# Effects of Dried Onion and Ascorbic Acid on Performance, Immune Response and Serum Blood Lipid Profiles of Growing Rabbits

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**ABSTRACT:** Thirty-six growing V-line rabbits of both sexes, 5 weeks old, with initial weights of 791.7 ± 14.1 g were used for the study through summer season from June to September(2104). The rabbits were randomly allocated to four treatments groups of 9 rabbits each. Each treatment was further sub-divided into 3 replicate of ٣ rabbits. Group one fed control diet free of feed additives and served as a control group. Group 2 and 3 supplemented with 400 and 800 mg dried onion / kg diet, respectively. Group 4 received control diet, but drinking water supplemented with 200 mg vitamin C / l water. Results showed that at 15 weeks of age the live body weight was significantly (P ≤ 0.05) increased by the addition of ascorbic acid and dried onion at different inclusion rate. A significant decrease in feed consumption was recorded in the group received diet supplemented with 800 mg onion / kg diet in comparison with the control group. Significant (P ≤ 0.05) improvement in feed conversion ratio was observed in dried onion or ascorbic acid groups in comparison with the control. Hematological parameters were insignificantly affected by treatments. Dried onion and ascorbic acid failed to induce any significant impact on sheep red blood cells(SRBCs) in comparison with the control group. All feed additives significantly (P ≤ 0.01) reduced serum total lipids, triglycerides, total cholesterol and low density lipoprotein, however, they had insignificant effect on high density lipoprotein concentration in comparison with the control group. Malondialdehyde as an indicator of lipid peroxidation was significantly decreased in all treatments, however, only the group received 400 mg onion in their diet recorded significant (P ≤ 0.05) increase in total antioxidant capacity in comparison with the control group. In conclusion, rabbit dietary supplementation with ascorbic acid or dried onion could have beneficial effects on performance under summer environment without any side effects.

**Key words:** Rabbits, dried onion, ascorbic acid, performance, immunity and blood lipid profile

## INTRODUCTION

The sub-therapeutic uses of antibiotics to enhance growth and prevent the infectious intestinal diseases have led to a problem of drug residues in final animal products and emerge of new antibiotic-resistance bacteria (Frankic *et al.,* 2009). In Egypt, the routine use of antibiotics in animal and poultry diets have been banned in November 2006 and thus, some endeavors are made to develop new in-feed antibiotics substitutes for reducing and treating infectious diseases in rabbit and poultry industry. Attempts to use the natural materials such as herb and botanicals could be widely accepted as feed additives to improve the efficiency of feed utilization and animal productive performance (Zeweil *et al.,* 2013). Ascorbic acid is one of the most widely studied vitamins used to alleviate heat stress in rabbits. Amakye-Anim *et al.* (2000) and El-Ghaffar *et al.* (2000) showed that, ascorbic acid has a role in lowering viral pathogenic actions and in protecting animals from heat

stress as well as in the enhancement of the immune system of infected rabbits. Ascorbic acid is not considered a required dietary nutrient, but under certain adverse environmental conditions, the metabolic need for this vitamin may exceed the inherent biosynthetic ability of ascorbic acid (Abou-Ashour *et al.,* 2004). However, many additives are recently added to rabbit feed or water as a way to help alleviate adverse effect during summer months and to enhance productive performance and immune response of rabbits. Onion bulbs have numerous organic sulphur compounds, flavonoids and phenolic acids with proven antibacterial, antioxidant and hypolipidemic efficacy (Melvin *et al.,* 2009; Srinivasan *et al.,* 2004). The results of Goodarzi *et al.* (2013) showed the beneficial influence of onion extract on the growth performance in meat-type broiler chickens. Vidyavati *et al.* (2010) suggested that the serum cholesterol was significantly decreased by dietary dehydrated onion in experimentally hypercholesterolemic rats. The aim of the present study is to determine the effects of dried onion and ascorbic acid as feed additives on growth performance, blood hematology, immune response and serum blood lipid profiles of growing rabbits through summer season from June to September.

