

## EFFECT OF ACETIC ACID AND DATE RESIDUES ON SOME PHYSIOLOGICAL CHARACTERISTICS, PRODUCTIVE AND REPRODUCTIVE PARAMETERS OF QUAIL DURING SUMMER SEASON

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### SUMMARY

One hundred and eight 8 wk-old Japanese quail were distributed randomly into six different dietary treatments in a 2 x 3 factorial with three replicates, each containing 6 birds (2 males and 4 females), assigning experimental unit to investigate the effect of vinegar (acetic acid) and date residues (date's by-product) on egg production, fertility and hatchability percentages, some physiological characteristics, blood parameters, hormones, antioxidant indices and immunity parameter. Average temperature ranged between 40°C and 43°C with 50 % relative humidity from 8 to 14 weeks of age. Dietary treatments were date residues levels (0 and 10%) supplemented into diets with three levels of acetic acid (0.0, 0.5 and 1ml /liter water) in drinking water. Results showed that dates residues and vinegar (acetic acid) and interactions between them had significant effect on all the productive performance (egg weight, egg production, egg mass/hen/day, feed conversion as (g feed/g egg)) and improved significantly ( $P<0.05$ ) fertility and hatchability percentages while decreased significantly ( $P<0.05$ ) non pipping embryos (%) and embryonic mortality (%). All treatments and interactions between them increased significantly some blood hematological, blood biochemical parameters, antioxidant indices and immunity parameter and hormones of quail, i.e., total protein, albumin, total lipids, HDL, GPX, GSH, SOD, IgG, progesterone and T3, T4 hormones, but WBCs count in all treatments were slightly increased in number, while serum cholesterol, glucose concentrations, AST and ALT were decreased significantly ( $P<0.05$ ) birds' in compared with control group. The nutrients digestibility were improved by treatment groups and interactions between them. The counts of total aerobic and anaerobic bacteria and total coliform of chick intestinal were decreased due to add different treatments compared with the control. In conclusion, It may be the application of date residues 10% (in feed) with vinegar (acetic acid) in drinking water (0.5 or 1ml/liter) improved the productive performance such as egg production, fertility, hatchability percentages, some physiological parameters and nutrients digestibility of laying Japanese quail during summer season.

**Keywords:** *Quail, vinegar, dates residues, egg production, hatchability, blood parameters.*

### INTRODUCTION

Summer months could be a difficult time for poultry production that a problem in many parts of the world. The main consequences of the hot environment are low feed intake and egg production (Peguri and Coon, 1991). It has also been shown that at high ambient temperatures, the potential of physiological birds is sharply reduced (Obidi *et al.*, 2008 and Ayo *et al.*, 2010).

Date palm (*Phoenix dactylifera*, L.), a member of the family of Arecaceae, is one of the most important wood plants grown in dry or semi-dry regions of the world (Moghaieb *et al.*, 2011). Dates, the fruit of the date palm tree (*Phoenix dactylifera*), are a major food in the arid regions of North Africa and the Middle East, and the date crop plays a major role in the economy and social life of these regions (FAO, 2007)

At the last few years, there have been increasing attempts to use date waste as a production of meat and

eggs. It is reported that the nitrogen-free extract from date waste with or without the pit allows it to be used as an energy source in poultry diets to reduce feed costs and reduce pollution problems (Soliman, 1996; Hussein *et al.*, 1998; Al-Harhi, 2006; Najib and Al-Yousef, 2012 and Ghasemi *et al.*, 2014). In addition, the secondary product contained about 26.6% galactose, 71.8% mannose and 9.8-22.3% beta-galactomannan polysaccharides which could replace the energy of maize in poultry diets (Ishrud *et al.*, 2001 and Hamada *et al.*, 2002).

