This study was conducted to investigate the effect of Peppermint oil (PO) and/or Vitex Agnus leaf extract (VALex) supplementations on growth performance of rabbits during summer season. Forty-eight Californian growing male rabbits aged 35 days with initial body weight of 640±34.7g were randomly divided into four equal groups. Rabbits in control group (C) were fed a basal diet without supplementation (1st group). The 2nd, 3rd, and 4th groups were fed basal diet supplemented with 800 mg/kg diet of PO, orally 1 ml VALex /kg body weight and 800 mg/kg diet of PO plus orally 1 ml VALex / kg body weight, respectively.

Results are summarized as follows:
1- Increasing in final body weight (BW) and average body weight gain (ABWG) for all treated groups with PO and /or VALex compared to control group.
2- Tested supplementations had insignificant effect on feed intake (FI), while feed conversion ratio (FCR) was significantly improved by 22.66%, 24.7% and 20.9% for the treated groups with PO, VALex and their combination groups, respectively, versus the control group.
3- Tested supplementations significantly (P ≤0.05) improved Pre-slaughter weight with those for control group, while insignificant differences were existed in carcass and edible parts.
4- Supplementations significantly decreased blood triglyceride (TG), total cholesterol(TC), high density lipoprotein (HDL) and low density lipoprotein (LDL) to control group, while supplemented groups did not represent any concentrations, alanine and aspartate aminotransferase (AST and ALT) and demeinching malonyaldehyde (MDA), while the groups supplied with...
PO and Vitex Agnnus extract had significantly high total antioxidant capacity (TAC) level compared with those of the control group.

5- Total antibody IgG significantly increased for all supplemented groups with PO and/or VAlex compared statistically change in IgM.

Conclusively, it could be recommended that using Peppermint oil and Vitex Agnnus extract could be a good tool for maximizing the growth performance, physiological status and immune response for growing rabbits under summer conditions.

Keywords: Peppermint oils- Vitex Agnnus extract – Rabbits- growth performance- Immune response- Antioxidant status.

High ambient temperature (heat stress) results in a widespread annual economic casualty in the animal production due to reductions in feed intake, weight loss, diminished carcass quality and attenuation of the immune system’s protection. Regulation of body temperature through cardiovascular system changes occur including the balance of acid-base, blood pH, respiratory alkalosis and decreased levels of blood viscosity (increase blood flow) and blood plasma protein concentration (Teeter et al. 1985).

Heat stress leads to immoderate production of free radicals, which diminished total antioxidant capacity (Robert et al. 2003). Actually, heat stress affects the sympathetic nerves and causes catecholamine hormone release thereby leading to a rise in free radicals in the blood and tissues of the body such as malonyaldehyde. Free radicals assault the construction of unsaturated fat, caused damaging cell membranes (Curi et al., 2003) and increase the peroxidation in cells whereof lead to raise lipoperoxide concentrations in the tissues. Lipoperoxide surplus leads to reduced enzyme activity of glutathione peroxides, superoxide dismutase and catalase (Du et al. 2000). On the other hand, Mashaly et al. (2004) showed that heat stress also alterations in various components of the immune system such as killer T-cell activity, cytokines secretion, propagation of lymphocytes and the level of immune proteins in broiler chickens.

Peppermint (Mentha piperita, PO) is a perennial herb belonging to the Lamiaceae family. The oil of M. piperita contains 1, 8-cineole, dihydrocarvone, limonene, phytol, linalool, thymol, carveol, piperitenone, and eugenol as the primary components (Pudpila et al., 2011). Moreover, peppermint oil is used to treat respiratory disorders (Nishino et al., 1997), digestive complaints, neuralgia,
myalgia, headaches, migraines and chicken pox (Blumenthal, 1998), menstrual cramps (Foster and Tyler, 1999), antispasmodic (Leicester et al 1982). Peppermint essential oil also has an antimicrobial effect (Pramila et al., 2012), a hepatoprotective effect due to its antioxidant content and free radical scavenger properties (Khalil et al., 2015).