## MATERIALS AND METHODS

Thirty-six growing V-line rabbits of both sexes, 5 weeks old, with initial weights of 791.7 ± 14.1 g were used for the study. The rabbits were randomly allocated to four treatments groups of 9 rabbits each. Each treatment was further sub-divided into 3 replicate of ٣ rabbits. Rabbits were housed in wire floor batteries of 45 x 36 x 36 cm and were offered diets for duration of the feeding trial until reaching 15 weeks of age. All animals were kept under similar hygienic conditions. Rabbits were housed in well ventilated block building. Fresh air circulated in the house using exhaust fans. The rabbits were kept within a cycle of 16 h light and 8 h dark. Four pelleted diets were prepared. Group one fed control diet free of feed additives and served as a control group. Group 2 and 3 supplemented with 400 and 800 mg dried onion / kg diet, respectively (American garden product - New York 11783 USA). Group 4 received control diet, but drinking water supplemented with 200 mg vitamin C /L (Fisher chemical -analytical reagent Grande). Fresh water was automatically available at all times through stainless steel nipples for each cage. The experimental diets were offered to rabbits *ad libitum*. The formula of basal experimental diet is presented in Table (1) that formulated to cover the requirements of rabbits according to NRC (1977).

Individual body weight and feed consumption were recorded weekly. Body weight gain and feed conversion ratio were also calculated. The incidence of dangerous diseases was largely avoided and rabbits have never been treated with any kind of systematic vaccination or medication. At the end of the feeding trial, 3 rabbits were selected from each treatment group randomly, starved of food but not water for 12 hours and slaughtered for carcass analysis. Before slaughtering, 6 ml

of blood sample was taken from the ear vein with a sterile syringe. 3 ml of the blood was put into a bijon bottle containing ethylene diamine tetracetic acid (EDTA) as an

**Table (1). Composition and chemical analyses of the basal experimental diet.**

| Ingredients | % |
|---|---|
| Yellow corn | 19.0 |
| Wheat bran | 11.0 |
| Barley | 17.2 |
| Berseem hay | 33.0 |
| Soybean meal (44%) | 15.0 |
| Molasses | 3.0 |
| Di-calcium phosphate | 1.0 |
| L-lysine | 0.1 |
| DI-Methionine | 0.1 |
| Premix | 0.3 |
| Salt | 0.3 |
| **Total** | **100** |
| Chemical analyses: | |
| Dry matter (DM), % | 91.36 |
| Crude protein(DM), % | 17.24 |
| Ether extract(DM), % | 3.26 |
| Crude fiber(DM), % | 12.58 |
| Nitrogen free extract(DM), % | 50.47 |
| Ash(DM), % | 7.57 |
| Organic matter (OM), % | 92.42 |

[1]Vit+Min mixture provides per kilogram contains: Vit A 6000 IU; Vit $D_3$ 450 IU; Vit E 40 mg; Vit $K_3$ 1 mg; Vit $B_1$ 1 mg; Vit $B_2$ 3 mg; Vit $B_3$ 180 mg; Vit $B_6$ 39 mg; Vit $B_{12}$ 2.5 mg; Pantothenic acid 10 mg; biotin 10 mg; folic acid 2.5 mg; choline chloride 1200 mg; Manganese 15 mg; Zinc 35 mg; Iron 38 mg; Copper 5 mg; Selenium 0.1 mg; Iodine 0.2 mg; Selenium 0.05 mg. [2]Analyzed values according to AOAC (2006).

Anticoagulant for haematological assay. The remaining 3ml of the blood sample was put into a sterile vacutainer tube without an anticoagulant for serum biochemical analysis. The haematological assay was carried out to determine erythrocyte indices such as packed cell volume (PCV), and haemoglobin (Hb) values. Red blood cell (RBC) counts were counted on an AO Bright line hemocytometer using a light microscope at 400X magnification after diluting blood samples 200 times with a physiological saline (0.9% NaCl solution) before counting (Natt and Herrick, 1952). White blood cell (WBC) were counted on an AO Bright line hemocytometer using a light microscopeat 100X magnification after diluting blood samples 20 times with a diluting fluid (1% acetic acid solution with a little of Leishman's stain) before counting (Hepler, 1966). Total lipids, triglycerides, cholesterol, low density lipoprotein (LDL) and high density lipoprotein (HDL),

