Journal of Desert and Environmental Agriculture, 3 (1): 41-61, 2023
DOI: 10.21608/jdea.2023.193053.1016

JDEA

Article

Impact of crushed celery seeds and cinnamon powder supplementation as natural additives on the performance, carcass parameters, some blood criteria and economical efficiency of Japanese quail

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Article info.

Received on:10-2-2023

Accepted on: 29-3-2023

Published on: 6-2023

Open Access

Abstract

Objectives: To evaluate the effect of using a mixture of ground celery seeds with cinnamon powder as natural additives on performance, carcass parameters and some blood constituents in Japanese quail.Materials and Methods:One hundred eighty, one day old of Japanese Quail were randomly assigned in (3×2) factorial design arrangement. Three crushed celery seeds levels (0, 3 and 6 g/kg diet) and two cinnamon powder levels (0 , and 4 g/kg diet) were used in six treatments of 30 birds each (three replicates of 10 chicks each). Results:The obtained results indicated that chicks fed diet contained mixture of 6g/kg celery+4 g/kg cinnamon exhibited the highest body weight (BW) and body weight gain (BWG) at 28, 35 and 42 days of age and improved feed conversion ratio (FCR) at 2,3 and 4 wks of age compared to the other treatments. Dressed percentage increased in chicks fed the last previous mixture. Albumin, total protein, cholesterol, phosphorus, triglycerides and AST were significantly (P<0.050 affected by the main effect of celery levels. Chicks fed the highest level of celery (6 g/kg feed) exhibited low levels of plasma total protein, cholesterol , phosphorus, triglycerides and AST. The highest economic efficiency and relative economic efficiency was found in the 6th treatment, as chicks fed diet containing combined supplementation of celery (6 g/kg) and cinnamon (4 g/kg) as compared with those fed the other treatment. Conclusions:It can be concluded that use of celery (6g/kg feed) and cinnamon (4 g/kg feed) in the diet of Japanese Quail has positive impact on the performance in terms of body weight , body weight gain, feed intake and feed conversion ratio, carcass characteristics as well as net profit per birds over control group. It also has positive impact on blood profile and is also effective as antioxidant, and be sure to use it a replacement of antibiotics.

Keywords: Celery, cinnamon, performance, blood, economical, Japanese Quail.

1.Introduction

As a result of the increasing in the population of some countries of the world, especially developing countries, the population suffers from a lack of animal protein, and this is considered one of the biggest problems today that arouses concern **(Omoikhoje *et al.*, 2008).** The per capita animal routine in these countries is less than 10 g/day compared to the 35 g/day recommended by the Food and Agriculture Organization as the minimum requirement for body growth and development **(Esobhawan *et al.*, 2008)**. One of the ways to increase the supply of animal protein is to improve poultry production, as well as to increase the production of other short-term small bird species, including the Japanese quail (Coturnix Coturnix Japanica).

Medicinal herbal plants or botanical herbal additives are alternatives to antibiotics that can be used as growth stimulants for poultry (**Mudragada and Dhulipalla 2020),** and can be used to improve the rate of performance in poultry due to their biological activity **(Sharifi et al., 2013).**The use of celery powder and cinnamon as herbal ingredients improved body weight and feed conversion ratio of broiler chickens **(Kim *et al*, 2010 and Ahmadipour *et al.*, 2018**), and increased the resistance of the body through increased antibody titers against viral diseases, especially Newcastle disease, thus reducing mortality and lowering cholesterol , triglycerides and lipid levels in the blood **(Hoschmand *et al., 2012).***

Celery has nutritional value, as it contains 2.5-3% volatile oil, 60-70% d-limonene and 10-20% selenine. However, due to the availability of oleicin, this product contains 12-16% volatile oil (**Wolski *et al.*, 2001).** A sesquiterpen, kessane (2.2–7.6)% **(Philippe *et al.*, 2002)** was also detected. Celery seeds also contain carbohydrates, fat, protein and ash. They also contain minerals (Ca, P, Na, K, Fe) and vitamins (A, C, B1, B2, Nacin). Although induction of antioxidant activity by celery seeds has been reported **(Shalaby and Zorba, 2010).**

Ahmadipour *et al*., (2018) found that the use of mountain celery in broiler chicks improved feed conversion ratio , reduced relative liver weight and abdominal fat deposition, besides highly significant down-regulation of genes involved in hepatic lipogenesis including acetyl CoA carboxylase, fatty acid synthase, and lipoprotein lipase. The use of crushed seeds of celery for broiler roosters increases the counts of white blood cells, lymphocytes, monocytes **and** phagocytic activity, total protein and decrease AST, ALT and ALP enzymes when compared with control group (**AL-Kafajii 2013).**

Several previous studies have used natural compounds such as cinnamon as an alternative to synthetic antibiotics in poultry feeds (**Ali *et al.*, 2021**), and plant phenol compounds **(Mahfouz *et al*., 2021)** and several other compounds intended to improve broiler production without any side effects.

Cinnamon (*Cinnamomum cassia*) aids in digestion and increases appetite. Several essential oils have been isolated from cinnamon such as cinnamic acid, cinnamaldehyde, cinnamate, caryophyllene oxide, eugenol, and L-borneol. Cinnamaldehyde possesses strong antibacterial, antioxidant, and antifungal properties, and some studies indicated that adding cinnamon powder at a level of 1.0% in the diet improved body weight gain and reduced feed cost/kg increase in quail body weight **(Chou *et al*., 2013 and Mudragada and Dhulipalla ,2020).**

It was found that the addition of cinnamon in the feed increased the intake of kibble eaten **(Isabel and Santos, 2009 and Vali and Mottaghi, 2016)** and improved growth performance and pancreatic lipase activity in broiler chickens **(Kim et al, 2010).** Meat quality was improved by cinnamon addition **(Sang-oh *et al*., 2013)** and enhanced growth performance and stimulate protein absorption in the intestine because cinnamon contains proxironin which convert into xeronein in the body and has a role in activating enzymes concerns **(Şimşek *et al*., 2015).** Cinnamon is used for its bioactive compounds cinnamaldehyde and phenolic compounds in poultry feed to improve growth performance, health, meat quality, blood metabolites, carcass traits, immunity, and blood metabolites **(Cottrell, *et al.* 2021). Sadeghi and Moghaddam (2018)** observed better growth performance in terms of increased body weight and better feed conversion ratio with cinnamon supplementation. Feeds supplemented with cinnamon powder (0.05%) increased body weight gain and feed intake compared to the control group **(Kanani, *et al,* 2016). Toghyani *et al.* (2011)** reported that the addition of 2% cinnamon powder resulted in a significant improvement in body weight gain of broilers at 28 and 42 days compared to 4% cinnamon powder. **Ebrahimi *et al*.,. (2013)** demonstrated that the addition of cinnamon into broiler chick diets improved body weight gain in 28 days. **Sang-Oh *et al*. (2013)** found that 5% cinnamon powder has a greater ability to improve growth performance in male broiler chickens. **Rashid *et al* (2020)** reported that the cinnamon-based diet had a significant effect on feed conversion ratio, body weight gain and feed intake compared to control groups at 42 days. Similar results were reported by **Najafi and Taherpour (2014)** who showed that cinnamon helps in lowering the cholesterol level in poultry. Furthermore, in another study, under cold stress, cinnamon added with zinc had an enhanced effect on some blood constituents (**Torki *et al*., 2015).** Therefore, this study aimed to evaluate the impact of both celery seeds and cinnamon powder in diets of growing Japanese quail.

