oxidation caused by reducing laying hens FCR (32). However, (21& 22) observed that stocking density decreases feed intake, while the non-significant effect on FCR. Moreover, The health of the flock, the type of basal diet, and environmental variables may all influence the effects of feed additives in different experiments (40).

Table3. Effect of stocking density herbal supplementations on egg production and Feed Conversion Ratio (FCR).

Traits	Negative control	Positive control	0.7% salvia	0.9% salvia	0.7% lavender	0.9% lavender	0.7% mixed	SEM
Hen day HD%	82.75^{a}	76.29c	80.12	77.87^{bc}	81.24^{ab}	82.46^{a}	81.14^{ab}	1.21
			egg production					
FCR/ 1g egg	2.47^{abc}	2.61^{a}	2.43^{bc}	2.52^{b}	2.41^{bc}	2.33^{c}	2.38^{c}	0.07
FCR/1 egg	147.05^{c}	173.85^{a}	155.99^{bc}	154.30^{bc}	150.07^{c}	147.35^{c}	159.08^{b}	3.86.

From positive control till 0.7% mixare stressed treatments. $^{a-c}$ Means within columns with different superscripts differ significantly at (P<0.01) and N.S= Non-significant. ±Standard error, SEM= Standard Error Mean

(Table.4) shows data obtained the influence of salvia and lavender on egg quality measurements. Treatments that were under S.D. and received herbals led to a significantly(P≤0.01) increased in egg weight (g), egg mass(g), haugh unit, egg shape index, shell weight(g), yolk weight (g), and yolk color as compared with positive control. However, egg strength and shell thickness (mm) did not show significant differences between treatments. The results in the current study are in agreement with those results (20& 39) when mentioned that stocking density significantly decreases egg weight, egg mass, egg shape. Moreover, the results are in agreement with (41)who showed that adding salvia powder in quail diet increased egg mass while egg shape index, shell thickness, and shell thickness effect nonsignificant. Also agree with (33& 38) when recommended that using lavender oil in layer feed significantly increased egg mass, yolk index, haugh unit, and yolk color when compared with the control group. Furthermore, in comparison to the control, treatments containing lavender essence had a higher yolk color score (35& 29). However, the current findings disagree with (27) when found that adding herbal plants in laying diet did not effect of haugh unit and shell weight. Considering the majority of albumin is water and that most herbs have a bitter flavor, it is reasonable to deduce that this results in increased water consumption and egg weight. There's also the possibility of getting heavier eggs due to an increase in the amount of ovosin protein (27& 31). The medicinal plants can increase the productivity and health of laying hens by stimulating the release of digestive enzymes and lowering the bacterial colony in their digestive tracts, which can lead to the creation of more egg protein (27). Increasing egg weight albumin weight led to increasing haugh unit. Adding lavender to the laying hen feed causes increasing shell weight due to the presence of a high amount of calcium 1980 mg more than salvia 460 mg (Table 1). Medical plants are caused by increasing yolk weight due to more presentation of unsaturated fatty acids, minerals, and vitamins. The stability of yellow pigments in the yolk membrane among the lipid molecules is related to an increase in the yolk index, and antioxidants can protect these molecules from oxidative stress (27). Carotenoids are the pigments that give eggs their color, and they also serve as antioxidants, pro-vitamin A, and immunological stimulants (4). And due to salvia containing 903 µg, lavender 690 µg of carotenes (Table 1), incorporating herbal plants into hen diets can boost the nutritional value of produced eggs by increasing the level of carotenoids and more colorful (16& 31).

Table.4. Effect of stocking density and herbal supplementations on egg quality measurements.