Vitex (Vitex Agnus cactus L from the family of Verbenaceae) extract have been containing phytomedicinal preparations and used in traditional medicine to treat production and reproduction problems (Lachowicz, et al., 1997). The chemical compounds of Vitex extract contain several active compounds such as alkaloid vitexin, flavanols derivatives, and Kaempferol and quercetin which are excessively composed of casticin (Karunamoorthi et al., 2008). Also, Van Die et al. (2013) resulted that this plant is composed of iridoid glycosides, flavonoids, diterpenes, and volatile oil. Water extracts and ethanolic extracts of Vitex have antioxidant activity because of its flavonoid, diterpenoid, and ecdysteroid content (Chaouche et al., 2014) and modulates the activities of superoxide dismutase (SOD), catalase (CAT) and glutathione peroxides (Liuet et al., 2004).

Therefore, the objective of the present study was to investigate the effects of Peppermint (OP), Vitex Agnus cactus leaves (AAL) and its combination on the growth performance, carcass traits, blood biochemistry, antioxidant and immune status of growing rabbits.

MATERIALS AND METHODS

Housing and Management:

The present study was carried out at a Private rabbit farm in Alexandria Governorate during summer season. Ambient temperature ranged from 29 to 32°C while, relative humidity ranged from 45 to 58% and light photo period 16 hr. light: 8 hr. dark.

Animals were kept in clean, separate wire-floor metal cages (50 cm length × 45 cm width × 40 cm high) and maintained under standard laboratory conditions and kept the same managerial conditions, healthy, hygienic and clinically free of external and internal parasites.

Aqueous extract of Vitex agnus leaf (VALex):

Weight dried 100 mg / kg of leaf of Vitex agnus, then grinded into fine powder and mixed with 10 milliliter of boiled distilled water and let for 10 minutes. After that, the crude extract was filtrate by Whatman No.1 paper and
evaporator the crude extract by water stemat 20 minutesthen concentrated solution using water vapor. The crude extract was stored at glass bottles with tight lids in a refrigerator in moisture-free conditions until used in the study (each 1 ml contained100mg of VALex) (Hussein, 2007).

Assessment of effective compounds by HPLC according to Dogan et al. (2011).

Analysis of Plant Oils:
The major important components of PO oil and VALex are presented in Table 1.

Table 1: Some chemical properties of Peppermint oil (PO) and aqueous extract of Vitex agnus castus leaf (VALex)

| Qualitative compounds | Peppermint oil | Aqueous extract of Vitex agnus castus (VALex) |
|-----------------------|----------------|---------------------------------------------|
| Pulegone              | 43.5%          | ====                                        |
| Piperitone            | 12.2%          | ====                                        |
| P-methane-1,2,3-trioe | 6.5%           | ====                                        |
| γ-elemenene (3.6 %),  | 3.6%           | ====                                        |
| Guaenee (cis-β)       | 3%             | ====                                        |
| Carvacerol acetate    | 2.6%           | ====                                        |
| Phenyl ethyl alcohol  | 2.4%           | ====                                        |
| Isovitexin            | ====           | 42,3437(µg/g)                               |
| Casticin              | ====           | 23,852(µg/g)                                |

Aqueous extract of vitexagnus castus analysis according to Dogan et al. (2011).Peppermint analysis according to Ahmed (2006)

Diet nutrient profiles:
Feed and drinking water were offered on ad libitum basis. All rabbits were fed the same basal diet formulated according to the nutritional requirements of the National Research Council (NRC, 1977), which ingredients and calculated chemical composition are displayed in Table 2.

Experimental design:
A total number of 48 male California growing rabbits (weaned) aged 35 days with initial body weight of 640 ±34.7g were randomly divided into four equal treatment groups (12 males per each). The experiment lasted for 7 weeks; the groups were submitted to different experimental dietary treatments as follows:
Table 2: The basal diet formulated ingredient composition and chemical analysis of the experimental diet

| Ingredients       | Kg/ton | Calculated analysis |  
|-------------------|--------|---------------------|
| Clover hay        | 395    | Crude protein, %    | 16.8  |
| Soybean meal      | 175    | Crude fiber, %      | 13.7  |
| Wheat bran        | 149    | Ether extract, %    | 3.0   |
| Barley            | 130    | Digestible energy (kcal/kg diet) | 2680 |
| Yellow corn       | 100    | n-6 PUFAs%         | 0.3   |
| Molasses          | 30     | n-3 PUFAs%         | 1.03  |
| Dicalcium phosphate | 8     | Determined analysis (g/kg)  |
| Limestone         | 5      | DM 897.1 CF 138.5   |
| Sodium chloride   | 2      | OM 801.4 EE 23.7    |
| Vit. + Min. Premix| 3      | CP 169.8 NFE 575.0  |
| DL-Methionine     | 3      | # # Ash 96.9        |

*Provides per kg of diet: Vit. A 6000 IU; Vit. D 450 IU; Vit.E 40 mg; Vit. K 1mg; Vit. B1 1mg; Vit. B2 3 mg; Vit. B3 180 mg; Vit. B6 39 mg; Folic acid 2.5 mg; Vit. B12 5 µg; Pantothenic acid 10 mg; Biotin 10 µg; Choline Chloride 1200 mg; Zn 35 mg; Fe 38 mg; Cu 5 mg; I 0.2 mg; Se 0.05 mg and Mn 15 mg.