2. MATERIALS AND METHODS

The present study wa carried out at the Poultry Research Farm of Department of Poultry Production at Assiut University to investigate the impact of crushed celery seeds and cinnamon powder supplementation as natural additives on the performance, carcass criteria, some blood parameters and economical efficiency of growing Japanese quail.

Housing and experimental design:

One hundred eighty, one day old of Japanese Quail were randomly assigned in (3×2) factorial design arrangement. Three crushed celery seeds levels (0, 3 and 6 g/kg diet) and two cinnamon powder levels (0 , and 4 g/kg diet) were used in six treatments of 30 birds each (three replicates of 10 chicks each).The experimental diets based on corn –soybean meal and contain 23% crude protein according to **NRC (1994)**, recommendation).The ingredient composition and chemical analysis of the basal diet are presented in **Table (1).** Samples of the experimental diets were analyzed according to **AOAC (1990).** Celery and cinnamon powder were added at the account of yellow corn.

The experimental design was as follows:

Treatment 1	Chicks were fed basal diet (control) without supplementation
Treatment 2	Chicks were fed basal diet+ 4g/kg cinamon
Treatment 3	Chicks were fed basal diet+ 3g/kg celery
Treatment 4	Chicks were fed basal diet+ 3g/kg celery+ 4g/kg cinamon
Treatment 5	Chicks were fed basal diet+ 6g/kg celery
Treatment 6	Chicks were fed basal diet+ 6g/kg celery+ 4 g/kg cinamon

Table 1. Composition and chemical analysis of the experimental basal diet.

Ingredients	%
Corn, Grains	52.98
Soybean Meal (44%)	36.22
Vegetable oil	1.00
Corn gluten Meal (60%)	6.38
Di calcium phosphate	2.05
Vit . Min. Premix*	0.32
Limestone	0.43
Na Cl	0.32
DL-Methionine	0.16
L-Lysine HCl	0.14
TOTAL	100
Determined[1] and calculated[2] composition (% as fed basis)	
Dry matter	85.82
Crude protein[1]	23.92
Ether extract[1]	3.51
Crude fiber[1]	4.02
ME (kcal/kg)[2]	2920
Crude protein[2]	24.79
Ether extract[2]	3.46
Crude fiber[2]	3.86
Calcium2	0.76
Available phosphorus[2]	0.53
Lysine[2]	1.29
Methionine[2]	0.59

*Vitamins and minerals mixture provide per kilogram of diet: Vitamin A (as all-trans-retinyl acetate); 12000 IU; Vitamin E (all rac--tocopheryl acetate); 10 IU; k_3 3mg; Vit.D_3, 2200 ICU; riboflavin, 10 mg; Ca pantothenate,10 mg; niacin, 20 mg; Choline chloride, 500 mg; Vitamin B_{12}, 10g; Vitamin B_6, 1.5 mg; Thiamine (as thiamine mononitrate); 2.2 mg; Folic acid, 1 mg; D-biotin, 50g. Trace mineral (milligrams per kilogram of diet) Mn, 55; Zn, 50; Fe, 30;Cu, 10; Se, 0.1 and Ethoxyquin 3mg.

Galvanized batteries were used in the experimental study, consisting of five floors and equipped with cages of dimensions (75*50*45cm) and placed in a semi-closed house. Chicks were raised under suitable and similar management; food *ad libitum* and health conditions were available. Chicks were exposed during the first three days of life to a period of

23 hours of light/day, which was gradually decreased by 1 hour/day to reach 12 hours of light: 12 hours of darkness per day during the rest of the development period. Body weight was recorded at the age of one day and every week for each replicate up to 6 weeks.. Feed consumed was also recorded every week until the last of experiment. Body weight gain and feed conversion ratio were calculated over the periods 0-7, 0-14, 0-21, 0-28, 0-35 and 0-42 days of age.Mortality was recorded daily. At last of the experiment, three chicks from each replicate were taken to slaughter to measure carcass parts. After complete bleeding, scalding and plucking, the edible organs weighed and estimated as percentage of the live body weight. The dressing percentage was estimated by dividing the weight of the carcass and giblets on the pre-slaughter body weight of birds.

Blood samples:

At the end of the experimental period and during chick slaughtering, blood samples were taken from 3 birds from each replicate. The blood samples were taken in heparin tubes. Separation of plasma was carried out by centrifugation of coagulated blood at 3000 rpm for 10 min. The clear plasma was transferred carefully to clean and dry vials and kept in deep freezer until analysis for determination of plasma total protein, albumin, glucose, , calcium, phosphorus, triglycerides, cholesterol, AST, ALT, ALP using the appropriate kits obtained from Bio diagnostic Co.

Economical Efficiency Rate (EE)

The cost of feed consumed and selling price per bird were calculated according to the Egyptian local market prices in the year 2022. Economical feed efficiency % (EE), net revenue per unit feed cost and body weight were calculated according to the following equations (**Bayoumi, 1980**

Statistical analysis

Data were statistically analyzed by using ANOVA and General linear Model (GLM) procedure of **SAS software (2009). Duncan's multiple range tests (1955),** was used to determine the difference among means, when the treatment effects were significant. Significant difference were considered to exist when ($p<0.05$).

The mathematical model used was:

$$Y_{ijk}=\mu+Ce_i+Cn_j+(Ce*Cn)_{ij}+e_{ijk}$$

Where: Y_{iK} is any observation by celery seeds and cinnamon powder level

μ=the population mean., Ce_i= Celery supplementation effect (i=1,2,3)

Cn_j=Cinnamon supplementation effect (j=1,2), $(Ce*Cn)_{ij}$ = Interaction effects

e_{ik}=Experimental random error.

3. RESULTS AND DISCUSSION

3.1. Body weight (BW) and body weight gain (BWG)

The results of body weight (BW) of Japanese Quails as affected by dietary celery and cinnamon supplementation are shown in Table (2). No significant differences (P>0.05) due to the main effect of either celery or cinnamon on BW through the experimental period were observed except at 28 days of age. However, numerically, chicks fed basal diets supplemented with 6 g/kg celery achieved the highest BW compared to the other level and control chicks. Medicinal herbal ingredients or phytogenic additives are considered as one of the possible alternatives to antibiotic growth promoters in poultry (**Mudragada and Dhulipalla, 2020),** and can be used to improve the performance in poultry because of their biological activity ((**Sharifi *et al.*, 2013).** Supplementation of herbal ingredient such as celery and cinnamon improved both body weight and feed conversion ratio (**Kim *et al*, 2010 and Ahmadipour *et al.*, 2018)**, also it increase antibody titers against viral diseases, especially Newcastle disease and reduce cholesterol and triglyceride levels **(Houshmand *et al.*, 2012).** Although cinnamon dietary supplementation improves growth performance of broiler chickens in some instances **(Al-Kassie, 2010),** some studies show no effect of cinnamon on growth characteristics (**Koochaksaraie *et al.*, 2011).** Moreover, the performance of laying quail did not affected by cinnamon supplementation at level of 12g/kg feed (**Santos *et al.*, (2019)**.

Concerning with the interaction between celery and cinnamon, no significant (P>0.05) effects on BW at 7, 14 and 21 days of age. While, at 28, 35 and 42 days of age, chicks fed diet T6 (basal diet+ 6g/kg celery+ 4 g/kg cinnamon) exhibited the highest BW compared to the other treatments. BW increased in chicks fed T6 by about 5.3, 4.57 and 3.52% than control chicks at 28, 35 and 42 days of age, respectively.

