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# EFFECT OF DIETARY SUPPLEMENTATION OF *LAURUS NOBILIS* LEAVES MEAL ON GROWTH PERFORMANCE, CARCASS TRAITS AND BLOOD ANTIOXIDANT STATUS OF GROWING NZW RABBITS

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**ABSTRACT:** The present study aimed to investigate the effects of different levels of dietary supplementation of bay laurel (*Laurus nobilis* L.) leaves meal (LNL) on growth performance, carcass traits, blood constituents, hematology and plasma antioxidant status of New Zealand White rabbits (NZW). Weaned New Zealand White rabbits 5 weeks old (n = 40, mean body weight 648 g) were randomly selected and classified to four dietary groups. The Control group was fed a basal diet without (LNL); the experimental groups received the basal diet with 1, 2 and 4 g LNL meal/kg diet (Groups LN1g, LN2g and LN4g, respectively). The experimental period lasted for 8 weeks. Results indicated that group LN4g rabbits recorded significantly the highest body weight at 9,11 and 13 weeks of age followed by LN2g. Also, LN4g recorded significantly the best feed conversion ratio followed by LN2g in comparison with the control group. There were no significant differences due to LNL supplementation in carcass characteristics, blood hematology, blood biochemistry and plasma antioxidant status. However, LNL supplementation numerically reduced abdominal fat, total plasma cholesterol (T.Ch), triglycerides (TG) and low-density lipoproteins (LDL) cholesterol compared to control, while, increased total protein, globulin and HDL cholesterol and the differences were not significant. Total antioxidant capacity (TAC), glutathione peroxidase activity (GPx) and catalase enzyme were not significantly affected by LNL supplementation. Generally, the results of the study revealed that bay laurel leaves were useful as a natural supplementation to promote growth of rabbits, with 4g LNL/kg diet being the best and could reduce the negative effects of summer conditions in rabbits.

**Key words:** *Laurus nobilis* L, rabbits , performance , carcass , blood, antioxidant status.

## INTRODUCTION

as a one of the Rabbits are considered important livestock that provide high quality protein to meet the high demand of animal protein for human food and contribute to decrease meat production shortage in developing countries (Dalle and Szendro, 2011). Rabbits are particularly favored for small-scale animal projects programmers as a result of their low investment, early profits and existence on economic resources for feeding, housing and general management. Therefore, small-scale rabbit projects could be used as an engine for the low income publics. (Lukefahr *et al*., 1999). Rabbit meat is categorized by a high protein and low fat and cholesterol content (Dalle and Szendro, 2011), these characteristics are of a very good value for the meat industry and consumers. However, rabbits production has many weaknesses, like high sensitivity to high ambient temperatures which cause heat stress and then affect the immunity of rabbits. Also, In growing rabbits, mostly weaned, digestive troubles are the main cause of the morbidity and death that create significant economic losses for rabbit projects (Marlier *et al.,* 2006 and Licois, 2004), and may occur bad health effects and an increase in the mortality rate (20 - 50%) particularly in intensive rabbit farming (Gidenne and Garcia, 2006)

Due to the continuous use of antibiotics as growth promoters and linked to the development, transmission and proliferation of resistant microbes via the food chain, and increase consumers awareness of the potential health negative effects and environmental problems, consequently, novel methods for promoting growth in productive animals have appeared after the prohibition of the use of antibiotics as feed additives. Aromatic plants may act as growth enhancers of the animals, mainly by increasing digestive secretions (endogenous digestive enzymes, bile and mucus), decreasing the bacterial populations in the gastrointestinal tract or improving gut morphology due to antioxidant and anti-inflammatory activities. Herbal plants and their essential oils also referred as phytobiotics, phytogenics, phytochemicals, spices, or botanicals, represent a wide range of biologically active compounds which may have positive effects on animal growth and health (Hashemi and Davoodi, 2011; Lavecchia *et al.,* 2013; Zeng *et al.,* 2015 and Gadde *et al.,* 2017).

*Laurus nobilis* L. (Lauraceous family) is a perfumed evergreen tree or large bush with dark-green, smooth leaves, native to the Mediterranean region countries and Europe (Ayoub *et al.,* 2013). It known in English as Bay leaf, bay laurel, Turkish laurel, and known AL Ghar in Arabic (Patrakar *et al.,* 2012). Bay leaf contains many types of flavonoids and glycosides, such as kaempferol, quercetin, apigenin, luteolin, quercetin (Ayoub *et al.,* 2013 and Abu-Dahab *et al.,* 2014). Nafis *et al.,* (2020) indicated that the main essencial oils in bay laurel were eucalyptol, α-terpinyl acetate and methyl eugenol representing about 40.85, 12.64 and 8.72% , respectively .