Organic acids are routinely incorporated into the monogastric animals diet in Europe as acidifiers and preservatives, to replace antibiotics as promoters of growth and to prevent or control pathogens (Papatsiros *et al.*, 2012 and Sugiharto, 2014). Organic acid (eg, acetic acid) and their slices inhibit the growth of microorganisms in the gastrointestinal tract, altering intestinal pH and improving feed utilization (Patten and Waldroup, 1998; Owings *et al.*, 1990; Skinner *et al.*, 1991 and Adams, 1999). Kadim *et al.* (2008) note that supplemental ascorbic acid significantly reduces the effects of heat-related stress on the performance of broiler chickens. This suggests that the addition of acetic acid to drinking water may reduce the heat stress conditions in laying hens and improve egg production and quality.

The objective of this study was to evaluate use date residues and acetic acid supplementation on physiological characteristics, egg production, fertility and hatchability percentages of laying Japanese quails reared during summer season.

## **MATERIALS AND METHODS**

The present study was carried out at Poultry Farm, Faculty of Agriculture, New Valley University. The experiment was conducted during the period between May and June 2017

### ***Experimental diets and design:***

The date of this study was purchased from a local factory in the New Valley Governorate, Egypt. Dates were dried in an automatic oven at (60 ° C) for 24 hours, after that dates were ready for grinding with crushing (Abdel Ghani *et al.*, 2004). Natural white vinegar 5% was purchased from a local company, Egypt. One hundred and eight 8 wk-old Japanese quail (*Coturnix coturnix japonica*) were weighed to equal live weight in all groups at the beginning of the study. They evenly distributed randomly into six different dietary treatments in a 2 x 3 factorial arrangement including two date residues (date's by-product) levels (0 and 10%) supplemented into diets with three levels of acetic acid (0, 0.5 and 1ml / liter) in drinking water with three replicates, each containing 6 birds (2 males and 4 females).

Quail were allowed *ad libitum* access to feed and water, and they were housed in wire cages on a 17-h lighting schedule. Chemical composition of the diet was analyzed by the methods of A.O.A.C. (1990). All birds were kept under the same environmental conditions. Average temperature ranged between 40°C and 43°C with 50% relative humidity from 8 to 14 weeks of age.

### ***Samples taken and Measurements:***

**Productive performance:** Egg weight and egg number were recorded daily 8<sup>th</sup> to 14<sup>th</sup> weeks of age for each replicate and calculate egg mass (g). Feed conversion ratio (FCR) as g feed /g egg was calculated and feed intake were recorded. The egg production traits were recorded throughout the experimental period for each treated. Hatchability percentages measuring by recorded the number of the hatched chicks for three days after 17 days of brooding. Then the remaining non-hatched eggs were cracked, and the unfertile eggs, fertile, non piping embryos and embryonic deaths were recorded.

At the end of the experiment (14 weeks of age), three birds from each treated group were randomly chosen, then individually weighed and slaughtered, (the assigned birds were fasted overnight). Three blood samples from each treated group were collected. Apportion of the fresh blood was used to determine blood hematological parameters (Hemoglobin (Hb), Red Blood Cells (RBCs), Packed cells volume (PCV) and the white blood cells (WBCs) and WBCs' fractions were measured. Serum was obtained from the blood samples by centrifugation for 15 min. At 3000 rpm and was stored at -20 C° until the time of analysis. Serum samples were analyzed to determine biochemical blood indicators such as (total lipids ,total protein, albumin, cholesterol, high density lipoprotein (HDL), glucose concentration ,alkaline phosphatase (ALP) and asparatate amino transferase (AST), antioxidant indices (glutathione peroxidase (GPX), glutathione

(GSH), superoxide dismutase (SOD), immune indices (IgG) and hormone (P<sub>4</sub>, T<sub>3</sub>, T<sub>4</sub>) by using the commercial kits.