Results presented in Table 3 showed that no significant differences (P>0.05) due to the main effect of either celery or cinnamon on BWG through the experimental period were detected except during the period from 0-4 wks of age for celery and during the period from 0-5 wks of age for cinnamon effects. At both ages, chicks fed the highest level of celery (basal diet+6 g/kg feed) had the highest BW compared with the other treatments. Also, the same trend for cinnamon, chicks fed basal diet +4 g/kg feed) had higher BW than control group. The obtained results are in the same line of **Sadeghi and Moghaddam, (2018)** who observed that better growth performance in terms of increased body weight and superior feed conversion ratio. In this connection, feed supplemented with cinnamon powder (0.05%) increased body weight gain and feed intake compared to the control group (**Kanani, *et al*, 2016). Also, Toghyani *et al.* (2011)** verified that the addition of 2% cinnamon powder significantly improved the body weight gain of broilers at 28 and 42 days compared to 4% cinnamon powder. **Ebrahimi *et al*.,. (2013)** reported that the inclusion of cinnamon in the diet of broilers improved body weight gain in 28 days. Concerning with the interaction between celery and cinneman, no significant (P>0.05) effects on BWG were obtained up to 3 weeks of age. While, during the period from 0-4, 0-5 and 0-6 wks of age, chicks fed diet T6 (basal diet+ 6g/kg celery+ 4 g/kg cinnamon) exhibited the highest BWG compared to the other treatments. BWG increased in chicks fed T6 by about 5.44, 4.64 and 3.55% than control chicks during the same previous periods, respectively. While chicks fed diet T4 (basal diet+ 3 g/kg celery +4g/kg cinnamon) had higher body weight than control groups during the period 0-4 and 0-6 wks of age. **Sang-Oh *et al*. (2013)** found that 5% cinnamon powder has a greater ability to improve growth performance in male broiler chickens.

3.2. Feed consumption (FC) and Feed conversion ratio (FCR)

Results in Table 4 showed that no significant differences (P>0.05) were observed due to the main effect of either celery or cinnamon and their combinations on FC through the experimental period. Numerically, chicks fed the highest level of either celery or cinnamon had the lowest FC compared to the other treatments. The results in the present study disagree with that reported by **Isabel and Santos, (2009) and Vali and Mottaghi, (2016)**, who showed that cinnamon supplementation increases feed intake **,** growth performance, and pancreatic lipase activity in broilers. Besides, cinnamon contains substances such as proxironin which is turned into xeronin, that activates enzymes helped in growth performance and improves protein absorption in the intestine **(Şimşek *et al.,* 2015).** Cinnamon is used for its bioactive compounds cinnamaldehyde and phenolic compounds in poultry feed to improve growth performance, health, meat quality, blood metabolites, carcass traits, immunity, and blood metabolites **(Cottrell, *et al.* 2021).** Also, chicks fed T6 (basal diet+6 g/kg celery and 4 g/kg cinnamon/feed) had the best FC than other treatments during all periods of growth. The results of **Zavaragh (2011)** showed that the best FCR and the highest feed intake were in group fed 200 ppm cinnamon extract).

Results in Table 5 showed no significant differences (P>0.05) due to the main effect of celery on FCR through the experimental period were obtained except during the period from 0-3 wks of age, however, chicks fed control diets exhibited the worst FCR compared to other treatments.The obtained results are in disagreement with the findings of **Ahmadipour *et al*., (2018)**, who reported that the use of mountain celery in broiler chicks improved feed conversion ratio. Concerning with cinnamon supplementation main effect, it had better FCR compared to control chicks except at 2 weeks of age. Several previous studies have used natural compounds such as cinnamon as an alternative to synthetic antibiotics in poultry feeds (**Ali *et al.,* 2021**), and plant phenolic compounds **(Mahfouz *et al.,* 2021)** and several other compounds intended to improve broiler production without any side effects.

Concerning with the interaction between celery and cinnamon, the results showed improved FCR for chicks fed T6 (basal diet+ 6 g/kg celery +4g/kg cinnamon) compared to other groups during the period from 0-4 wks of age. While control groups had the best FCR during the period from 0-2 and 0-3 wks of age.On the other hand, there were no significant differences due to the interactions on FCR in the remainder ages of the experiment. **Rashid *et al* (2020)** reported that the cinnamon-based diet had a significant effect on feed conversion ratio, body weight gain and feed intake compared to control groups at 42 days. The enhanced effect of cinnamon oil on growth performance and feeding efficiency was due to increasing the secretion of endogenous enzymes, cultivating the intestinal ecosystem, and improving the immune system through eliciting antimicrobial and antioxidant activities.

3.3. Carcass criteria

Results in Table 6 showed that no significant differences due to the main effects of celery or cinnamon on carcass criteria except for dressed percentage. However, chicks fed the basal diet supplemented with celery seeds (3 or 6g/kg feed) or cinnamon (4 g/kg feed) had the best dressed percentages than control chicks.

Concerning with the combination between celery and cinnamon, chicks fed T6 (basal diets+6 g celery/kg feed+4 g cinnamon/kg feed) had the best values for heart and dressed% compared to other treatments. Also, chicks fed T5 (basal diets+6 g celery/kg feed) had higher liver percentage than other treatments. Gizzard% exhibited the highest value in chicks fed T3 (basal diet+3 g celery/kg feed). The results of **Zavaragh (2011)** showed that the best percentage of carcass was observed in chicks fed the 250 mg of herbal extract of cinnamon/kg feed while the lowest percentage was found in the control group, and the highest percentage of liver was found in the group fed 200 mg of cinnamon extract/kg feed.

3.4.Blood biochemical parameters

Results in Table 7 showed that albumin, total protein, cholesterol , phosphorus, triglycerides and AST were significantly (P<0.050 affected by the main effect of celery levels. chicks fed the highest level of celery (6 g/kg feed) exhibited low levels of plasma total protein, cholesterol , phosphorus, triglycerides and AST. The obtained results concerning with total protein are in same line of **AL-Kafajii (2013)** who reported that total protein of broilers having celery seeds were decreased when compared with control group. On the other hand, glucose, calcium , ALP and ALT levels in plasma didn't affected by the main effect of celery. Numerically, AST and ALT values were decreased in birds fed the highest level of celery.The obtained results are in agreement with **AL-Kafajii (2013)** who reported that the use of crushed seeds of celery for broiler roosters decreased AST, ALT and ALP enzymes when compared with control group.

No significant (P>0.05) effects on all the measured biochemical parameters (albumin, total protein, cholesterol phosphorus, triglycerides glucose, calcium ALP ,GPT and GOT) due to the main effect of cinnamon supplementation were observed. The obtained results concerning with cholesterol are in disagreement with **Muwaffaq *et al.*, (2015)** who reported that cholesterol concentration was significantly (P≤0.01) increased in birds fed level of 2% cinnamon supplemented to basal diet compared with control and 1% cinnamon level. The obtained results concerning with glucose are in the same line of **Zavaragh, (2011)** who found that concentration of glucose was not significantly reduced in groups fed cinnamon compared to the control group**.** The serum total cholesterol and triglycerides concentration were significantly reduced in group of (2% and 1% cnnamon) compared to the control group (**Zavaragh, 2011)**

total protein, The interaction between celery and cinnamon showed that the levels of albumin, calcium, triglycerides and ALT in blood plasma were significantly (P<0.05) affected by the interactions. Chicks fed T5 exhibited low levels of total protein, albumin and triglycerides while, T4 exhibited low level of calcium and triglycerides compared to control. While, ALT level was increased by the interaction, this may indicate the improvement of liver function and activity in metabolism.