Bay leaf has a broad range of biological properties including anti-microbial and antioxidant. Tomar *et al.,* (2020) indicated that laurel leaves essential oil showed the significantly highest antibacterial effect on *Enterococcus faecalis*, followed by *Escherichia coli* and *Salmonella pullorum*. *Laurus nobilis* essential oil had a bactericidal effect on

all tested food and waterborne pathogens except of *Listeria monocytogenes*. Also, Bekhti *et al.,* (2020) indicated that the highest essential oil antibacterial power of the bay laurel leaves grown in North West Algerian was recorded on *Streptococcus faecalis* and *Staphylococcus aureus* and a minimal inhibitory concentration (MIC) for both strains was 0.25 mg/mL. Similarly, Rebickov *et al.,* (2020) showed that essential oils from bay leaves had a remarkable antimicrobial against many types of harmful bacteria (*E.coli, Staphylococcus aureus, Enterococcus faecalis, Pseudomonas aeruginosa* and *Candida albicans)* in addition to the antioxidant effect. The synergistic interaction between *Laurus nobilis L* essential oil and standard antibiotics may constitute encouraging anti-infectious agents useful for antibiotic resistant bacteria (Nafis *et al.,* 2020). In the same way, Tometri *et al.,* (2020) indicated that nano-extract of *Laurus nobilis* leaves treatment inhibited *E. coli* and *Staphaureus* growth and can be used as a natural antibacterial with appropriate antioxidant effects. Also, Riabov *et al.,* (2020) indicate that essential oil of bay laurel may be used in the pharmaceutical and food industries as an antioxidant and antimicrobial agent.

Bay laurel leaves has been used in poultry and rabbits nutrition. Palazzoa *et al.,* (2020) showed that dietary treatment with dried bay leaves (1 g/kg feed) significantly reduced the cholesterol level and improved the sensory characteristics (juiciness and fibrous texture) of rabbits Longissimuslumborum (LL) muscle compared to control with 2.5% lard supplemented diet. AL-Samarrai1 *et al.,* (2017) indicated that oral bay leaves administration and its isolated flavonoids and glycosides to local Iraqi female rabbits reduced T. cholesterol, LDL-Cholesterol, VLDL-Cholesterol and TG compared to control. Moreover, Casamassima *et al.,* (2017) demonstrated that *Laurus nobilis* oral administration has a protective role on cataract development hazard in rabbits under fat-enriched diet. Ali *et al.,* (2020) showed that crushed laurel leaves in the diet can improve the immunity and digestive tract microbial content in broilers. Al-Rubaee, (2018) reported that the dietary supplementation levels (1, 2, and 3%) of bay leaves meal had a positive effect on dressing percentage, carcass traits and carcass cuts of quail birds. Karaalp and Genc (2013) found that feeding Japanese quails on diet supplemented with 0 , 2 and 4 g leaves/kg of bay laurel leaves, for 70 days could reduce MDA content of refrigerated meat samples only at 8 day.

Therefore, the objective of this study was to evaluate the effect of bay laurel (*Laurus nobilis L*.) leaves meal supplementation in growing New Zealand white rabbits on growth performance, carcass traits, physiological and antioxidant status under summer conditions.

## MATERIALS AND METHODS

### Experimental design , management and diets

The study was carried out at Sakha Experimental station, Animal Production Research Institute, ARC, Ministry of Agriculture, Egypt during August-September 2020. Total 40 weaned mixed sex growing NZW rabbits at 5 weeks of age (mean initial body weight is 648 g) were randomly assigned to four experimental treatment groups (10 rabbits each) in a simple randomized design experiment. All rabbits were fed pelleted feed *ad libitum*. The experimental diets

were pelleted and formulated to meet the recommended nutrient requirements of growing rabbits according to the Agriculture Ministry Decree 1996) as shown in Table (1).Bay leaves were used on air dried basis. The Control group (T1) was fed a diet without Bay leaves, the experimental groups were fed control diet with 1, 2 and 4 g Bay leaves /kg diet (Groups T2 (LN1g), T3 (LN2g), T4 (LN4g) respectively). The experimental period lasted for 8 weeks (from weeks 5 to 13 of age).