DM: Dry matter, OM: Organic matter, CP: Crude protein, CF: Crude fiber, EE: Ether extract, NFE: Nitrogen-free extract,

**Group 1:** Feed basal diet and served as control.

**Group 2:** Feed basal diet mixed with 800 mg PO/kg diet.

**Group 3:** Feed basal diet + orally 1ml VALex/ kg BW.

**Group 4:** Feed basal diet +800 mg PO/kg diet + orally 1 ml VALex/ kg BW.

**Growth performance traits:**
The average daily gain (ADG) was calculated on a group basis as follows:

$$ ADG = \frac{\text{(final live BW} - \text{initial live BW during a certain period)}}{\text{number of days for this period}} $$

Feed intake (FI) was calculated as the difference between the weight of the feed offered and the weight of the remained at same day of weighing the animals. Feed conversion (FC) ratio was computed as the ratio between feed intake and weight gain per period.

**Carcass characteristics:**

At the end of the experimental growing period, six rabbits were selected around the average of each treatment for carcass evaluations. The rabbits were fasted with a free water supply for 12 h before slaughtering. The rabbits were weighed pre-slaughter, slaughtered for complete depletion, skinned, and...
eviscerated. The dressed carcass free from any internal organs was weighed (carcass weight without the head). The eviscerated carcass included liver, heart and kidney were weighed. The carcass yields were calculated as a percentage of the pre-slaughter live initial body weight of the rabbits. Additionally the percentages of the total edible parts and giblets were calculated as follows:

\[
\text{Giblets\%} = \text{Kidney\%} + \text{Heart\%} + \text{Liver\%},
\]
\[
\text{Total edible parts\%} = \text{Carcass\%} + \text{Kidney\%} + \text{Heart\%} + \text{Liver\%} + \text{Lung\%}.
\]

(Sabrin et al., 2019).

**Blood biochemical and serum metabolites:**

The blood samples were withdrawn at morning from marginal ear veins under vacuum in clean tubes without heparin for each treatment group before access feed and water. Serum was obtained by centrifugation the blood at 4000 rpm for 20 min for analysis the blood biochemical parameters (total plasma protein, albumin, globulin was calculated, cholesterol, aspartate aminotransferase, alanine aminotransferase, triglycerides (TG), high-density lipoprotein (HDL), low-density lipoprotein (LDL) and malonyaldehyde (MAD), total antioxidant capacity (TAC).

All biochemical parameters were analyzed by commercially available kit methods. GNW-Model: SM-721 Spectrophotometers, Absorbance Microplate Reader and other laboratory equipment aids were used for biochemical analysis. Moreover, each parameter was done according to the instructions of its kit.

**Immune Response:**

Different types of immunoglobulins in blood serum (IgG and IgM) were determined using commercial ELISA kits (Kamiya Biomedical Company, USA).

**Statistical Analysis:**

All data were subjected to analysis of variance according to the statistical analysis system (SAS, 2002). The differences among groups means were tested by using Duncan's multiple range test (Duncan, 1955).

**RESULTS AND DISCUSSION**

**Growth Performance:**

Effect of PO, VALex and their combination supplementation on the growth performance of growing California male rabbits are shown in Table 3. The experimental supplemetations significantly (P ≤ 0.05) increased the final BW,
**Table 3:** Effect of dietary supplemented with peppermint oil (PO), oral administrated aqueous extract of *vitex agnus* leaf (VALex) and their combination on growth performance of growing male rabbits during summer season