3.5. Economical Evaluation.

The results in Table 8. Showed that the economical evaluation of Japanese Quail as affected by celery and cinnamon supplementation. The highest economic efficiency and relative economic efficiency was found in the 6th treatment, as chicks fed diet containing combined supplementation of celery (6 g/kg) and cinnamon (4 g/kg) as compared with those fed the other treatment. However, the 6 treatment achieved 87.07% for economic efficiency% and 84.75% for relative economic efficiency. Chicks fed 3 g celery/kg feed achieved the worst value of both economic efficiency and relative economic efficiency. T2 in which quails fed 4 g cinnamon/kg alone exhibited good profitability ratio followed to the 6 treatment. In this concern, **Safa-Eltazi (2014)** reported that the highest profitability ratio was obtained by the diet supplemented with 5% cinnamon powder in the broiler diet. **Singh *et al*. (2014)** revealed that dietary inclusion of cinnamon powder at 0.5 percent level had the potential to act as a natural alternative to antibiotic growth promoters in respect of cost.

GENERAL DISCUSSION

Growth performance of broiler chicks were improvd by cinnamon addition **(Kim *et al*, 2010)** and meat quality **(Sang-oh *et al*., 2013).** Cinnamon is used for its bioactive compounds cinnamaldehyde and phenolic compounds in poultry feed to improve growth performance, health, meat quality, blood metabolites, carcass traits, immunity, and blood metabolites **(Cottrell, *et al.* 2021). Sadeghi and Moghaddam, (2018)** observed better growth performance in terms of increased body weight and better feed conversion ratio in broilers fed herbal supplemented diets compared to control. Moreover, feed supplemented with cinnamon powder (0.05%) increased body weight gain and feed intake compared to the control group (**Kanani, *et al*, 2016). Toghyani *et al*. (2011)** verified that the addition of 2% cinnamon powder significantly improved the body weight gain of broilers at 28 and 42 days compared to 4% cinnamon powder. **Ebrahimi *et al*.,. (2013)** reported that the inclusion of cinnamon in the diet of broilers improved body weight gain in 28 days. **Sang-Oh *et al*. (2013)** found that 5% cinnamon powder has a greater ability to improve growth performance in male broiler chickens. **Rashid *et al* (2020)** reported that the cinnamon-based diet had a significant effect on feed conversion ratio, body weight gain and feed intake compared to control groups at 42 days. Similar findings were found by **Najafi and Taherpour (2014)** who mentioned that cinnamon helps in lowering the cholesterol level in poultry. The reduction in total protein due to celery seeds (*Apium graveolens*) supplementation could due to the non-active biological compounds of celery seeds particularly glycosides, which have stimulating effects for building proteins and prevent its break down (**Glombitza, *et al.* 1994**). The present study revealed also that the celery seeds has no harmful effect on liver function in birds. Our findings are in agreement with those obtained by (**Al-Sa'aidi *et al*., 2012),** who observed decrease in AST and ALT enzymes content in the liver of rats treated with n-butanol extract of celery seeds when compared to control and diabetic rats.

Table (2) Body weight (g) of Japanese quail as affected by dietary celery and cinnamon supplementation.

Treatments	Body weight (g) during the trial period						
	One day old	(7 days of age)	(14 days of age)	(21 days of age)	(28days of age)	(35 days of age)	(42 days of age)
Celery (g/kg)							
0	7.75 ± 0.12	15.47 ± 0.21	55.28 ± 0.66	109.03 ± 0.9	158.33^{ab} ±1.5	203.29 ± 5.5	219.17 ± 1.4
3	7.73 ± 0.13	15.75 ± 0.2	55.83 ± 0.95	106.94 ± 2.1	154.58^{b} ± 1.3	190.56 ± 4.6	220.09 ± 0.7
6	7.70 ± 0.14	15.53 ± 0.21	56.94 ± 1.23	110 ± 2.49	163.19^{a} ± 2.7	198.19 ± 4.7	223.61 ± 2.7
Cinnamon (g/kg)							
0	7.60 ± 0.04	15.51 ± 0.19	56.20 ± 0.63	109.44 ± 1.3	157.59 ± 1.8	190.56 ± 3.3	219.51 ± 0.55
4	7.85 ± 0.11	15.65 ± 0.16	55.83 ± 0.96	107.87 ± 1.8	159.82 ± 2.3	204.14 ± 3.3	222.41 ± 2.08
Interactions							
T1	7.60 ± 0	15.11 ± 0.11	55.83 ± 0.28	108.61 ± 1.3	157.22^{ab} ±2.7	194.7^{ab} ± 3	220.56^{b} ± 1.7
T2	7.90 ± 020	15.83 ± 0.06	54.72 ± 1.39	109.44 ± 1.6	159.44^{ab}± 1.6	211.88^{a}± 6	217.78^{b} ± 2.2
T3	7.60 ± 0.10	15.56 ± 0.44	56.67 ± 1.67	109.44 ± 3.8	154.72^{ab} ±3.0	184.17^{b}± 6	219.09^{b} ± 0.2
T4	7.85 ± 0.28	15.94 ± 0.06	55 ± 1.11	104.44 ± 1.1	154.72^{b} ± 1.1	196.94^{ab}± 4	221.11^{b} ± 1.1
T5	7.60 ± 0.10	15.89 ± 0.11	56.11 ± 1.67	110.28 ± 3.0	160.83^{ab} ± 4	192.78^{ab}± 8	218.89^{b} ± 0
T6	7.80 ± 0.30	15.17 ± 0.06	57.78 ± 2.22	109.72 ± 5.2	165.56^{a} ± 4.4	203.61^{a}± 3	228.33^{a} ± 0.5

$^{a-d}$Means in the same column with different superscripts are significantly different (P<0.05).

T1=Basal control diet; T2=basal diet+4 g/kg cinnamon; T3= basal diet+ 3g/kg celery; T4= basal diet+ 3g/kg celery+ 4g/kg cinamon; T5= basal diet+ 6g/kg celery; T6= basal diet+ 6g/kg celery+ 4 g/kg cinnamon.

Table (3). Body weight gain (BWG/g) of Japanese quail as affected by dietary celery and cinnamon supplementation.

Treatments	Body weight gain (g) during the trial period					
	(0-1 wks of age)	(0-2 wks of age)	(0-3 wks of age)	(0-4 wks of age)	(0-5 wks of age)	(0-6 wks of age)
Celery (g/kg)						
0	7.72 ± 0.16	47.53 ± 0.77	101.28 ±0.9	150.58[ab] ± 2	195.55 ± 5.44	211.42 ± 1.6
3	8.03 ± 0.26	48.11 ± 1.01	99.22 ± 2.24	146.86[b] ± 1.1	182.83 ± 4.63	212.37 ± 0.6
6	7.83 ± 0.30	49.24 ± 1.15	102.30 ± 2.3	155.49[a] ± 2.5	190.49 ± 4.69	215.91 ± 2.6
cinnamon (g/kg)						
0	7.92 ± 0.20	48.60 ± 0.63	101.84 ± 1.3	149.99 ± 1.8	182.96[b] ± 3.3	211.91 ± 0.5
4	7.79 ± 0.19	47.98 ± 0.97	100.02 ± 1.7	151.97 ± 2.3	196.29[a] ± 3.2	214.58 ± 2.1
Interactions						
T1	7. ± 0.11	48.23 ± 0.28	101.01 ± 1.3	149.62[ab] ± 3	187.12[ab] ±2.5	212.96[b] ± 2
T2	7.93 ± 0.26	46.82 ± 1.59	101.54 ± 1.8	151.54 ± 1.8	203.98[a]± 5.42	209.88[b] ± 3
T3	7.96 ± 0.54	49.07 ± 1.57	101.84 ± 3.7	147.12[ab] ± 3	176.57[b]± 5.93	211.49[b] ± 0.1
T4	8.09 ± 0.31	47.15 ± 1.36	96.59 ± 1.36	146.59[b] ± 1.3	189.09[ab]±3.86	213.26[b] ± 0.8
T5	8.29 ± 0.01	48.51 ± 1.77	102.68 ± 2.9	153.23[ab] ± 3	185.18[ab] ±8.2	211.29[b] ± 0.1
T6	7.37 ± 0.36	49.98 ± 1.92	101.92 ± 4.9	157.76[a] ± 4.1	195.81[a] ± 2.7	220.53[a] ± 0.2

[a-d]Means in the same column with different superscripts are significantly different (P<0.05).T1=Basal control diet; T2=basal diet+ 4 g/kg cinamon; T3= basal diet+ 3g/kg celery; T4= basal diet+ 3g/kg celery+ 4g/kg cinnamon; T5= basal diet+ 6g/kg celery; T6= basal diet+ 6g/kg celery+ 4 g/kg cinnamon.