**Table (1): Composition and calculated analysis of the experimental diet.**

Ingredient	Basal diet, g/kg	date residues, g/kg
Yellow corn	600.5	493
Soybean meal (44%)	250	236
Corn gluten meal (62%)	57	70.5
Calcium diphosphate	23	23
Limestone	48	48
Vit. + Min. premix <sup>(1)</sup>	2.5	2.5
NaCl	2	2
DL- Methionine	0.5	0.5
L-Lysine HCl	1.5	1.5
Cotton seed oil	15	23
Date residues		100
Total	1000	1000
Calculated analysis		
Crude protein %	20	20
ME (kcal/kg)	2925	2926
Crude fiber %	3.32	4.64
Crude fat %	4.21	5.15
Calcium %	2.44	2.44
Available phosphorus %	0.54	0.53
Lysine %	1.05	1.04
Methionine	0.4	0.41
Methionine + Cystine %	0.75	0.74

<sup>(1)</sup> Layer Vit. + Min. premix: Each 2.5 kg of vitamins and minerals premix (commercial source pfizer Co.): consist of Vit. A 12 MIU, Vit E15 KIU, Vit. D3 4 MIU, Vit. B1 1g, Vit B2 8g, Vit B6 2g, Vit B12 10mg, Pantothonic acid 10.87g, Niacin 30g, Folic acid 1g, Biotin 150 mg, Copper 5g, Iron 15g, manganese 70g, Iodine 0.5g, Selenium 0.15g, Zinc 60g and antioxidant 10g.

**Table (2): Chemical composition of date residues.**

Composition	%
Dry matter%	97.45
ME (kcal/kg)	2699.5
Crude protein%	6.40
Crude fat%	5.58
Crude fiber%	16.4
Nitrogen free extract (sugar + starch %)	46.08

The metabolizable energy content of date wastes used was calculated according to Carpenter and Clegg (1956) equation as follows: metabolizable energy (kcal/kg) = 53+38 [crude protein% + 2.25\* ether extract%+1.1\* nitrogen free extract%].

**Digestibility of nutrients:** at 14 weeks of age, digestibility of nutrients were conducted according to A.O.A.C. (1990) e.g. crude protein (CP), ether extract (EE), crude fiber (CF), dry matter (DM) and nitrogen free extract (NFE) was estimated by subtracting previous components from one hundred and expressed on a dry matter basis. Then the estimation was made according to Han *et al.* (1976).

**Bacteriological count:** Total anaerobic count, aerobic plate counts (APC) and total coliform counts were carried out according to American Public Health Association (A.P.H.A, 1985).

**Statistical analysis:** Data collected were subjected to Analysis of Variance (ANOVA). Differences among treatments were evaluated according to procedure outlined by Gomez & Gomez (1983). Significant differences between means was defined at 5 percent level compared using the Duncan's multiple range test (Duncan, 1955).

## RESULTS AND DISCUSSION

### *Productive performance:*

Data given in Table (3) shows that date residues irrespective of acetic acid and acetic acid irrespective of date residues of level had significantly ( $P < 0.05$ ) higher effect on all the productive performance (egg weight, egg production and egg mass/hen/day) and improved ( $P < 0.05$ ) feed conversion as in compared with control (zero date residues or acetic acid). Increasing date residues in the birds fed date residues from zero to 10%, as well as acetic acid supplemented in drinking water from zero, 0.5 or 1 ml acetic acid /liter led to an increase in egg weight by 5.2% of the control value (zero date residues), 3.9 and 4.3% of the control value (zero acetic acid), egg production by 10.73% of the control value (zero date residues), 15.96 and 20.25% of the control value (zero acetic acid), egg mass/hen/day by 16.41% of the control value (zero date residues), 20.85 and 25.40 % of the control value (zero acetic acid), while feed conversion decreased by 4.82% of the control value (zero date residues), 5.2 and 6.3% of the control value (zero acetic acid), respectively.