Rabbits were individually housed in galvanized wire cages (dimensions: 30×20×35 cm) until marketing at 13 weeks of age under a 12:12 h light–dark cycle. All rabbits were kept under the same management, hygienic and environmental conditions. Rabbits were reared in a well-ventilated building; fresh water was automatically available all the time by stainless steel nipples fixed in each cage. During the experimental period (August - September) the minimum and the maximum temperatures, ranged between 29 – 37° C and the relative humidity ranged between 36 – 79%. Throughout the experimental period, body weight was recorded every 2 weeks (5, 7, 9, 11 and 13 weeks of age) and average body weight gain was calculated. During the whole experimental period, the feed intake was recorded precisely and expressed as grams per rabbit per period. From each cage, feed residuals were collected daily, weighed and taken into consideration for the calculation of feed intake.Feed conversion ratio (FCR) was calculated as a ratio of g feed intake / g weight gain.

**Slaughtering and carcass traits**

At the end of the experimental period, five rabbits from each group (aged 13 weeks) were randomly taken, fasted for 12 h, individually weighed and immediately slaughtered. After complete bleeding, pelt, viscera and tail were removed, and then the carcass and its components were weighed as edible parts (kidney, liver, heart) and non-edible parts including spleen, caecum and abdominal fat were also weighed as percentage of pre-slaughter weight. Dressing percentage was calculated by dividing the hot dressed carcass weight by pre-slaughter weight and expressed as a percentage.

**Blood samples and determination of hematological and biochemical parameters**

For determining blood biochemical components, 2 blood samples (5 ml /sample from each rabbit) were collected during slaughter in heparinized tubes. In the first sample plasma was separated from blood by centrifugation at 3000 g for 20 min.. Plasma total protein, albumin, alanine amino transferase (ALT), aspartate amino transferase (AST), blood urea, creatinine, total cholesterol, LDL- and HDL-cholesterol, triglycerides, plasma glutathione peroxidase (GPx) , total antioxidant capacity (T-AOC) and catalase (CAT) activity were measured colorimetrically using commercial kits. The 2nd sample used to determine blood hematological parameters (hemoglobin (Hb), total red blood cells count (RBCs), red blood Indies, total white blood cells count (WBCs) and their differentiations (Monocytes, Heterophils%, lymphocyte%, and H/L ratio) and platelet count according to Clark *et al.* (2011). All blood examinations were done by using analytical kits produced by Bio-diagnostic Cairo, Egypt, www.bio-diagnostic.com**).**

**Statistical analysis:**

Data were analyzed by the least square analysis of variance using the General Linear Model Procedure (SAS, 2004). The design was one way analysis and significant differences of $P<0.05$ among means were determined using Duncan's Multiple Range Test (Duncan,1955).

The following model used was : $Y_{ik} = \mu + T_i + e_{ik}$

Where: $Y_{ik}$ = an observation, $\mu$ = overall mean, $T_i$ = effect due to experimental diets (i =1, 2, 3, and 4)

$e_{ik}$ = residual error.

## RESULTS AND DISCUSSION

### Productive performance

Data of body weight and body weight gain as well as those of feed intake and FCR of growing New Zealand rabbits as affected by bay leaves meal supplementation are presented in Tables (2) and (3). The results showed that there were progressive improvement in body weight with bay leaves addition in all experimental periods, However, group (LN4g) recorded significantly the highest BW in 9, 11 and 13 weeks of age compared to control and other groups. While group (LN2g) recorded significantly high BW compared to control at 11 and 13 weeks of age. In addition, the groups (LN2g) and (LN4g) recorded significantly higher BWG during the periods (5-7 and 7-9 weeks and the overall period) compared to control.

Results of feed intake and FCR indicated no significant effect of bay laurel leaves on FI in all groups during all periods due to bay leaves supplementation (Table 3) , except the period (11- 13 weeks of age), as groups LN1g and LN4g recorded significantly less FI compared to control. However, adding 4 g/ kg diet bay leaves recorded significantly the best FCR during the periods 5-7 , 7-9 weeks and the overall period compared to control and the other groups. In addition, group LN2g improved significantly FCR during 5-7 and the overall period compared to control. These results are in agreement with the finding of Fayed and Azoz, (2018) who found that bay laurel leaves supplementation at 1% of the diet of New Zealand rabbits improved body weight and body weight gain at 9 and 13 weeks of age compared to control and significantly improved FCR during (5-9 and 5-13 weeks of age) and consumed significantly less feed during (5-9, 9-13 and 5-13 weeks of age) compared to control. Also, the results are in agreement with previous studies in other species. For instance, Fdam *et al.*, (2016) found that bay leaves meal at 3 and 6 g/kg of broiler diet significantly improved BW and BWG and FCR while, there no significant differences in feed intake. In addition. Ali and Al-Shuhaib, (2021) showed that bay leaves meal at 1, 2, and 3 g/kg diet of broiler chicks recorded significant improvement in live body weight and body weight gain and FCR in all experimental periods. Moreover, Al-Rubaee (2018) indicated that supplementation of quail diets with bay laurel leaves meal at 0, 1, 2 and 3% significantly increased final BW. In the same way, Turan *et al.*, (2016) observed that 1.5% bay laurel in the diet of catfish resulted in highest survival rates and PER (100% and 1.10±0.02, respectively), also recorded the best body protein content (21.49%). On the other hand, Palazzoa *et al.,* (2020) showed that dried bay leaves at 1 g/kg feed has no effect on body weight or body weight gain in rabbits, while there was slight improvement in FCR in growing rabbits. Furthermore, Karaalp *et al.*, (2011) found that the addition of bay laurel leaves (2 or 4 g/kg