Table (4) Feed consumption (FC/g) of Japanese quail as affected by dietary celery and cinnamon supplementation..

Treatments	Feed consumation (g) during the trial period					
	(0-1 wks of age)	(0-2 wks of age)	(0-3 wks of age)	(0-4 wks of age)	(0-5 wks of age)	(0-6 wks of age)
Celery (g/kg)						
0	$23^{b} \pm 0.82$	116.50 ± 3	254.83 ±9	336.64±14	540.67 ±32	898.6 ±38
3	$23.75^{ab} \pm 1$	126.25 ± 3.7	284.86±12	395.28±32	599.91 ±46	953.1 ±56
6	$25.25^{a} \pm 0.4$	120.75 ± 2.3	263.39± 8	337.97±19	528.67 ±23	866.5 ±22
cinnnamon (g/kg)						
0	24.33 ± 0.49	116.83b ± 2	271.28±11	369.61±26	566.78 ± 37	919.0± 42
4	23.67 ± 0.71	125.50a ± 2	264.11 ±7	343.65 13	546.06 ± 21	893.2 ± 26
Interactions						
T1	$24^{ab} \pm 1$	$112^{c} \pm 3$	244.50 ± 3	317.56± 5	496.72 ±11	852.8±27
T2	$22^{a} \pm 1$	$121^{bc} \pm 2$	265.17±18	355.72±21	584.61± 47	944.3±63
T3	$24^{ab} \pm 1$	$120^{bc} \pm 2$	290.83±29	420.83±71	637.60±101	1004.6±117
T4	$23.5^{ab} \pm 5$	$132.50^{a} \pm 0.5$	278.89± 6	369.72 ± 2	562.22± 5	907.7 ±7
T5	$25^{ab} \pm 1$	118.50^{b} 4.5	278.50± 2	370.44 13	566± 23	899.6 ± 29
T6	$25.50^{a} \pm 0.5$	$123^{b} \pm 2$	248.28± 2	305.50 ± 9	491.33±4	833.6 ± 0.78

$^{a-d}$Means in the same column with different superscripts are significantly different (P<0.05).T1=Basal control diet; T2=basal diet+4 g/kg cinamon; T3= basal diet+ 3g/kg celery; T4= basal diet+ 3g/kg celery+ 4g/kg cinnamon; T5= basal diet+ 6g/kg celery; T6= basal diet+ 6g/kg celery+ 4 g/kg cinnamon.

Table (5) Feed Conversion ratio (FCR) of Japanese quail as affected by dietary celery and cinnamon supplementation.

Treatments	Feed conversion ratio (g feed/g gain)					
	(0-1 wks of age)	(0-2 wks of age)	(0-3 wks of age)	(0-4 wks of age)	(0-5 wks of age)	(0-6 wks of age)
Celery (g/kg)						
0	2.99 ± 0.15	2.46 ± 0.09	2.51^{b} ± 0.08	2.23 ± 0.08	2.76 ± 0.14	4.25 ± 0
3	2.97 ± 0.08	2.63 ± 0.12	2.87^{a} ± 0.08	2.69 ± 0.25	3.30 ± 0.34	4.48 ± 0.50
6	3.24 ± 0.17	2.45 ± 0.06	2.58^{b} ± 0.09	2.18 ± 0.16	2.79 ± 0.19	4.01.56 ± 0.19
cinnamon (g/kg)						
0	3.08 ± 0.06	2.40^{b} ± 0.04	2.66 ± 0.09	2.47 ± 0.20	3.12 ± 0.26	4.33 ± 0.33
4	3.05 ± 0.16	2.62^{a} ± 0.08	2.65 ± 0.09	2.27 ±0 .12	2.79 ± 0.012	4..16 ± 0.24
Interactions						
T1	3.19^{ab} ± 0.09	2.32^{b} ± 0.08	2.42^{c}±0.001	2.12^{ab} ± 0.07	2.65 ± 0.03	4.00 ± 0.18
T2	2.78^{b} ± 0.22	2.59^{ab} ± 0.1	2.61^{abc} ±0.14	2.35^{ab} ± 0.11	2.87 ± 0.31	4.49 ± 0.39
T3	3.02^{ab} ± 0.01	2.45^{ab} ± 0.1	2.85^{ab} ± 0.19	2.87^{a} ± 0.55	3.63 ± 0.69	4.75 ± 0.95
T4	2.91^{ab} ± 0.17	2.81^{a} ± 0.01	2.89^{a} ± 0.02	2.52^{ab} ± 0.01	2.97 ± 0.03	4.25 ± 0.05
T5	3.01^{ab} ± 0.12	2.44^{b} ±0.01	2.72^{abc}± 0.10	2.42^{ab} ± 0.14	3.07 ± 0.26	4.25 ± 0.14
T6	3.02^{a} ± 0.24	2.47^{ab} ± 0.1	2.44^{bc} ± 0.11	1.94^{b} ± 0.11	2.51 ± 0.01	3.77 ± 0.13

^{a}-^{d}Means in the same column with different superscripts are significantly different (P<0.05).

T1=Basal control diet; T2=basal diet+4 g/kg cinnamon; T3= basal diet+ 3g/kg celery; T4= basal diet+ 3g/kg celery+ 4g/kg cinnamon; T5= basal diet+ 6g/kg celery; T6= basal diet+ 6g/kg celery+ 4 g/kg cinnamon.

Table (6). Carcass parts (%) of Japanese quail as affected by dietary celery and cinnamon supplementation.