concentrations in serum were estimated using commercial kits (Bio Merieux, France) accordingto the procedure outlined by the manufacturer. Three rabbits of each treatment were immunized with 0.1 ml of a 2.5% Sheep Red Blood Cells (SRBC) via the marginal ear vein at 15 days after starting the dietary treatment supplementation, to measure Antibody titer against Sheep Red Blood Cells. The dosage of SRBC for inoculation was pre-determined by a separate trial. Antiserum to SRBC was collected 7, 14 and 21 days post challenge. One ml of blood was refrigerated to allow red blood cells to settle. If sedimentation was not complete, samples were centrifuged for 1 to 2 min at 3000 rpm to separate serum and erythrocytes, and the supernatant was collected. Briefly, 96-well plates were first filled with 25 µl of physiological saline solution in each well. Then 25 µl of antiserum was pipetted into the first well in duplicates after which 25 µl from the first well was pipetted into the second well, and so forth using an automatic pipette. Finally, a 0.75% of SRBC solution was added to each well. Plates were incubated at 37 $^{o}$ C for 3 hours and then examined visually for agglutination Wegmann and Smithies. (1966). The agglutination titer was expressed as the $\log^2$ of the reciprocal of the highest serum dilution giving complete agglutination (Nelson *et al.,* 1995). The results were expressed as the mean ± SEM. All data were analyzed using one way analysis of variance (ANOVA) using SPSS 11.0 statistical software (SPSS, Inc., Chicago, Il, 2001). Significant differences between means were detected using new Duncan multiple range test (Duncan, 1955).

## RESULTS AND DISCUSSIONS

The impact of dietary treatments on growth performance indices is presented in Table 2. At 15 weeks of age the live body weight was increased by the addition of ascorbic acid and dried onion at different inclusion rats. The obtained results and recorded observation clearly focused in group received ration supplemented with 400 and 800 mg onion / kg diet. Results showed that diets containing 400 and 800 mg onion / kg diet resulted in numerical increase in weight gain and significant ($P \leq 0.05$) increase in daily weight gain through the experimental period from 5-15 weeks of age. Goodarzi *et al.*(2013) reported that dietary supplementation of 30 g/kg onion bulb increased final body weight of broilers at 42$^{nd}$ day of age compared to the other treatments ($P \leq 0.05$) fed 15 mg Virginiamycin / kg or dietary supplementation of 10 g onion bulb/kg diet. The above results may be explained due to their contents of sulphur components that are considered as active antimicrobial agents. Similar to our results also was obtained by Aji*et al.* (2011)reported an enhancement in body weight of broilers received diets containing fresh onion bulbs as compared with birds fed basal diet. Concerning ascorbic acid, Al-Shanty (2003) showed that adding ascorbic acid (1.0 g/L water) significantly improved averages of daily gain when compared with the control group. Selim*et al.* (2004) cleared that rabbits had access to extra levels of ascorbic acid beyond recommendation level achieved ($P \leq 0.01$) better live weight gain compared to the control group. More recently, Selim *et al.* (2008) found that

diet treated with 200 ppm of ascorbic acid recorded significantly (P ≤ 0.01) the highest weight gain (1312 g vs. 943 g in control group).

A significant (P ≤ 0.05) decrease in feed intake in the group received diet supplemented with 800 mg onion / kg diet in comparison with the control group through the experimental period, however, insignificant effect on feed intake was observed due to addition of 400 mg onion or ascorbic acid. This result agrees partially with that obtained by Ibrahim *et al.* (2004)

**Table (2). Effect of dried onion and ascorbic acid on rabbit's performance**

| Characteristics | Control | Onion (mg/kg diet) | | Ascorbic acid 200 mg/l |
|---|---|---|---|---|
| | | 400 | 800 | |
| Initial body weight, g | 687.8 ± 89.1 | 665.56±100.1 | 683.9±112.90 | 687.8±84.6 |
| Final body weight, g | 2373.9b±78.6 | 2418.9a±92.6 | 2484.4a±100.3 | 2399.4a±113.6 |
| Daily weight gain, g | 22.8±1.0$^{b}$ | 25.1±2.0 $^{a}$ | 25.7±2.2 $^{a}$ | 24.5±2.0 $^{ab}$ |
| Daily feed onsumption,g | 74.68±1.11$^{ab}$ | 75.86±3.47 $^{a}$ | 66.86±5.16 $^{c}$ | 70.62±6.52 $^{bc}$ |
| Feed conversion ratio | 3.83±0.20 $^{a}$ | 3.54±0.30 $^{b}$ | 3.24±0.29 $^{c}$ | 3.58±0.36 $^{ab}$ |