feed) had no effect on body weight at 54 or 124 days of age , egg production, feed intake or feed efficiency and egg quality parameters of quails. Also, Bulbul *et al.*,(2015) demonstrated that supplementation of laurel oil to the diets of quails at 100,200 and 400 mg/kg diet did not affect final body weight, body weight gain, feed consumption and FCR , the highest BW was recorded by L200 g and the best FCR was recorded by L400.

This improvement in body weight and FCR may be due to the increasing of beneficial bacteria content in the digestive system in rabbits which attributed to the remarkable antimicrobial effects of bay laurel against harmful bacteria like *E. coli*, *Staphylococcus aureus*, *Enterococcus faecalis* ,*Pseudomonas aeruginosa* and *Candida albicans* and antioxidant effect (Tomar *et al.,* 2020 ; Bekhti *et al.,* 2020 ; Rebickova *et al.,* 2020 ; Nafis *et al.,* 2020; and Tometri *et al.,* 2020).

Also, Nafea *et al.,* (2018) confirmed that a decrease in the number of total aerobic bacteria and the count of the colon bacteria in broiler by increasing the levels of *Laurus nobilis* ( 0,2,4 and 6 g/kg diet) compared to control. In addition, Ali *et al.,* (2020) indicated that adding the crushed laurel leaves to broiler chicks diets (1, 2 and 3 g/kg) improved significantly cellular and antibody immune response against Newcastle disease and decreased the numbers of total aerobic and coliform bacteria and increased Lactobacillus bacteria number in duodenum contents and ceca compared to the control. However, this antibacterial effect of bay laurel improved digestion and absorption of nutrients due to the increase in the depth of crypts and the length of villi which increases the utilization of nutrients. Ali and Al-Shuhaib, (2021) indicated that superiority of LN supplementation (1,2 and 3 gram/kg diet of broiler chicks) were observed in the length of villus, depth of crypts, and villus length/crypts depth ratio compared to control. As a result , Fayed and Azoz, (2018) indicated that bay laurel leaves supplementation 1% of the diet of New Zealand rabbits improved significantly digestion coefficient of ether extract, crude protein, nitrogen free extract, crude fiber and nitrogen balance.

Carcass traits

Data presented in Table (4) show the effect of adding bay leaves meal to the diets of New Zealand rabbits on carcass traits. The results indicated that there were no significant difference in dressing percent and relative weight of giblets, spleen, abdominal fat and caecum among groups due to supplementation. These results are in agreement with Bulbul *et al.,* (2015) who found that Hot and cold carcass weights and relative weight of liver, heart and spleen were not affected by sage oil, laurel oil each at 100,200 and 400 mg/kg either singly or in combination of quails diet. While, Fayed and Azoz, (2018) found that bay laurel leaves supplementation at 1% of the diet of New Zealand rabbits improved carcass dressing and total edible parts percentages compared to control. Also, Al-Rubaee, (2018) found that quail diets supplemented with bay laurel leaves meal at 0, 1, 2 and 3% significantly increased carcass weight, dressing percent, and percentage weights of breast, drumstick, and thigh cuts, also improves taste, tenderness, and total acceptance of breast meat. Palazzoa *et al.*,(2020) showed that dietary treatment with dried bay leaves (1 g/kg feed) improved dressing percentage in growing rabbit. Ismoyowati and Sumarmono (2016) found that total meat

fat decreased significantly in Mallard ducks fed diets supplemented with 6-9% bay leaves, while no significant effect was observed in dressing%.