| Items               | Control        | PO 800 mg/kg diet | Orally 100 mg/kg BW VALex | PO 800 mg/kg diet + orally 100 mg/kg BW VALex |
|---------------------|----------------|-------------------|---------------------------|-----------------------------------------------|
| Initial BW, g       | 635 ±36.3      | 632 ±37.8         | 640 ±34.7                 | 625 ±25.2                                     |
| Final BW, g         | 1700 ±46.5     | 1950 ±34.3        | 2006 ±29.8                | 2000 ±25.8                                    |
| ADG, g/rabbit/day   | 21.73 ±0.94    | 26.9 ±1.21        | 27.88 ±1.10               | 28.06 ±0.99                                   |
| FI, g/rabbit/day    | 135.3 ±4.5     | 129.38 ±2.87      | 130.10 ±3.66              | 132.00 ±3.42                                  |
| FCR                 | 6.22 ±0.45     | 4.81 ±0.39        | 4.68 ±0.62                | 4.70 ±0.44                                    |

*a,b*: Values in the same row with different superscripts differ significantly (P ≤ 0.05).

BW: body weight, ADG = average daily gain, FI = feed intake, FCR = feed conversion ratio.

ADG and improved FCR of the California growing rabbits during the experimental period compared with those in for control group. Feed intake was not statistically changed.

The improvement in FCR reached 22.66%, 24.7% and 20.9% for the groups supplied with PO, VALex and their combination, respectively compared with the control group.

Improvement results obtained due to supplying growing rabbit’s diets with PO oil, oral VALex and their combination were coincided with the results reported by Arab Ameri et al. (2016) who demonstrated that consumed peppermint powder significantly improved feed conversion ratio and body weight. Same results obtained by Galib and Al-Kassi (2010) who showed that anamelioration in BWG and FCR under dietary treatment with peppermint powder. Otherwise, Helander et al. (1998) argued that the antimicrobial activity compounds present in peppermint, increased growth, appetite and BW by restricting the growth of harmful microorganisms. Counteractively, Sabrin et al. (2019) reported the supplemented diet with PO (400mg/kg diet) did not
significantly affect the final live body weight and average daily gain compared with the control.

Same results obtained by Akbari and Torki (2014) who showed that the average BW, ADG and daily FI in female broiler chicks did not significantly affected by dietary supplementation with PO.

On the other hand, regarding V. agnus-castus this plant has well-known biological potential on digestive, antifungal and aperitif (Regiane et al., 2017). Also, Ekundayo et al. (1990) recorded that the essential oils from different parts of V. agnus-castus have been reported to display antibacterial activity against Escherichia coli, Pseudomonas aeruginosa, Bacillus subtilis, and Staphylococcus aureus, so led to increased growth, appetite and BW.

In same context, V. agnus-castus leaves and fruits contained several major classes of phytoconstituents (Lee et al., 2017). Photochemical have been shown to exert their positive antioxidant benefits toward animals in terms of favored performance, production quality (Ansari et al., 2012) and enhanced indirectly as stabilized conjugates affecting metabolic pathway (Aggarwal and Shishodia, 2006).

Carcass traits:

Date of Table 4 presents the effects of the PO, VALex and their combination on carcass characteristics. All treatment groups represented significant (P≤0.05) improvement in Pre-slaughter weight compared with control.

The rest parameters of carcass such as hot carcass, liver, heart, kidney and lung did not reveal any statistical change among the experimental groups. In agreement with the present results, Abdel-Wahab et al. (2018) display that all carcass parameters of quails were not significant affected due to peppermint supplementation. Also, Khempaka et al. (2013) showed that the percentages of eviscerated carcasses and giblets of broilers consumed dried peppermint containing diets (0.5-2.0%) were identical to those in the control group. Same result obtained by Ocak et al. (2008) who reported that broiler diet supplemented with dry peppermint had not significant effect on the relative weights of the whole gut, pancreas and edible inner organs, at slaughter. In contrast, dietary supplementation with peppermint resulted in a decreasing trend in the carcass percentages of growing Japanese quail (Mehri et al., 2015a).