Traits	Negative control	Positive control	0.7% salvia	0.9% salvia	0.7% lavender	0.9% lavender	0.7% mixed	SEM
Egg weight (g)	61.10^{bc}	60.25^{c}	61.46^{b}	61.31^{b}	61.58^{b}	63.38^{a}	62.47^{ab}	0.88
Egg mass (g)	50.60^{ab}	45.20^{c}	48.52^{b}	47.81^{b}	49.83^{ab}	52.60^{a}	50.97^{ab}	1.31
Haugh unit	94.07^{a}	89.74^{c}	92.71^{b}	91.76^{b}	91.65^{b}	93.41^{ab}	95.88^{a}	2.34
Egg shape index	78.71^{a}	77.46^{b}	78.07^{ab}	78.42^{ab}	78.95^{a}	78.40^{ab}	78.50^{ab}	0.70
Egg strength (g/cm^2)	1390.16	1378.62	1282.10	1499.47	1478.44	1605.16	1474.73	143.06
Shell thickness (mm)	0.405	0.404	0.410	0.401	0.409	0.401	0.402	0.01
Shell weight(g)	6.13^{b}	6.11^{b}	6.27^{a}	6.12^{b}	6.27^{ab}	6.30^{a}	6.17^{ab}	0.15
Yolk weight (g)	16.01^{b}	16.03^{b}	16.23^{ab}	16.80^{a}	16.39^{ab}	16.58^{ab}	16.54^{ab}	0.34
Yolk color	5.95^{d}	6.15^{d}	7.19^{c}	7.71^{ab}	7.61^{b}	7.88^{a}	7.53^{b}	0.21

From positive control till 0.7% mixare stressed treatments. $^{a-d}$ Means within columns with different superscripts differ significantly at (P<0.01) and N.S= Non-Significant. ±Standard error, SEM= Standard Error Mean.

The influence of adding salvia and lavender powders on some blood parameters and immunity are represented in (Table 5). The results in the present study reveal that using 0.7, 0.9% salvia,0.7, 0.9% lavender powder, and combination between them by 0.7% in the layer feed improved whole blood characteristics under S.D. RBCs (10^6 cells/mm^3), PCV%, Hb(g/dL), and lymphocyte% were significantly (P≤0.01) increased, while heterophil% and stress indicator H/L ratio decreased when compared with positive control. 0.9% of salvia increased significantly (P≤0.01) serum total protein (TP mg/dL). As well as, salvia and lavender decreased serum glucose(mg/dL) when compared with the positive control, however, a slight decrease in serum cholesterol (mg/dL) was seen in 0.9% salvia but that does not affect significantly differences among treatments. Hens under crowding stress while received salvia and lavender kept liver enzyme AST(U/L) in a normal range similar to negative control and effect significantly different conditions by checking and significantly (P≤0.01) increased, however, did not effect of ALT (U/L). In addition, the antibody against diseases ND and IBV in supplementations treatments under S.D. significantly (P≤0.05) increased when compared with positive control. The findings in the current study are in agreement with(30) when revealed that birds' overcrowding cause significantly decrease blood parameters include red blood cells, hemoglobin, leucocyte, lymphocyte, while increased heterophile, H/L ratio, and glucose. Haemoconcentration overcrowding stress occurs when birds receive insufficient oxygen, resulting in hypoxia, which stimulates erythropoietin secretion and causes erythropoiesis in stressed birds(30). Medical plants have role in cooling body system and maintain normal temperature during heat stress (26). As well, the current findings are in agreement with (3)when observed that red blood cell counts, PCV, and hemoglobin concentrations significantly(P≤0.05) increased by adding 1 and 2 % salvia powder in the broilers feed. Also, (25) illustrated broilers fed with lavender in the diet decreased serum glucose. Moreover, (12) stated that supplementation 12g/ kg diet of sage powder to broiler chickens diets had significant increased (P≤0.05) plasma total protein and high-density lipoprotein HDL, while reduced total cholesterol, Low-density lipoprotein LDL, and ALT enzyme value compared to control, lowering cholesterol level may return to rich in herbals fibrous substance and may inhibit intestinal cholesterol absorption, could explain the lower plasma total cholesterol content (12). Using a mixture of herbs decreased the H/L ratio in turn increased birds' immunity (27). However, in disagreement with (25) when showed total protein, cholesterol, triglycerides, (HDL), and (LDL) no significant changes were observed by adding lavender between treatments. The presence of phenolic compounds, flavonoids, and carvacrol in probiotics in the two plants leads to a higher level of immunoglobulins and enhanced immune response in poultry against diseases Newcastle, influenza, and Infectious