**Blood hematology and metabolites**

Bay laurel leaves supplementation has no significant effect on blood hematology parameters including while blood cell total count, lymphocytes, monocyte and heterophil percentages red blood cell count, red blood cell Indies (MCV, MCH and MCHC), hemoglobin and platelet count Table (5). Also, there are no significant differences among groups due to supplementation in blood constituents (total protein, albumin, globulin, liver and kidney functions (ALT, AST, urea and creatinine) and lipid profile. However, bay leaves recorded numerically high values of total protein, globulin, HDL cholesterol and recorded less values of total cholesterol , triglycerides and LDL cholesterol. These results are in agreement with the finding of Fayed and Azoz (2018) who found that there were no significant differences due to bay laurel leaves supplementation at 1% of the diet of New Zealand rabbits in total protein, Albumin, globulin, urea, creatinine and uric acid, while the supplementation decreased significantly total lipids, triglycerides, total cholesterol, LDL and VLDL cholesterol. In the same way, Abdel-Azeem *et al.,* (2018) showed that 1.0% bay laurel leaves significantly decreased total cholesterol, total lipids triglycerides, lDL-cholesterol, AST and ALT as compared to the control in mature New Zealand White (NZW) rabbits, while, plasma total protein and albumin were increased. Blood plasma TAC significantly increased but MDA decreased due to the addition of bay laurel leaves compared to the control. In addition, AL-Samarrai *et al.,* (2017) showed that *Laurus nobilis* leaves oral administration at 100 mg/kg and its isolated flavonoids (50 mg/kg) and glycosides (12.5 mg/kg) to local Iraqi female rabbits, reduced TC, TG, LDL-C and VLDL-C levels compared to control.

**Blood antioxidant activity**

Results of plasma total antioxidant capacity (TAC), glutathione peroxidase activity (GPx) and catalase in blood of the NZW rabbits are shown in Table (7). There were no significant differences among groups due to Bay laurel leaves meal supplementation. However, groups LN1g and LN4g recorded the highest GPx activity, while LN1g recorded the highest catalase activity followed by control. Similar results were obtained by Riabova *et al.,* (2020) who indicate that *Laurus nobilis* essential oil may be used in the food and pharmaceutical industries as an antioxidant and antimicrobial agent. In addition, Abdel-Azeem *et al.,* (2018) observed that bay laurel leaves significantly increased blood plasma total antioxidant capacity as compared to the control, but MDA levels decreased. Moreover, El-Sawi *et al.,* (2009) studied the fresh essential oil (EO) of leaves of *Laurus nobilis* L grown under Egyptian conditions, and they found that EO contains approximately 50.38% 1,8cinol, 19.97% , α-terpenyl acetate and 6.48% 4-terpineol, these EOs were found to possess an antioxidant activity as demonstrated by 1-diphenyl-2picrylhydrazyl radical methods, also EO showed prominent antimicrobial activity at very low concentration (100µ) .

**IN CONCLUSION**,

The current study proved that bay laurel (*Laurus nobilis* L.) leaves as growth promoter are an effective resource to promote performance of rabbit under summer conditions and to correct some of

deleterious effects of high ambient temperatures, besides bay leaves meal at the level of 4 g/kg diet improved body weight, feed conversion ratio and decrease abdominal fat.

**Table (1):** Composition and chemical analysis of basal diet.

| **Ingredient** | **%** | **Calculated analysis[2]** | % |
|---|---|---|---|
| Alfalfa hay | 34.80 | C.P % | 17.0 |
| Yellow corn | 12.10 | C.F% | 12.5 |
| Soybean meal (44%) | 14.50 | D.E. Kcal/kg | 2500 |
| Wheat bran | 14.70 | Ca % | 1.12 |
| Barely | 17.71 | Total phosphorus% | 0.80 |
| Molasses | 3.00 | Lys. % | 0.92 |
| Lime stone | 0.70 | Meth. % | 0.34 |
| Mono calcium phos. | 1.90 | Meth + Cys % | 0.61 |
| Vit.&Min. Premix[1] | 0.30 | | |
| DL-Methionine | 0..09 | | |
| L-Lysine-HCl | 0..04 | | |
| NaCl | 0.36 | | |
| Total | 100 | | |

[1]Supplied per kg of diet: 12000 IU vit.A; 2200 IU vit. D3; 10 mg vit.E; 2.0 mg vit.K3; 1.0 mg vit.B1; 4.0 mg vit.B2; 1.5 mg vit.B6; 0.0010 mg vit.B12; 6.7 mg vit.PP; 6.67 mg vit. B5; 0.07 mg B8; 1.67 mg B9; 400 mg Choline chloride; 133.4 mg Mg; 25.0 mg Fe; 22.3 mg Zn; 10.0 mg Mn;1. 67 mg Cu; 0.25 mg I and 0.033 mg Se

[2]According to Feed Composition Tables for Animal and Poultry Feedstuffs Used in Egypt (2001).