However, supplemented diet with PO led to significant improvement of pre-slaughter weight (Arab Ameri et al., 2016). Concerning, Vitex agnus castus, limited information is available in effect on carcass traits.
**Table 4:** Effect of dietary supplemented with peppermint oil (PO), oral administrated aqueous extract of *vitexa gnus* leaf (VALex) and their combination on carcass traits of growing male rabbits during summer season

| Items                  | Control         | PO, 800 mg/kg diet | VALex, orally 100 mg/ kg BW | PO 800 mg/kg diet + orally 100 mg/ kg BW,VALex |
|------------------------|-----------------|--------------------|-----------------------------|-----------------------------------------------|
| Pre-slaughter weight, g| 1853.33±21.32   | 2161.66±35.41      | 2210.33±25.61               | 2225.01±31.22                               |
| Hot carcass, %         | 53.51±2.12      | 55.51±2.45         | 56.19±3.12                  | 54.16±2.11                                  |
| Liver, %               | 3.8±0.74        | 3.42±0.65          | 3.39±0.42                   | 3.34±0.39                                   |
| Heart, %               | 0.33±0.06       | 0.32±0.03          | 0.30±0.32                   | 0.35±0.04                                   |
| Kidneys, %             | 0.59±0.03       | 0.56±0.07          | 0.53±0.02                   | 0.56±0.06                                   |
| Lung, %                | 0.73±0.07       | 0.70±0.09          | 0.73±0.04                   | 0.65±0.08                                   |
| Giblets¹, %            | 4.72±0.67       | 5.00±0.46          | 4.95±0.59                   | 5.00±0.46                                   |
| Total edible parts², % | 58.23±2.27      | 60.51±1.88         | 61.04±3.16                  | 59.16±1.88                                  |

*a,b: Values in the same row with different superscripts differ significantly (P ≤ 0.05).

Giblets¹ % = Kidney %+ Heart%+Liver%+Lung%. Total edible parts² % = Hot carcass%+Kidney%+Heart%+Liver%.

**Serum Lipid Profile, Antioxidant Status, Biochemical Blood and Immune Response:**

Data in Table 5 show the effects of PO, VALex supplementations and their combination between them on serum lipid profile and antioxidant status. In the present study, the experimental treatments had a significant (P≤0.05) improvement in the blood serum total cholesterol, triglyceride, HDL and LDL levels compared with those of the control group. Moreover, data showed that growing rabbits reared during the Egyptian summer season exhibited significant (P ≤ 0.05) decrease in serum TAC based on the results obtained for the control group, whereas the PO, VALex and their combination supplementation significantly (P ≤ 0.05) ameliorated the effect of stress during summer season, decreasing serum MDA concentration...
Table 5: Effect of dietary supplemented with peppermint oil (PO), oral administrated aqueous extract of *vitex agnus* leaf (VAlex) and their combination on serum lipid profile and antioxidant status of growing male rabbits during summer season

| Items          | Control                  | PO 800 mg/kg diet | orally 100 mg/kg BW VAl ex | PO 800 mg/kg diet + orally 100 mg/kg BW VAl ex |
|----------------|--------------------------|-------------------|-----------------------------|-----------------------------------------------|
| TG, mg/dL      | 94.80 ± 4.24             | 72.13 ± 12.21     | 78.13 ± 2.83                | 75.84 ± 2.33                                 |
| TC, mg/dL      | 82.57 ± 10.40            | 74.30 ± 6.57      | 71.24 ± 2.57                | 73.44 ± 2.17                                 |
| HDL mg/dL      | 34.62 ± 0.67             | 41.62 ± 0.88      | 39.51 ± 1.31                | 41.72 ± 0.88                                 |
| LDL mg/dL      | 42.15 ± 1.06             | 33.55 ± 1.21      | 31.62 ± 1.40                | 30.92 ± 1.40                                 |
| TAC, µmol/ml   | 1.26 ± 0.06              | 1.63 ± 0.11       | 1.65 ± 0.44                 | 1.87 ± 0.12                                  |
| MDA, nmol/ml   | 6.04 ± 0.28              | 4.83 ± 0.42       | 5.17 ± 0.78                 | 4.98 ± 0.65                                  |

\(^{abc}\): Values in the same row with different superscripts differ significantly \((P \leq 0.05)\). TG = Triglyceride, TC = total cholesterol, HDL = high density lipoprotein, LDL = low density lipoprotein, IgG = immunoglobulin G, IgM = immunoglobulin M, TAC = total antioxidant capacity, MDA = malondialdehyde.