**Table (3): Effects of date residues and acetic acid on egg production of quail during summer season.**

Trait	Egg weight (g)	Egg production %	Egg mass(g/hen/day)	Feed conversion ratio (g feed/g egg)
Date residues (D) effect:				
D <sub>0</sub> (zero date residues) control	11.15 <sup>b</sup>	71.43 <sup>b</sup>	7.98 <sup>b</sup>	4.35 <sup>a</sup>
D <sub>1</sub> (10% date residues)	11.73 <sup>a</sup>	79.10 <sup>a</sup>	9.29 <sup>a</sup>	4.14 <sup>b</sup>
Pooled SEM	0.08	2.09	0.29	0.04
Acetic acid (A) effect:				
A <sub>0</sub> (zero acetic acid) control	11.12 <sup>b</sup>	67.16 <sup>c</sup>	7.48 <sup>c</sup>	4.42 <sup>a</sup>
A <sub>1</sub> (0.5 ml /liter) acetic acid	11.59 <sup>a</sup>	77.88 <sup>b</sup>	9.04 <sup>b</sup>	4.19 <sup>b</sup>
A <sub>2</sub> (1 ml /liter) acetic acid	11.60 <sup>a</sup>	80.76 <sup>a</sup>	9.38 <sup>a</sup>	4.14 <sup>b</sup>
Pooled SEM	0.13	1.74	0.29	0.05
Interactions between date residues (D) and acetic acid (A) :				
D <sub>0</sub> X A <sub>0</sub>	10.81 <sup>e</sup>	63.09 <sup>f</sup>	6.82 <sup>f</sup>	4.43 <sup>a</sup>
D <sub>0</sub> X A <sub>1</sub>	11.36 <sup>d</sup>	73.61 <sup>d</sup>	8.36 <sup>d</sup>	4.33 <sup>b</sup>
D <sub>0</sub> X A <sub>2</sub>	11.28 <sup>c</sup>	77.58 <sup>c</sup>	8.75 <sup>c</sup>	4.30 <sup>b</sup>
D <sub>1</sub> X A <sub>0</sub>	11.43 <sup>c</sup>	71.23 <sup>e</sup>	8.14 <sup>e</sup>	4.40 <sup>ab</sup>
D <sub>1</sub> X A <sub>1</sub>	11.83 <sup>b</sup>	82.14 <sup>b</sup>	9.72 <sup>b</sup>	4.04 <sup>c</sup>
D <sub>1</sub> X A <sub>2</sub>	11.92 <sup>a</sup>	83.92 <sup>a</sup>	10.00 <sup>a</sup>	3.98 <sup>c</sup>
Pooled SEM	0.0	0.48	0.05	0.03

Means with the same letters are not significantly differed at ( $P < 0.05$ ) according to Duncan's multiple range test.

There were significant interactions between adding dietary date residues into diets and acetic acid levels into water used in the present study on all the productive performance as shown in Table (3). Result showed that bird treated by 1ml acetic acid/liter water and date residues (10%) into diets had the higher ( $P < 0.05$ ) egg weight, egg production, egg mass and improved ( $P < 0.05$ ) feed conversion as compared with the other dietary treatments. In agreement with the present study, Jensen and Chang (1976), Gama *et al.* (2000), Yesibag and Colpan (2006) and Soltan (2008) reported that organic acid supplementation had positive effects on egg production in laying hens. In this respect, Whitehead *et al.* (1998) and Kirunda *et al.* (2001)

found that egg production decreased due to elevated of environmental temperature. They suggested that the decline in egg production was most likely due to reduced feed consumption in chickens and reduction of available nutrients for egg production. This depression can be attributed to the high ambient temperature and its impact on the different physiological characteristics of the chickens. According to Mahdavi *et al.* (2005), the effect of organic acid on poultry production depends on the intestinal flora and environmental temperatures. High ambient temperatures lead to reduced vitamin and mineral serum concentrations in poultry (Anderson, 1987), resulting in lower egg production. It has been suggested that the effects of organic acids include an improvement in the digestibility and retention of nutrients, as well as modifying the population microbes in the digestive system (Caja *et al.*, 2000). In addition, organic acid has been proposed to improve digestive enzyme activity microbial phytase activity, increase pancreatic secretion and increase the growth of gastrointestinal mucosa (Dibner and Buttin, 2002) and promotes intestinal absorption of nutrients in ligated duodenal loops (Combs and Pesti, 1976). Kadim *et al.* (2008) reported that, acetic acid can be used during hot months to reduce heat stress and improve egg weight, egg production, diameter and length of eggs from the laying hens between 30–40 weeks of age. This indicates that acetic acid has a potential effect on some stresses, allowing better egg production and egg weight.