Different letters (a-c) within a raw denote significant differences between treatments (P ≤ 0.05)

Who reported a significant decrease in feed consumption and the largest reduction of feed consumption in broiler ducks were observed when received 3% garlic (5.2%) and 1% onion + 3% garlic (4.6%) but cumulative feed consumption at week 0-10$^{th}$ lower than the same at 0-12$^{th}$ week. Goodarzi *et al.* (2013) reported that birds fed 30 g onion/kg in the diet had the highest (P ≤ 0.05) feed intake than the other treatments fed 15 mg Virginiamycin/kg or dietary supplementation of 10 g onion bulb/kg diet. Birds fed 10 g onion bulb/kg diet was significantly equal to the group fed the control diet. Aji *et al.* (2011) reported an enhancement in average feed intake of broilers offered diets containing fresh onion bulbs in comparison with broilers fed basal diet. Sallam *et al.* (2005) indicated that the treatment with ascorbic acid (40 mg/kg body weight) resulted in non-significant increase in feed intake and drinking water comparing with those of control group. Moreover, Selim *et al.* (2004) reported that the treated with ascorbic acid (300 mg/kg diet) did not significantly affect feed intake.

In contrast, Shehata (2005) reported that ascorbic acid supplementation caused significant increase in feed intake. In addition, Yassein *et al.* (2008) showed that the water supplementing with ascorbic acid at 1 g/L increased daily feed consumption when compared with those of control group of NZW rabbits does.

The observed results showing that supplementation of dried onion or ascorbic acid improve (P ≤ 0.05) the feed conversion ratio in comparison with the control group. The groups fed 400 and 800 mg onion /kg showed better feed

conversion ratio (3.54 and 3.24) vs. control group (3.83). The same results were obtained by Ibrahim *et al.* (2004) on broiler dusks and they attributed the improvement in feed conversion ratio to the reduction of small intestine thickness since the nutrient absorption is more efficient through thinner intestinal wall that reflected on the improvement of absorption which translated to improvement in feed conversion ratio.

Similar to our results Aji *et al.*(2011) reported an enhancement in feed conversion ratio of broilers offered diets containing fresh onion bulbs in comparison with broilers fed basal diet. On the other hand, El Nawawy (1991) found that feed conversion ratio was nearly identical when compared Hubbard broiler chicken control with those fed garlic, onion or garlic plus onion. Using ascorbic acid, Selim *et al.* (2004) reported that rabbits had access to extra levels of ascorbic acid beyond recommendation level achieved better performance in feed conversion ratio compared to the control group. In addition, Selim*et al.* (2008) cleared that the treated with 200 ppm of ascorbic acid recorded significantly the best feed conversion ratio (2.68 vs. 3.68 in control group).

Results presented in Table 3 indicated that hematological parameters of the rabbits showed insignificant effect on hematocrit, RBCs, WBCs, and Hb of rabbits given different levels of onion or ascorbic acid in comparison with the control group. The percentage of lymphocytes, eosinophils, neutrophils and monocytes were not affected by different treatments also in comparison with the control group. The normal hematocrit indicates the absence of normocytic anemia.

The result is corroborated by the normal RBCs which further elucidated the absence of hemolytic anemia and depression of erythrogenesis. The normal hemoglobin concentration for all the experimental rabbits is probably an indication that onion or ascorbic acid at studied levels supported hemoglobin synthesis, which according to Sirosis (1995) is among other factors, primarily affected by protein intake. Njidda *et al.* (2006) reported that normal range of values for Hb indicated that the vital physiological relationship of hemoglobin with oxygen in the transport of gases (oxygen and carbon dioxide) to and from the tissues of the body has been maintained and was normal.