and significantly \((P \leq 0.05)\) improved TAC for groups supplied with the PO oil and AEx compared with that of the control group. These results are consistent with those of Ghazaghi et al. (2014) who showed that consumed peppermint supplementation resulted in a diminishing in the LDL concentration in growing quail. Also, Abdel-wahab et al. (2018) reported that the triglyceride, total cholesterol and LDL concentrations decreased in birds that supplemented dietary peppermint. Additionally, Barbalho et al. (2009) confirm our results and represented that the supplementation of peppermint extract improves plasma lipids profile in mice such as significantly decreases triglycerides, total cholesterol, LDL-cholesterol, VLDL-cholesterol and increases HDL-cholesterol in blood serum. On the other hand, Akbari and Torki (2014) documented that the serum total cholesterol, HDL and LDL levels in female broiler chicks had not been affected by dietary supplementation with the PO.
Concerning, Mentha piperita (EO) possesses antiradical activity with treat with deep respect to DPPH (2,2-diphenyl-1-picrylhydrazyl), and hydroxyl (OH−) radicals; actually, Schmidt et al. (2009) who revealed the antiradical activity of this EO for DPPH such as (IC50). Furthermore, Ferreira et al. (2014) reported that M. piperita is associated with rise levels of intracellular ROS, which is indicative of an apoptotic process without the loss of the plasma membrane integrity.

Regarding effect of VALex on lipid profile, Ahmed et al. (2015) reported that vitex agnus castus extracts, led to significant decreased TC, TG and LDL and increase HDL in mice. Same result obtained by Berrani et al. (2018) who showed an improvement in the lipide profile due to oral administration of methanolic extract of Vitex agnus.

Concerning, Vitex agnus castus plays major role on antioxidant capacity, Loch et al. (2000) mentioned that the methanolic extract of V. agnus-castus leaves exhibited major antioxidant activity in different antioxidant type, including ferric-chelating, scavenging activity of hydrogen peroxide and cupric-reducing antioxidant capacity. Additionally, it is owned several active materials as flavonoids, castein, orientin and which isovitexin possess the antioxidant and radical scavenging properties (Sarikurkcu et al., 2009). Interestingly, Özlem et al. (2013) illustrated that crude extracts of V. agnus-castus seeds have potent antioxidant, cytotoxic and apoptotic activity and reinstatement of activities of some antioxidant enzymes and reduction in the mitochondrial hydrogen peroxide production in animals therapeutic treated with the extract (Moreno et al., 2015).

Data in Table 6 display that the levels of serum total protein, albumin and globulin are significantly (P<0.05) increased for the rabbit groups supplied with VALex and the combination between VALex and PO compared with that of control group. Moreover, rabbits of the supplemented groups with VALex lonely or combination between VALex and PO represented significant improvement of liver function as induction of the significant reduction of AST and ALT enzymes and improvement synthesis globulin and albumen for these groups compared with control. Besides, the growing rabbits consumed a diet supplemented with PO and VALex had significant (P<0.05) higher total antibody IgG antibodies compared to control group, while titer IgM did not represented any statistical change among all experimental groups. For fore mentioned results, it is apparent the important role of peppermint for dominant the liver function.

Such findings of total protein, albumin and globulin are in harmony with that previously by Fallah et al. (2013) who mentioned that peppermint had
Table 6: Effect of dietary supplemented with peppermint oil (PO), oral administrated aqueous extract of *vitex agnus* leaf (VALex) and theira combination on the serum biochemical and immune response of growing male rabbits during summer season.

| Items       | Control           | PO 800 mg/kg diet | orally 100 mg/kg BW VALex | PO 800 mg/kg diet + orally 100 mg/kg BW VALex |
|-------------|-------------------|-------------------|---------------------------|-----------------------------------------------|
| TP (g/dL)   | 6.34<sup>b</sup> ±0.32 | 6.56<sup>c</sup> ±0.41 | 7.54<sup>a</sup> ±0.44 | 7.15<sup>a</sup> ±0.34                      |
| ALb (g/dl)  | 3.61<sup>b</sup> ±0.31 | 3.74<sup>c</sup> ±0.61 | 4.12<sup>a</sup> ±0.31 | 4.03<sup>a</sup> ±0.33                       |
| GLO (g/dl)  | 2.73<sup>b</sup> ±0.25 | 2.82<sup>b</sup> ±0.45 | 3.42<sup>a</sup> ±0.45 | 3.12<sup>a</sup> ±0.36                       |
| AST (U/L)   | 40.26<sup>a</sup> ±2.45 | 33.21<sup>b</sup> ±0.12 | 36.21<sup>b</sup> ±1.45 | 35.41<sup>b</sup> ±1.23                    |
| ALT (U/L)   | 30.42<sup>a</sup> ±1.87 | 27.45<sup>b</sup> ±0.33 | 25.35<sup>b</sup> ±1.65 | 26.44<sup>b</sup> ±2.12                    |
| IgG, mg/dl  | 198.13<sup>ab</sup> ±35.85 | 216.17<sup>a</sup> ±29.82 | 205.57<sup>a</sup> ±29.82 | 210.13<sup>a</sup> ±24.87               |
| IgM, mg/dl  | 59.43 ±9.57       | 61.89 ±13.03       | 58.39 ±13.03             | 61.11 ±10.13                               |