Treatment	Carcass parts							
	LBW/g	Liver, %	Heart, %	Gizzard, %	Proventry, %	Carcass,%	Giblets%,	Dressed, %
Celery levels (mg)								
0	237.5 ± 16.52	1.99 ± 0.26	0.58^{b} ± 0.2	0.84 ± 0.05	0.39 ± 0.06	63.55 ± 2.	3.41± 0.46	66.96^{c} ± 2.62
3	240 ± 13.1	2.22 ± 0.12	0.70^{ab} ± 0.4	1.18 ± 0.16	0.37 ± 0.04	65.82 ± 1.3	4.10 ± 0.06	69.92^{b}± 1.31
6	260 ± 9.13	2.31 ± 0.18	0.95^{a}± 0.03	1.006 ± 0.1	0.38 ± 0.03	67.6 ± 0.4	4.26 ± 0.11	72.02^{a} ±0.35
cinnamon seeds (1%)								
0	239.2 ± 10.19	2.06 ± 0.19	0.61b ± 0.1	1.06 ± 0.13	0.29 ± 0.04	63.8 ± 1.5	3.73 ±0.36	67.48^{b} ± 1.81
4	252.5 ± 11.38	2.28 ± 0.09	0.88^{a} ± 0.1	0.96 ± 0.03	0.34 ± 0.07	67.66 ± 0.3	4.12 ± 0.05	71.79^{a} ± 0.27
Interactions								
T1	210 ± 10	1.55^{d}± 0.05	0.31^{e} ± 0.	0.76^{e}± 0.01	0.28^{bc} ±0.1	60.11 ± 2.4	2.61 ± 0.07	62.73c ± 2.32
T2	265 ± 5	2.43^{b} ± 0.1	0.86^{bc} ± 0.1	0.92^{cd} ± 0.1	0.49^{a} ± 0.1	66.99 ± 0.3	4.21 ± 0.02	71.19^{b} ± 1.34
T3	262.5 ± 2.5	2.02^{c} ± 0.1	0.63^{d} ± 0.	1.47^{a} ± 0.1	0.36^{abc}± 0.1	63.82 ± 1.5	4.11± 0.08	67.94^{c} ± 1.49
T4	217.5 ± 2.5	2.41^{b} ± 0.1	0.78^{c} ± 0.	0.89^{d}± 0.01	0.39^{ab} ± 0.1	67.81 ± 0.3	4.09±0.14	71.90^{b} ± 0.51
T5	245 ± 5	2.61^{a}± 0.01	0.89^{b}± 0.02	0.94^{c}± 0.02	0.22^{cd}± 0.	67.33 ± 0.6	4.45±0.03	71.78^{b} ± 0.69
T6	275 ± 5	2^{c}± 0	1^{a} ± 0.04	1.07^{b}± 0.01	0.13^{d} ± 0.	68.19 ± 0.3	4.07±0.04	72.26^{a} ± 0.37

^{a}-^{d}Means in the same column with different superscripts are significantly different (P<0.05).LBW=Live body weight

T1=Basal control diet; T2=basal diet+4 g/kg cinnamon; T3= basal diet+ 3g/kg celery; T4= basal diet+ 3g/kg celery+ 4g/kg cinnamon; T5= basal diet+ 6g/kg celery; T6= basal diet+ 6g/kg celery+ 4 g/kg cinnamon.

Table 7. Blood biochemical parameters of Japanese quail as affected by dietary celery and cinnamon supplementation.

Treatm-ent	Blood biochemical parameters									
	T.Protein (g/dl)	Albumin (g/dl)	Glucose (mg/dl)	Cholesterol (mg/dl)	Calcium (%)	Phosphorus (%)	Triglyceri-des (mg/dl)	ALP (U/L)	AST (U/L)	ALT (U/L)
Celery levels (mg)										
0	4.11^{a}±0.4	1.80^{a}±0.1	306.31±33	381.1^{a}±54.4	10.34±0.2	7.32^{a}±0.27	363.3^{a}±35	272±21	95.2^{a}±2	92.01±1.0
3	3.74^{ab}±0.3	1.57^{ab}±0.1	291.6±28	343.9^{ab}±54	9.79±0.3	6.08^{ab}± 0.5	217.2^{ab}±64	279.5±42	84.4^{ab}±4	89.9±0.91
6	3.06^{b}±0.1	1.43^{b}±0.06	299.21±43	218.3^{b}±30.2	9.69±0.1	5.84^{b}±0.47	125.3^{b}±47	280.21±13	83.2±3.	21.1±1.44
cinnamon seeds (1%)										
0	3.95±0.33	1.53±0.7	302.7±23	350.2±38.28	10.17±0.3	6.50±0.3	271.7±55	237.1±10	86.6±2	91.5±0.74
4	3.32±0.14	1.67±0.9	295.4±32	278.6±47.87	9.71±0.16	6.33±0.4	198..9±47	277.3±31	89.2±3	91.2±1.15
Interactions										
T1	4.7^{a}±0.4	1.7^{a} ±0.06	322.0±40	417.3±81.1	10.8^{a}±0.2	7.2±0.21	400^{a}±20	206.8±17	93.1±2.4	92.5^{ab}±2.0
T2	3.6^{bc}±0.3	1.9^{a}±0.12	290.4±61	344.8±83.04	9.9^{ab}±0.37	7.5±0.5	326.7^{ab}±6	216.9±23	97.3±3.7	91.3^{ab}±0.7
T3	4.3^{ab}±0.5	1.6^{ab}±0.14	328.5±52	391.7±42.15	10.3^{ab}±0.5	6.7±0.8	360^{a}±20	234.2±8	79.8±4.6	91.6^{ab}±0.4
T4	3.2^{bc}±0.1	1.6^{ab}±0.19	254.7±50	296.2±104.7	9.3^{b}±0.09	5.5±0.14	74.3^{c}±9	315.8±8	89.03±8	88.3^{b}±1.0
T5	2.9^{c}±0.21	1.3^{b}±0.04	257.6±31	241.7±15.52	9.5^{b}±0.20	5.7±0.33	55^{c}±1	261.3±13	85.2±4.2	90.5^{ab}±0.9
T6	3.2^{c}±0.27	1.5^{ab}±0.07	340.9±82	195±61.67	9.9^{ab}±0.21	6.03±0.98	195.7^{bc}±8	299.1±20	81.2±6	93.7^{a}±2.6

^{a}-^{d}Means in the same column with different superscripts are significantly different ($P<0.05$).

T1=Basal control diet; T2=basal diet+4g/kg cinnamon; T3= basal diet+ 3g/kg celery; T4= basal diet+ 3g/kg celery+ 4g/kg cinnamon; T5= basal diet+ 6g/kg celery; T6= basal diet+ 6g/kg celery+ 4 g/kg cinnamon.

Table 8. Economical Efficiency of Japanese quail as affected by dietary celery and cinnamon supplementation.

Treatment	Economical Effeciency Rate (EE)								
	Feed intake (Kg/bird)	Price/kg feed (LE)	Total cost (LE)	BW(kg)	Price(kg) L.E	Total Revenue (TR)	Net Revenue (ER)	Economic efficiency %	Relative Economic effecieny
Celery levels (mg)									
0	$0.89^{ab}\pm0.03$	$12.35^{b}\pm0.14$	$11.10^{b}\pm0.46$	0.22 ± 0.001	95	20.75 ± 0.08	$9.66^{a}\pm0.54$	$88.02^{a}\pm8.49$	$100^{a}\pm1.11$
3	$0.95^{a}\pm0.03$	$13.3^{a}\pm0.12$	$12.690^{a}\pm0.26$	0.22 ± 0.001	95	20.90 ± 0.08	$8.20^{b}\pm0.31$	$64.82^{c}\pm3.83$	$73.64^{c}\pm3.34$
6	$0.86^{b}\pm0.02$	$13.65^{a}\pm0.14$	$11.81^{ab}\pm0.14$	0.22 ± 0.003	95	21.19 ± 0.27	$9.37^{a}\pm0.41$	$79.49^{b}\pm4.37$	$90.30^{b}\pm3.19$
cinnamon seeds (1%)									
0	0.92 ± 0.03	12.87 ± 0.25	11.84 ± 0.53	0.22 ± 0.001	95	20.81 ± 0.03	$8.97^{b}\pm0.54$	77.61 ± 8.33	$100^{a}\pm1.12$
4	0.89 ± 0.02	13.33 ± 0.24	11.91 ± 0.12	0.22 ± 0.002	95	21.09 ± 0.19	$9.18^{a}\pm0.28$	77.28 ± 3.11	$99.5^{b}\pm3.11$
Interactions									
T1	$0.85^{e}\pm0.03$	$12.10^{f}\pm0.12$	$10.31^{f}\pm0.15$	$0.22^{c}\pm0.001$	95	$20.90^{c}\pm0.03$	$10.59^{a}\pm0.2$	$102.73^{a}\pm3.11$	$100^{a}\pm3.25$
T2	$0.94^{b}\pm0.03$	$12.60^{e}\pm0.14$	$11.89^{d}\pm0.12$	$0.22^{f}\pm0.003$	95	$20.62^{f}\pm0.03$	$8.72^{b}\pm0.28$	$73.32^{c}\pm3.15$	$71.36^{c}\pm3.11$
T3	$1.004^{a}\pm0.04$	$13.10^{d}\pm0.14$	$13.15^{a}\pm0.24$	$0.22^{d}\pm0.001$	95	$20.81^{d}\pm0.03$	$7.65^{c}\pm0.21$	$58.18^{d}\pm3.12$	56.6f±2.11
T4	$0.91^{c}\pm0.03$	$13.5^{b}\pm0.11$	$12.24^{b}\pm0.11$	$0.22^{b}\pm0.004$	95	$20.99^{b}\pm0.03$	$8.75^{b}\pm0.28$	$71.64^{c}\pm3.14$	$69.56^{e}\pm2.17$
T5	$0.89^{d}\pm0.03$	$13.40^{c}\pm0.14$	$12.05^{c}\pm0.16$	$0.22^{e}\pm0.006$	95	$20.71^{e}\pm0.03$	$8.66^{b}\pm0.23$	$71.92^{c}\pm3.17$	$70.004^{d}\pm3.11$
T6	$0.83^{f}\pm0.01$	$13.9^{a}\pm0.10$	$11.58^{e}\pm0.14$	$0.23^{a}\pm0.002$	95	$21.61^{a}\pm0.03$	$10.08^{a}\pm0.2$	$87.07^{b}\pm3.11$	$84.75^{b}\pm3.12$