**Table (2):**Effect of bay laurel leaves meal supplementation on body weight and body weight gain of growing NZW rabbits.

| Interval | Bay laurel (*Laurus nobilis*) leaves meal | | | | SEM | P-Value |
|---|---|---|---|---|---|---|
| | Control | (1g/kg diet) | (2g/kg diet) | (4g/kg diet) | | |
| **Live body weight** | | | | | | |
| Week 5 | 648 | 648 | 648 | 648 | 37.34 | 1.00 |
| Week 7 | 967 | 1043 | 1034 | 1146 | 49.67 | 0.1048 |
| Week 9 | 1414$^{b}$ | 1490$^{b}$ | 1557$^{ab}$ | 1703$^{a}$ | 52.80 | 0.0036 |
| Week 11 | 1857$^{c}$ | 1946$^{bc}$ | 2003$^{b}$ | 2165$^{a}$ | 46.62 | 0.0004 |
| Week 13 | 2220$^{c}$ | 2324$^{b}$ | 2356$^{b}$ | 2483$^{a}$ | 31.34 | 0.0001 |
| **Body weight gain** | | | | | | |
| BWG (5-7 wks) | 319$^{b}$ | 395$^{b}$ | 386$^{b}$ | 498$^{a}$ | 30.21 | 0.0021 |
| BWG (7-9 wks) | 447$^{b}$ | 447$^{b}$ | 522$^{a}$ | 557$^{a}$ | 24.57 | 0.0048 |
| BWG (9-11wks) | 443 | 455 | 446 | 461 | 20.55 | 0.9171 |
| BWG (11-13wks.) | 363 | 378 | 352 | 318 | 21.94 | 0.2734 |
| BWG (5-13 wks.) | 1572$^{c}$ | 1676$^{b}$ | 1708$^{b}$ | 1835$^{a}$ | 25.00 | 0.0001 |

$^{a, b}$ Means bearing different superscripts within the same row are significantly different (P<0.05).

**Table (3):**Effect of bay laurel leaves meal supplementation on feed intake and feed conversion ratio of growing NZW rabbits .

| Age | Bay laurel (*Laurus nobilis*) leaves meal | | | | SEM | P-Value |
|---|---|---|---|---|---|---|
| | Control | (1g/kg diet) | (2g/kg diet) | (4g/kg diet) | | |
| Feed intake | | | | | | |
| 5-7 wks | 1228 | 1224 | 1090 | 1253 | 54.29 | 0.1584 |
| 7-9 wks | 1520 | 1580 | 1601 | 1524 | 50.32 | 0.5893 |
| 9-11wks | 1594 | 1492 | 1586 | 1447 | 59.89 | 0.2466 |
| 11-13wks | 1799$^{a}$ | 1504$^{b}$ | 1826$^{a}$ | 1643$^{b}$ | 50.07 | 0.0001 |
| 5-13 wks | 6140 | 5800 | 6102 | 5866 | 130.24 | 0.1870 |
| Feed conversion ratio | | | | | | |
| 5-7 wks | 4.06$^{a}$ | 3.27$^{ab}$ | 3.01$^{b}$ | 2.67$^{b}$ | 0.3016 | 0.0170 |
| 7-9 wks | 3.59$^{a}$ | 3.67$^{a}$ | 3.10$^{ab}$ | 2.76$^{b}$ | 0.24 | 0.0400 |
| 9-11 wks | 3.64 | 3.37 | 3.62 | 3.20 | 0.216 | 0.4259 |
| 11-13 wks | 5.13$^{a}$ | 4.08$^{b}$ | 5.32$^{a}$ | 5.40$^{a}$ | 0.34 | 0.0327 |
| 5-13 wks | 3.92$^{a}$ | 3.47$^{b}$ | 3.58$^{b}$ | 3.20$^{c}$ | 0.09 | 0.0001 |

$^{a, b}$ Means bearing different superscripts within the same row are significantly different (P<0.05).