<sup>a,b</sup>: Values in the same row with different superscripts differ significantly (P ≤ 0.05).

ALT= alanine minotransferase, AST = aspartate aminotransferase, TP = Total protein, ALb =Albumen, GLO= Globulin, IgG = Immunoglobulin G, IgM= Immunoglobulin M,

increased albumin, total protein in broilers.

Concerning immune response, Awaad *et al.* (2010) found that the addition of 0.25 mL of PO on drinking water raise the antibody titer against the Newcastle virus vaccine in chickens. Recently, Abdel-Wahab *et al.* (2018) stated that IgG, IgA and IgM in quails are increased significantly with peppermint supplementation. On another side, the results of immune response in this study completely confirmed those of El-naggar and El-Tahawy (2018) that broiler supplemented with peppermint had higher IgG.

اين الكفاءة الاقتصادية للبحث
Conclusively, using Peppermint oil and Vitex Agnnus extract could be a good tool for maximizing the growth performance, antioxidant status and immune response for growing rabbits under summer conditions.

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الأداء الإنتاجي والفسيولوجي للأرانب النامية متاثراً بإضافة زيت النعناع ومستخلص كف مريم خلال موسم الصيف

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**قسم بحوث الثروة الحيوانية - معهد بحوث زراعة المناطق الجافة - مدينة البحث العلمي والتطبيقات التكنولوجية – الإسكندرية. مصر


أجريت هذه الدراسة لمعرفة تأثير إضافة زيت النعناع و/أو مستخلص نبات كف مريم على أداء النمو للأرانب النامية خلال موسم الصيف. تم تقسيم 48 ذكر أرنب نامي من سلالة كاليفورنيا في عمر 35 يوماً بمتوسط وزن 640 ± 4.7 جم بشكل عشوائي إلى أربعة مجموعات متساوية. تم تغذية الأرانب في مجموعة الدكاترة على الزيت الأساسية دون إضافات (المجموعة 1). تم تغذية المجموعات الثانية والثانية والرابعة على الزيت الأساسية مضافة إليها 800 ملغ/جم علف من زيت النعناع، وتجري 1 مل من مستخلص كف مريم/PKG من وزن الجسم و800 ملغ/جم من الزيت بالإضافة لتجريع 100 ملغ من مستخلص كف مريم/PKG من وزن الجسم، على التوالي.

ويمكن تلخيص النتائج على النحو التالي:

1- زيادة ملحوظة في كل من وزن الجسم النهائي، معدل الزيادة في الجسم، لجميع المجموعات المعالمة مقارنة بالمجموعة الضابطة.

2- ليس هناك أي تأثير معنوي على كمية الغذاء المأكول، بينما تحسن معدل التحويل الغذائي بنسبة 22.66%, 24.7% و 20.9% للمجموعات المعالمة بزيت النعناع، أو مستخلص كف مريم أو خليطهما، على التوالي مقارنة بالمجموعة الضابطة.
3- أدت جميع المعاملات التجريبية إلى تحسن معنوي على مستوى معنوي 5% في وزن الجسم ما قبل الربح مقارنة بمجموعة المقارنة، في حين لم تتأثر صفات النبالة والأجزاء الصالحة للأكل إحصائيًا.

4- إنخفض كل من الدهون الثلاثية والكوليسترول ووظائف الكبد ودلالات الإجهاد وارتفاع مستوى السعة الكلية لمضادات الأكسدة بشكل كبير لمجموعات المعاملة مقارنة مع مجموعة контроль.

5- لوحظت زيادة IgG إحصائيًا، بينما لم يتأثر IgM التوصية: استخدام زيت النعناع ومستخلص كف مريم يمكن أن يؤدي لتحسين أداء النمو والصحة الفسيولوجية والاستجابة المناعية للأرانب النامية في ظل ظروف موسم الصيف.