$^{a\text{-}d}$Means in the same column with different superscripts are significantly different ($P<0.05$).

T1=Basal control diet; T2=basal diet+4g/kg cinnamon; T3= basal diet+ 3g/kg celery; T4= basal diet+ 3g/kg celery+ 4g/kg cinnamon; T5= basal diet+ 6g/kg celery; T6= basal diet+ 6g/kg celery+ 4 g/kg cinnamon.

DECLARATIONS

Ethics approval: The experiment was conducted following animal welfare regulations at Poultry Production Farm, Faculty of Agriculture, Assiut University, Assiut. Egypt with all procedures approved by the Poultry Production Care and Use Committee.

Conflict of interest: The authors declare no competing interests

4. REFERENCES

Ahmadipour, B., Hassanpour, H. and Khajali, F. (2018). Evaluation of hepatic lipogenesis and antioxidant status of broiler chickens fed mountain celery. BMC Veterinary Research (2018) 14:234

Ali, A., Ponnampalam, E. N., Pushpakumara, G., Cottrell, J. J., Suleria, H. A. R., and Dunshea, F. R. (2021). Cinnamon: A natural feed additive for poultry health and production—a review. Animals, 11(7):20-26.

AL-Kafajii, S.S.O. (2013). Effect of dietary supplementation of crushed seed of Celery (Apium graveolens) on Blood traits & Some Immunological parameters of broiler roosters (Hubbard flex). J. of Kerbala University , Vol. 11 No.4 Scientific . 2013

Al-Kassie, G.A.M. (2010). The effect of thyme and cinnamon on the microbial balance in gastro intestinal tract on broiler chicks Int. J. Poult. Sci., 9. , pp. 495-498.

Al-Sa'aidi, J. A. A.; Alrodhan, M. N. A. and Ismael, A. K. (2012). Antioxidant activity of nbutanol extract of celery (Apium graveolens) seed in streptozotocin -induced diabetic male rats. Research in Pharmaceutical Biotechnology. 4(2):24-29.

AOAC (1990). Association of Official Analytical Chemists. Official methods of analysis. Assoc Anal Chem.

Bayoumi, S.B. (1980). Effect of different ration on egg production of breeding hens. Master of Science. Thesis, Faculty of Agric. kafr El-Sheikh, Tanta Univ. Egypt.

Chou S.T, Chang W.L, Chang C.T, Hsu S.L, Lin Y.C. and Shih Y. (2013). Cinnamomum cassia essential oil inhibits α-MSH-induced melanin production and oxidative stress in murine B16 melanoma cells. International Journal of Molecular Sciences, 14(9): 19186-19201

Cottrell, J. J., Le, H. H., Artaiz, O., Iqbal, Y., Suleria, H. A., Ali, A., Ali, A., Celi, P., and Dunshea, F. R. (2021). Recent advances in the use of phytochemicals to manage gastrointestinal oxidative stress in poultry and pigs. Animal Production Science. 10:1071. doi: 10.1071/ AN20667.s

Duncan, O. D., (1955). A methodological analysis of segregation indexes. American sociological review, 20(2), 210-217.

Ebrahimi M, Hoseini A, Palizdar M . H, Mohamadian-Tabrizi H . R and Porelmi M . R (2013). Effect of cinnamon, red pepper, ginger and cumin on broiler performance. Research Opinions in Animal and Veterinary Sciences, 3(5): 131-135.

Esobhawan, A. O.;. OJO, S.O. Ikhelao, E.E. (2008). Profitability, input elasticity and returns to scale in agriculture production in Lagos

State. Proceedings of 14th Annual Conference of Agriculture In Nigeria. Wetlands FUTA, Akure.219-222.

Glombitza, K. W.; Mabran, G. H.; Mirhon, Y. W.; Michel, K. G. and Motawi, K. (1994). Hypoglycemic & anti-hyperglycemic effect of zizuphus spinachristi in rats. Plant, Med. 60:244- 247.

Houshmand M, Azhar K, Zulkifli I, Bejo M.H and Kamyab A. (2012). Effects of non-antibiotic feed additives on performance, immunity and intestinal morphology of broilers fed different levels of protein. South African Journal of Animal Science, 42(1): 23-32.

Isabel B and Santos Y. (2009). Effects of dietary organic acids and essential oils on growth performance and carcass characteristics of broiler chickens. Journal of Applied Poultry Research. 18(3): 472–476.

Kanani, P.B., Daneshyar, M., and Najafi, R. (2016). "Effects of cinnamon (cinnamomum zeylanicum) and turmeric (curcuma longa) powders on performance, enzyme activity, and blood parameters of broiler chickens under heat stress" 4 (2016): 47-53.

Kim, D . K, Lillehoj, H . S, Lee, S . H, Jang, S . I and Bravo, D. (2010). High-throughput gene expression analysis of intestinal intraepithelial lymphocytes after oral feeding of carvacrol, cinnamaldehyde, or Capsicum oleoresin. Poultry Science, 89(1): 68-81.

Koochaksaraie, R.R., Irani, M. and Gharavysi, S.(2011). The effects of cinnamon powder feeding on some blood metabolites in broiler chicks

Mahfouz, S., Shang, Q.,and Piao, X. (2021). Phenolic compounds as natural feed additives in poultry and swine diets: a review. Journal of Animal Science and Biotechnology, 12(48). https://doi.org/10.1186/s40104-021-0056 5-3

Mudragada, V.P. and Dhulipalla, S.K. (2020). Cinnamon as photobiotic growth promoter on the performance of quail: Effect of Cinnamon (Cinnamomum cassia) powder as phytobiotic growth promoter on the performance of Japanese quail. International Kindle Paperwhite. Paperback – November 5, 2020

Muwaffaq, B. S.; Mustafa, S. and Merkhan M. (2015).Effect of different levels of cinnamon on performance and some serum parameters of japanese quails. gricultural and Veterinary Sciences (Dec. 2014), pp.80-89, 10 p

Najafi, S. and Taherpour, K. (2014). Effects of Dietary Ginger, Cinnamon, Synbiotic and Antibiotic supplementation on performance of broilers. Journal of Animal Science Advances, 4(1):658-667.