**Table (4):** Effect of bay laurel leaves meal supplementation on carcass characteristics of growing NZW rabbits.

| Items | Bay laurel (*Laurus nobilis*) leaves meal | | | | SEM | P-Value |
|---|---|---|---|---|---|---|
| | Control | (1g/kg diet) | (2g/kg diet) | (4g/kg diet) | | |
| Live body weight | 2218 | 2320 | 2362 | 2448 | 81.32 | 0.317 |
| Carcass (%) | 57.38 | 57.08 | 54.9 | 55.68 | 2.60 | 0.892 |
| Giblets Part (%) | 3.57 | 2.68 | 3.06 | 3.18 | 0.27 | 0.217 |
| Abdominal fat (%) | 1.03 | 0.67 | 0.87 | 0.70 | 0.095 | 0.093 |
| Caecum (%) | 4.50 | 3.62 | 4.50 | 4.32 | 0.44 | 0.474 |
| Liver (%) | 2.71 | 2.22 | 2.26 | 2.27 | 0.21 | 0.348 |
| Kidney (%) | 0.52 | 0.48 | 0.56 | 0.58 | 0.03 | 0.201 |
| Spleen (%) | 0.07 | 0.06 | 0.07 | 0.06 | 0.01 | 0.539 |
| Heart (%) | $0.34^{a}$ | $0.14^{b}$ | $0.25^{ab}$ | $0.32^{a}$ | 0.04 | 0.024 |

[a, b] Means bearing different superscripts within the same row are significantly different (P<0.05).

**Table (5) :** Effect of bay laurel leaves meal supplementation on complete blood count of growing NZW rabbits.

| Items | Bay laurel (*Laurus nobilis*) leaves meal | | | | SEM | P-Value |
|---|---|---|---|---|---|---|
| | Control | (1g/kg diet) | (2g/kg diet) | (4g/kg diet) | | |
| WBC (x103µ / l ) | 4.73 | 3.37 | 4.93 | 4.97 | 1.08 | 0.6921 |
| Lymphocytes % | 47.73 | 59.33 | 52.80 | 57.17 | 6.59 | 0.6297 |
| Monocyte % | 12.97 | 12.90 | 11.33 | 10.67 | 2.36 | 0.8679 |
| Heterophil % | 39.30 | 27.77 | 35.87 | 32.17 | 6.92 | 0.6853 |
| H/L | 0.90 | 0.47 | 0.85 | 0.58 | 0.28 | 0.6634 |
| RBC (x106µ / l ) | 6.24 | 6.16 | 6.21 | 5.98 | 0.37 | 0.9596 |
| Hb (g/dl) | 12.53 | 12.6 | 12.37 | 12.07 | 0.56 | 0.9047 |
| PCV% | 34.77 | 35.43 | 34.60 | 33.90 | 1.68 | 0.9333 |
| MCV (fl) | 55.80 | 57.67 | 55.83 | 57.00 | 0.97 | 0.4887 |
| MCH (pg) | 20.07 | 19.93 | 19.93 | 20.17 | 0.41 | 0.9714 |
| MCHC % | 36.03 | 35.53 | 35.73 | 35.53 | 0.43 | 0.8228 |
| PLT | 285.4 | 263 | 178 | 207 | 52.19 | 0.4829 |

[a,b] Means bearing different superscripts within the same row are significantly different (P<0.05). wheres WBC white blood cell count, RBC red blood cell count, HB: hemoglobin percent PCV packed cell volume, MCV: mean corpuscular volume, MCH; Mean corpuscular hemoglobin, MCHC: mean corpuscular hemoglobin concentration, PLT; platelet count.

**Table (6):** Effect of bay laurel leaves meal supplementation on blood constituents of growing NZW rabbits

| Items | Bay laurel (*Laurus nobilis*) leaves meal | | | | SEM | P-Value |
|---|---|---|---|---|---|---|
| | Control | (1g/kg diet) | (2g/kg diet) | (4g/kg diet) | | |
| Total protein (mg/dl) | 4.92 | 5.35 | 5.57 | 5.50 | 0.39 | 0.675 |
| Albumin (mg/dl) | 1.87 | 1.70 | 1.78 | 1.57 | 0.18 | 0.706 |
| Globulin (mg/dl) | 3.06 | 3.65 | 3.79 | 3.92 | 0.35 | 0.375 |
| AST (U/l) | 11.12 | 9.93 | 11.73 | 12.14 | 3.09 | 0.959 |
| ALT (U/l) | 4.75 | 5.15 | 7.88 | 6.45 | 0.84 | 0.103 |
| Creatinine (mg/dl) | $0.80^{a}$ | $0.33^{b}$ | $0.53^{b}$ | $0.47^{b}$ | 0.082 | 0.0211 |
| Urea (mg/dl) | 23.72 | 15.79 | 13.98 | 24.03 | 3.163 | 0.113 |
| T.Cholesterol (mg/dl) | 220 | 194.59 | 207.59 | 210.53 | 15.64 | 0.724 |
| Triglycerides (mg/dl) | 113.09 | 102.38 | 100.95 | 102.95 | 8.03 | 0.701 |
| HDL (mg/dl) | 60.56 | 62.08 | 63.27 | 69.60 | 2.54 | 0.139 |
| LDL (mg/dl) | 136.82 | 112.04 | 123.74 | 120.41 | 14.21 | 0.677 |

[a, b] Means bearing different superscripts within the same row are significantly different (P<0.05).