**Table (3). Effect of dried onion and ascorbic acid on hematological parameters and sheep RBCs of growing rabbits at 15 weeks of age**

| Characteristics | Control | Onion (mg/kg diet) | | Ascorbic acid 200 mg/l |
|---|---|---|---|---|
| | | 400 | 800 | |
| Red blood cells (RBCs) $10^6$ | 3.57±0.11 | 3.53±0.17 | 3.54±0.12 | 3.73±0.10 |
| White blood cells(WBCs) $10^3$ | 6.40±0.52$^{ab}$ | 7.36±0.73$^{a}$ | 5.56±1.59$^{b}$ | 6.07±0.30$^{ab}$ |
| Hemoglobin (Hb)mg/dl | 10.70±0.45$^{ab}$ | 10.53±0.45$^{b}$ | 10.50±0.30$^{b}$ | 11.46±0.50$^{a}$ |
| PCV % | 33.03±1.26 | 33.30±1.47 | 33.97±1.18 | 32.70±5.49 |
| Eosinophil % | 3.33±0.57 | 3.33±0.57 | 3.67±0.58 | 3.33±0.58 |
| Neutrophils % | 55.00±1.00$^{ab}$ | 52.67±2.08$^{b}$ | 55.00±1.00$^{ab}$ | 55.33±0.58$^{a}$ |
| Lymphocytes % | 39.67±1.52 | 40.00±1.73 | 38.67±2.08 | 37.66±2.52 |
| Monocytes % | 4.67±0.58 | 4.67±0.58 | 5.33±0.57 | 4.67±0.57 |
| **Sheep RBCs titer** | | | | |
| 7 days | 0.660 ±0.05 | 0.687±0.09 | 0.687±0.09 | 0.660±0.05 |
| 14 days | 0.743±0.05 | 0.740±0.08 | 0.770±0.00 | 0.767±0.07 |
| 21 days | 0.736±0.12 | 0.770±0.00 | 0.816±0.04 | 0.766±0.07 |

Different letters (a-c) within a raw denote significant differences between treatments (P ≤ 0.05)

Dried onion and ascorbic acid failed to induce any significant impact on SRBCs in comparison with the control group (Table 3). Results presented by Goodarzi*et al.* (2013) found that dietary supplementation of 10 and 30 g onion bulb/kg diet fiasco to induce any significant effect on antibody titers against NDV, although the weight of lymphoid organs was significantly (P ≤ 0.05) higher for birds fed diets supplemented with 30 g/kg Onion. In the present trial SRBCs measured, neither positive nor negative effect was affected. Since antimicrobial agents started to be used as growth promoters, researchers (Coates *et al.,* 1952; White hair and Thompson, 1956) working with broilers and swine respectively understood that the presence of an important health challenge in the field was essential to reveal the significant effects of these products. This was while the current trial was conducted in optimum conditions and no external challenges were impelled to the rabbits. On the other hand, Lee *et al.* (2014) suggested that an onion peel extract supplement at levels 4, 20, or100 mg/kg can improve the immune status of rats by increasing the number of immune-related cells and specific cytokine levels in comparison with the control group.

Results illustrated in Table 4 indicated that all feed additives used in the present study were significantly (P ≤ 0.01) reduced serum total lipids, triglycerides, total cholesterol and low density lipoprotein; however, they had insignificant effect on high density lipoprotein concentration in comparison with the control group. Generally, it was observed that 800 mg dried onion was more effective in decreasing serum total lipids, total cholesterol and low density lipoprotein,

however, ascorbic acid was more effective in decreasing serum triglycerides concentration in comparison with the other experimental groups.

**Table (4). Effect of dried onion and ascorbic acid on serum lipid profile at 15 weeks of age**

| Characteristics | Control | Onion (mg/kg diet) | | Ascorbic acid 200 mg/l |
|---|---|---|---|---|
| | | 400 | 800 | |
| Total lipids, mg/dl | 320.00±4.6[a] | 310.67±12.5[a] | 217.00±5.3[b] | 230.00±4.0[b] |
| Triglycerides, mg/dl | 80.87±2.4[a] | 70.30±1.5[b] | 71.20±0.9[b] | 63.97±1.4[c] |
| Total cholesterol, mg/dl | 112.33±1.5[a] | 102.40±6.6[b] | 61.90±0.8[d] | 70.53±1.5[c] |
| High density lipoprotein,mg/dl | 49.66±0.6 | 48.00±2.6 | 48.67±1.2 | 49.33±1.2 |
| Low density lipoprotein, mg/dl | 48.60±1.2[a] | 38.23±6.7[b] | 31.1±0.8[c] | 38.40±2.4[b] |
| Total antioxidant capacity, mmol/l | 0.90±0.10[b] | 1.85±0.57[a] | 1.20±0.26[b] | 1.41±0.09[ab] |
| Malondialdehyde, nmol/ml | 68.90±3.18[a] | 46.07±4.49[b] | 49.37±5.36[b] | 45.07±4.41[b] |