NRC (1994). Nutrient Requirements of Poultry. 9th rev. ed. Natl. Acad. Press, Washington, DC, USA

Omoikhoje, S. O.; A. M. Bamgbose and Aruna, M. B. (2008). Replacement value of unpeeled cassava root meal (UCRM) for maize in weaner Rabbit Diets. Nig. J. Anim. Prod., 35: 63-68.

Philippe, J., G. Suvarnalatha, R. Sankar and S. Suresh (2002). Kessane in the Indian celery seed oils. Journal of Essential Oil Research, 14 (4) : 276- 277.

Rashid, Z., Mirani, Z. A., Zehra, S., Gilani, S. M. H., Ashraf, A., Azhar, A., and Galani, S. (2020). Enhanced modulation of gut microbial dynamics affecting body weight in birds triggered by natural growth promoters administered in conventional feed. Saudi Journal of Biological Sciences, 27(10), 2747-2755. https://doi.org/10.1016/j.sjbs.2020.06.027

SAS (2009). User's Guide. Version, 9.2, 2002-2009, SAS institute Inc., Cary, NC, USA.

Sadeghi A., and Moghaddam, M. (2018). "The effects of turmeric, cinnamon, ginger and garlic powder nutrition on antioxidant enzymes' status and hormones involved in energy metabolism of broilers during heat stress" 8 (2018): 125-130.

Safa-Eltazi M.A (2014). Effect of using cinnamon powder as natural feed additive on performance and carcass quality of broiler chickens. International Journal of Innovative Agriculture and Biology Research, 2(3): 1-8

Sang-Oh P, Chae-Min R, Byung-Sung P and Jong H (2013). The meat quality and growth performance in broiler chickens fed diet with cinnamon powder. Journal of Environmental Biology, 34(1): 127.

Santos, T.S., C. da C. Lopes , G. M. O. J. , L. M. Santos , C.C Santos, and D.M. Souza, (2019). The use of cinnamon powder in the diet of Japanese laying quail. Animal Production, v. 41, e42963, 2019.

Sharifi SD, Khorsandi SH, Khadem AA, Salehi A and Moslehi H (2013). The effect of four medicinal plants on the performance, blood biochemical traits and ileal microflora of broiler chicks. Veterinarski arhiv, 83(1): 69-80.

Shalaby, M. A. and El-Zobra, H.Y. (2010). Protective effect of celery oil, vitamin E and their combination against testicular toxicity in male rats. Global Veterinaria, 5 : 122-128.

Şimşek ÜG, Ciftci M, Özçelik M, Azman MA, Tonbak F and Özhan, N. (2015). Effects of cinnamon and rosemary oils on egg production, egg quality, hatchability traits and blood serum mineral contents in laying quails (Coturnix coturnix Japonica). Ankara Üniv Vet Fak Derg, 62, 229-236.

Singh J, Sethi APS, Sikka SS, Chatli MK and Kumar, P. (2014). Effect of cinnamon (C. Cassia) powder as a phytobiotic growth promoter in commercial broiler chickens. Animal Nutrition and Feed Technology, 14: 471-479.

Toghyani, M., Toghyani, M., Gheisari, A., Ghalamkari, G., and Eghbalsaied, S. (2011). Evaluation of cinnamon and garlic as antibiotic growth promoter substitutions on performance, immune responses, serum biochemical and haematological parameters in broiler chicks. Livestock science, 138(1-3), 167-173.

Torki M., Akbari M., and Kaviani, K. **2015**. Single and combined effects of zinc and cinnamon essential oil in diet on productive performance, egg quality traits, and blood parameters of laying hens reared under cold stress condition. Int. J. Biometeorol. 2015;59:1169–1177.

Vali, N. and Mottaghi, S. (2016). The effect of using different levels of cinnamon and thyme powder on egg characteristics and fatty acids profile in Japanesese quail. CIBTech Journal of Zoology, 5(3): 2319-3883.

Wolski, T., A. Najda and Mardarowicz, M. (2001). GC/MS analysis of essential oil of the fruits of three varieties of Apium graveolens L. var dulce mill. Pers. Annales Universitstis Mariae Curie Skodowska Sectio EEE, Horticultura (Supplement), PP. 203- 211.

Zavaragh, F.M. (2011). Influence of different levels of cinnamon extract on performance, carcass and blood parameters of Japanese quails. Annals of Biological Research, 2011, 2 (6):306-310.

تأثير إضافة مسحوق بذور الكرفس والقرفة كإضافات طبيعية على معدل الأداء ومقاييس الذبيحة وبعض معايير الدم والكفاءة الاقتصادية السمان الياباني

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الملخص العربي

هدفت هذه الدراسة إلى تقييم تأثير إضافة خليط من مسحوق بذور الكرفس المطحون ومسحوق القرفة كإضافات طبيعية على معدل الأداء ومعايير الذبيحة وبعض مقاييس و الكفاءة الاقتصادية فى السمان الياباني النامى .تم استخدام مائة وثمانين كتكوت من السمان الياباني بشكل عشوائي في ترتيب تصميم عاملي (3 × 2). إستخدم فى الدراسة ثلاثة مستويات من مسحوق بذور الكرفس المطحون (0 ، 3 ، 6 جم / كجم علف) ومستويين من مسحوق القرفة (صفر ، 4 جم / كجم علف) في ستة معاملات لكل منها 30 طائرً. واستخدم ثلاثة مكررات بكل منها 10 كتاكيت . أشارت النتائج المتحصل عليها إلى أن الكتاكيت التي تم تغذيتها على الخليط المحتوى على 6 جم كرفس/ كجم + 4جم قرفة/ كجم علف أظهرت أعلى وزن للجسم (BW) وزيادة في وزن الجسم (BWG) في عمر 28 و 35 و 42 يومًا وتحسن معدل التحويل الغذائي (FCR) في عمر 2، 3 و 4 أسابيع مقارنة بالمعاملات الأخرى. زادت ايضا نسبة التصافى فى الكتاكيت التى تغذت على الخليط السابق. تركيزات الألبومين والبروتين الكلي والكوليسترول والفوسفور والدهون الثلاثية و AST معنويا (P <0.0 50) بالتأثير الرئيسي لمستويات الكرفس. وظهرت الكتاكيت التي تغذت على أعلى مستوى من الكرفس 6 جم / كجم علف) مستويات منخفضة من البروتين الكلي في البلازما والكوليسترول والفوسفور والدهون الثلاثية و AST. وإضافة النتائج المتحصل عليها الى أن التغذية على المخلوط المكون من 6 جم كرفس / كجم علف + 4 جم قرفة / كجم علف أدى إلى الحصول على أعلى كفاءة اقتصادية وكفاءة اقتصادية نسبية مقارنة بالمعاملات الاخرى. امكن الاستنتاج أن استخدام الكرفس (6 جم / كجم علف) والقرفة (4 جم / كجم علف) في علف السمان الياباني له تأثير إيجابي على الأداء من حيث وزن الجسم وزيادة وزن الجسم وكمية العلف المستهلك ومعدل التحويل الغذائي وخصائص الذبيحة ومما كان له تأثير إيجابي على ملف الدم وكذلك صافي الربح مقارنة بالمعاملات الاخرى وهو فعال أيضًا كمضاد للأكسدة ، وتأكد من استخدامه كبديل للمضادات الحيوية.