bronchitis. High antioxidants in lavender and salvia prevent producing free radicals during metabolism and with the effect of the two herbals in liver enzymes function increase immunity in the body (31& 23). Despite the studies on the immuno-stimulatory effects of herbal plants. Phytogenic stimulates both the innate and adaptive components of the immune system (17). As well as, containing a good amount of immune minerals, medical plants, particularly salvia and lavender, aids in the normalization of birds' functions, resulting in increased T-lymphocyte and natural killer cell activity. Additionally, Chinese medicines have been shown to boost the growth of immunological organs such as the thymus bursa fabricia and spleen, as well as increase antibody production (17; 14& 36).

Table. 5. Impact of stocking density and herbal supplementations on some physiological and immunity traits.

	Negative control	Positive control	0.7% salvia	0.9% salvia	0.7% lavender	0.9% lavender	0.7% mixed	SEM
RBCs (10^6 cells/ mm^3)	2.42^{bc}	2.18^{d}	2.49^{b}	2.68^{a}	2.71^{a}	2.60^{ab}	2.60^{a}	0.02
PCV %	29.14^{c}	28.06^{d}	28.90^{cd}	30.77^{a}	30.52^{a}	30.75^{a}	30.13^{b}	0.17
Hb(g/dL)	9.63^{a}	8.00^{b}	9.87^{a}	10.23^{a}	10.00^{a}	10.23^{a}	10.00^{a}	0.12
Lymphocyte %	66.90^{bc}	64.90^{c}	68.23^{ab}	69.40^{ab}	69.70^{a}	69.93^{a}	69.47^{ab}	0.28
Heterophil%	32.23^{b}	37.57^{a}	30.77^{bc}	28.83^{cd}	28.20^{d}	27.50^{a}	27.17^{a}	0.49
H/L ratio	0.48^{b}	0.58^{a}	0.45^{bc}	0.42^{cd}	0.40^{d}	0.39^{d}	0.39^{d}	0.01
Cholesterol (mg/dl)	134.00	133.33	133.67	130.67	109.67	127.00	128.67	2.13
TP (mg/dl)	3.03^{b}	3.04^{b}	3.17^{b}	4.01^{a}	3.22^{b}	3.33^{ab}	3.62^{ab}	0.06
Glucose(mg/dL)	250.00^{a}	234.67^{a}	223.67^{ab}	196.00^{b}	194.00^{b}	195.67^{b}	191.67^{b}	3.58
AST (U/L)	140.00^{b}	181.33^{a}	144.67^{b}	156.67^{ab}	153.33^{ab}	138.00^{b}	150.00^{ab}	2.67
ALT (U/L)	2.00	1.67	1.00	1.00	1.00	1.00	1.33	0.10
ND	10899.67^{ab}	8429.67^{c}	9135.00^{b}	10934.33^{ab}	12010.67^{a}	10998.00^{ab}	12623.67^{a}	478.05
IBV	21980.00^{ab}	6581.67^{c}	17015.00^{b}	29047.33^{a}	22852.67^{ab}	28184.00^{a}	23356.33^{ab}	1360.01

From positive control till 0.7% mixare stressed treatments. RBCs=Red Blood Cells, PCV= Packed Cell Volume, HGB=Hemoglobin, H/L= Heterophil/Lymphocyte, TP= Total Protein, AST= Aspartate aminotransferase AST= alanine aminotransferase, ND= Newcastle disease, IBV= Infectious Bronchitis Virus. $^{a-d}$ Means within columns with different superscripts differ significantly at probability (P<0.01) and N.S= Non-significant. ±Standard error, SEM= Standard Error Mean

CONCLUSIONS

The results of this study revealed that stress produced by stocking density in hen layers might be reduced by using medical plants salvia (*Salvia officinalis L*) and lavender (*Lavandulaangustifolia L*), with no negative effects on productivity, physiological, and immunological traits. Poultry managers should consider cultivating more medical plants like salvia and lavender with a determined level and applying it in poultry when the birds are stressed, as well as improving productivity and immunity.

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