Different letters (a-c) within a raw denote significant differences between treatments (P ≤ 0.05)

Suresh and Srinivasan (1997) found that 3% onion powder reduced blood lipids, lipid peroxides and cholesterol. Goodarzi *et al.* (2013) reported that broilers receiving 30 g/kg onion had a significantly higher HDL and lower triglyceride concentrations compared to control group and dietary supplementation of 10 g onion bulb/kg diet. Also, An *et al.* (2015) stated that the concentrations of serum free cholesterol and triacylglycerol in broilers groups fed diet containing onion extract were significantly decreased compared with those of control or the group fed diet containing antibiotic (P ≤ 0.01).Chung *et al.* (2011) reported that onion peel extract supplementation to Sprague-Dawley male rats fed high fat diet significantly decreased serum level of LDL-cholesterol and increased HDL-cholesterol, while total cholesterol and triglyceride level were not affected. Hematological parameters were also not significantly affected by treatments. In contrast, Sklan *et al*. (1992) did not observe any effect of onion on hepatic cholesterol. The effects of onion have been ascribed to its sulfur containing principles which oxidize thiol compounds either present free or combined with a protein and NADPH which are necessary for lipid synthesis (Sebastian *et al*., 1979). The lipid lowering action of S-methyl cysteine sulfoxide (SMCS) isolated from *Allium cepa* was investigated in Sprague–Dawley rats fed on 1% cholesterol diet (Kumari and Augusti, 2007). Administration of SMCS at a dose of 200 mg/kg body weight for 45 days ameliorated the hyperlipidemic condition. The lipid profile in serum and tissues showed that concentrations of cholesterol, triglyceride and phospholipids were significantly reduced when compared to their untreated counterparts. The total lipoprotein lipase activity in the adipose tissue was decreased with also a decrease in the free fatty acid levels in serum and tissues. The activities of the lipogenic enzymes glucose 6-phosphate dehydrogenase and malic enzyme as also of 3-hydroxy-3-methyl-glutaryl-CoA reductase in the tissues remained low on treatment

indicating that SMCS did not favor lipogenesis and cholesterogenesis in the hyperlipidemic animals. The fecal excretion of bile acids and sterols was further increased upon treatment with SCMS.

Concerning ascorbic acid, Gad Alla *et al.* (2002) reported that cholesterol was significantly decreased with ascorbic acid addition as compared to the control group of bucks and does Bouscat rabbits. Also, Yousef *et al*. (2003) found that rabbits treated with ascorbic acid (20 mg/kg BW) showed a decrease in plasma cholesterol. However, Yousef (2004) suggested that ascorbic acid supplementation significantly decreased the level of total lipids and cholesterol. Similarly, Ibrahim (2005) found that vitamin C significantly decreased the cholesterol level by 4.7% compared to the control group. On the other hand, Salem *et al.* (2003) investigated the influence of ascorbic acid supplementation on some blood constituents of growing New Zealand White rabbits. They indicated that ascorbic acid supplementation did not effect on the serum cholesterol.