**Table (7):** Effect of bay laurel leaves meal supplementation on blood antioxidant status of growing NZW rabbits status

| Items | Bay laurel (*Laurus nobilis*) leaves meal | | | | SEM | P-Value |
|---|---|---|---|---|---|---|
| | Control | (1g/kg diet) | (2g/kg diet) | (4g/kg diet) | | |
| Total antioxidant capacity | 0.54 | 0.41 | 0.52 | 0.48 | 0.042 | 0.206 |
| Glutathione peroxidase activity | 0.16 | 0.21 | 0.16 | 0.21 | 0.038 | 0.595 |
| Catalase activity | 164.66 | 167.87 | 139.76 | 107.63 | 23.93 | 0.323 |

[a, b] Means bearing different superscripts within the same row are significantly different (P<0.05).

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## الملخص العربي

## "تأثير إضافة مسحوق أوراق الغار علي الاداء الانتاجي وصفات الذبيحة و مكونات الدم و الحالة التاكسدية في الأرانب النامية"

**ابراهيم حمدان سالم ، عنايات ابوالعزايم حسن ، هناء عوض بسيوني**
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أجريت هذه الدراسة لدراسة مستويات مختلفة من مسحوق اوراق الغار كإضافة غذائية طبيعية علي الأداء الإنتاجي و صفات الذبيحة وبعض مكونات الدم و الحالة التاكسدية في ارانب النيوزيلاندي الابيض النامية . تم اجراء هذه التجربة في محطة تجارب بحوث سخا التابعة لمركز البحوث الزراعية خلال الفترة من بداية اغسطس الي نهاية سبتمبر. و قد تم استخدام ٤٠ ارنب نيوزيلاندي ابيض عمر ٥ اسابيع (متوسط وزن ٦٨٤ جرام) و تم تقسيمهم الي ٤ معاملات : المعاملة الأولي كنترول (بدون أي إضافات) ، المعاملة الثانية الكنترول + ١جرام مسحوق ورق غار/كجم عليقه ، المعاملة الثالثة الكنترول + ٢جرام مسحوق اوراق الغار/كجم عليقة، المعاملة الرابعة الكنترول + ٤جرام مسحوق اوراق الغار/كجم عليقة و تم التغذية لمدة ٨ اسابيع ، تم الوزن كل أسبوعين (علي عمر ٥، ٧، ٩، ١١، ١٣ اسبوع) وذلك لمعرفة الوزن الحي و حساب معدل الزيادة في الوزن كما تم حساب المتبقي من العلف المقدم لحساب العلف المأكول و معدل التحويل الغذائي و في نهاية التجربة تم ذبح ٥ ارانب من كل معاملة لتقدير صفات الذبيحة و اخذ عينات دم لتقدير صفات الدم.

أظهرت النتائج أن إضافة مسحوق اوراق الغار ادي الي زيادة متتابعة بزيادة الكمية المضافة حيث سجلت المعاملة الرابعة التي غذيت علي ٤ جرام مسحوق اوراق الغار/ كجم عليقة اعلي وزن للجسم و كذلك الزيادة في الوزن وأفضل معامل تحويل غذائي يليها المعاملة الثالثة التي غذيت علي ٢جرام مسحوق اوراق الغار/كجم عليقة بالمقارنة بالكنترول. لم يكن هناك أي فروق معنوية بين المعاملات علي صفات الذبيحة او صورة الدم او صفات الدم حيث كانت هناك انخفاض و لكن غير معنوي في دهن البطن و الكوليسترول الكلي و الدهون الثلاثية و زيادة عددية ايضا في البروتين الكلي في الدم و الجلوبيولين و الكوليسترول عالي الكثافة ايضا هناك زيادة عددية في المعاملة الثانية التي غذيت علي ١جرام مسحوق أوراق الغار/ كجم عليقه في إنزيمات الجلوتاثيون بيروكسيديز و الكتاليز. نستخلص من ذلك إن تغذية الأرانب النامية علي مسحوق أوراق الغار كإضافة غذائية طبيعية خلال مرحلة النمو يحسن من الأداء الإنتاجي وتقليل دهن البطن و دهون الدم ، لذلك ينصح بإضافة مسحوق أوراق الغار إلي علائق الأرانب النامية بمعدل ٤ جرام / كجم علف تحت الظروف المصرية فى شهور الصيف.