Malondialdehyde (MDA) as an indicator of lipid peroxidation was significantly decreased in all treatments in comparison with the control group (Table 4), while the results showed numerical increasein serum total antioxidant capacity (TAC) in the groups given 800 mg onion or 200 mg ascorbic acid. However, the group received 400 mg onion in their diet recorded significant ($P \leq 0.05$) increase in total antioxidant capacity in comparison with the control and 800 mg onion fed groups. It is reported that oral administration of fresh onion juice (3 cc/daily) for 4 weeks meaningfully decreased serum MDA levels, however, it increased TAC in Wistar rats (Khaki *et al*., 2012). The same reduction on MDA levels is demonstrated in male rats treated with onion (Ige and Akhigbe, 2012).The study of Prakash *et al.*(2007) showed that onion (Allium cepa) is a rich source of polyphenols with promising antioxidant and free radical scavenging potentials and has the ability to provide protection against DNA damage caused by reactive oxygen and reactive nitrogen species. Ogunlade *et al.* (2012) reported that under stress of alcohol administration in rabbits the results showed a statistically significant decrease in superoxide dismutase (SOD), catalse (CAT) and glutathione peroxidase (GPx) activity in liver compared to control animals, however, treatment with combined alcohol and Allium cepa (AC) significantly increased the liver SOD, CAT and GPx activity compared to animals that received alcohol alone. The authors also showed that alcohol significantly elevated the liver lipid peroxides expressed as MDA by about five folds as compared to the control value, however, co-administration of alcohol and Allium cepa (AC) exhibited a notable reduction in the liver MDA level compared to alcohol alone treated rabbits. Abdel-Salam *et al.* (2014) reported that the essential oils of red onion had the highest phenolic contents and antioxidant activity in contrast to garlic essential oils. In addition, Peluso *et al.* (2015) demonstrated that the onion peel ethanol extract have a strong antioxidant activity with quercetin and polyphenol proposed to be the major

components responsible for this effect suggesting the possibility that an onion peel supplement could improve the immune status.

In conclusion, rabbit dietary supplementation with ascorbic acid or dried onion could have beneficial effects on performance under summer environment without any side effects.

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**الملخص العربي**

# تأثير البصل المجفف والأسكوربيك أسيد علي الأداء والمناعة ودهون الدم في الأرانب النامية

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أستخدم ٣٦ أرنب نامي عمر خمسة أسابيع من كلا الجنسين متوسط وزن ابتدائي ٧٩١.٧جم خلال فصل الصيف في الفترة من يونيو – سبتمبر .

تم توزيع الأرانب عشوائياً علي أربع معاملات بكل معاملة تسعة أرانب ، وكل معاملة تم توزيعها علي ثلاث مكررات بكل مكررة ثلاث أرانب .المجموعة الأولي تناولت عليقة خالية من أي اضافات واستخدمت كمجموعة شاهد ، المجموعة الثانية والثالثة أضيف للعليقة البصل المجفف بمعدل ٤٠٠ ،٨٠٠ ملجم /كجم عليقة علي التوالي ، والمجموعة الرابعة تناولت عليقة الشاهد ولكن أضيف الأسكوربيك أسيد بمعدل ٢٠٠ملجم / لتر ماء .

**أوضحت النتائج :** انه عند عمر ١٥ أسبوع توجد زيادة معنوية في وزن الجسم نتيجة لأضافة البصل المجفف بمستويات مختلفة وكذلك الأسكوربيك أسيد . لوحظ أنخفاض معنوي في استهلاك العليقة في المجموعة التي أضيف لها ٨٠٠ ملجم / كجم عليقة مقارنة بمجموعة الشاهد تلاحظ تحسن معنوي في الكفاءة التحويلية في جميع المعاملات التجريبية مقارنة بمجموعة الشاهد . لم تتأثر الصفات الهيماتولوجية بالمعاملات المختلفة كما لم تؤثر المعاملات علي الاستجابة المناعية لكريات الدم الحمراء للأغنام مقارنة بمجموعة الشاهد . جميع الاضافات المستخدمة أدت إلي انخفاض في الدهون الكلية ، الدهون الثلاثية ، الكوليسترول الكلي والكليسترول منخفض الكثافة في سيرم الدم بينما لم يكن لها أي تأثير معنوي علي الكوليسترول مرتفع الكثافة مقارنة بمجموعة الشاهد . المالوندهايد كدليل لأكسدة الدهون أنخفض معنوياً في جميع المعاملات بينما المجموعة التي تناولت البصل المجفف بمعدل ٤٠٠ملجم في العليقة أدت إلي زيادة في السعة الضد تأكسدية مقارنة بمجموعة الشاهد . والخلاصة وجد أن الأرانب المضاف لعليقتها الأسكوربيك أسيد والبصل المجفف لها تأثير مفيد علي أداء الأرانب خلال فصل الصيف بدون أي تأثيرات جانبية .