Addition of date residues may also stimulate feed and energy consumption at high temperatures, which in turn, provide better performance response and increase the energy value of the other feed constituents. In addition, the secondary product contained about 26.6% galactose, 71.8% mannose and 9.8–22.3% beta-galactomannan polysaccharides which could replace the energy of maize in poultry diets (Ishrud *et al.*, 2001 and Hamada *et al.*, 2002). Hermes and Al-Homidan (2004) reported that layer hens fed diets containing 10% date pits meal enhanced the egg weight, feed conversion ratio (kg feed/kg egg), egg production and egg mass. However, Najib and Al-Yousef (2012) found that layer hens fed 10% date pits meal without enzymes improved the feed consumption, feed conversion ratio, egg production and egg mass, but reduced egg size compared to those fed 15% date pits meal without enzymes. Torki *et al.* (2014) found that hens fed on the diet containing 10% whole date waste ( $P < 0.05$ ) had the highest value of egg weight.

#### ***Fertility and hatchability percentages:***

Data given in Table (4) shows that date residues irrespective of acetic acid and acetic acid irrespective date residues of level had a significant ( $P < 0.05$ ) increasing in fertility and hatchability percentages while non pipping embryos (%) and embryonic mortality (%) were significantly ( $P < 0.05$ ) decreased compared with the control (zero date residues or acetic acid). Increasing date residues in the birds fed date residues from zero to 10%, as well as acetic acid supplemented in drinking water from zero, 0.5 or 1 ml acetic acid /l water led to an increase in fertility by 8.89% of the control value (zero date residues), 11.28 and 14.35% of the control value (zero acetic acid), hatchability percentages by 10.89% of the control value (zero date residues), 12.47 and 18.99% of the control value (zero acetic acid), while non pipping embryos decreased by 20.63% of the control value (zero date residues), 30.72 and 37.52% of the control value (zero acetic acid), embryonic mortality % by 28.14% of the control value (zero date residues), 16.04 and 35.64% of the control value (zero acetic acid), respectively.

There were significant interactions between adding dietary date residues into diets and acetic acid levels into water used in the present study on fertility and hatchability percentages as shown in Table (4). Result showed that bird treated by 1ml/l acetic acid in water and date residues (10%) into diets had the higher ( $P < 0.05$ ) fertility and hatchability percentages and decreased ( $P < 0.05$ ) non pipping embryos % and embryonic mortality % compared with the other dietary treatments. In this respect, Deeming and Ferguson (1991), reported the effect of temperature on hatching, and Lourens *et al.* (2005) emphasized the adverse effects of temperature on embryonic development of chicks. It can be argued that the increase in hatchability may be due to the supplementation of organic acids in drinking water that improve the quality of the internal eggs, which is consistent with Gama *et al.* (2000), Yalcin *et al.* (2000) and Soltan (2008).

#### ***Blood constituents and hormones:***

Data given in Tables (5,6 and 7) shows that date residues irrespective of acetic acid and acetic acid irrespective date's by-product of level had a significant ( $P < 0.05$ ) increasing in hematological traits of quail parameters RBCs, Hb, PCV, but there were no significant on the WBCs and WBCs' fractions and had a significant ( $P < 0.05$ ) increasing in blood biochemical parameters of quail, i.e., (total protein, albumin, total lipids and HDL, antioxidant indices (GPX), GSH, SOD, immune indices (IgG) and hormone ( $P_4$ , thyroid hormone ( $T_4$ ) and triiodothyronine ( $T_3$ )), while serum cholesterol, glucose concentration, and AST and ALT were significantly ( $P < 0.05$ ) decreased compared with the control (zero date residues or acetic acid).

**Table (4): Effects of date residues and acetic acid on fertility (%), hatchability (%), non pipping embryos (%) and embryonic mortality (%) of quail during summer season.**

Trait	Fertility (%)	Hatchability (%)	Non pipping embryos (%)	Embryonic Mortality (%)
Date residues (D) effect:				
D <sub>0</sub> (zero date residues) control	80.42 <sup>b</sup>	69.02 <sup>b</sup>	16.09 <sup>a</sup>	14.89 <sup>a</sup>
D <sub>1</sub> (10% date residues)	87.57 <sup>a</sup>	76.54 <sup>a</sup>	12.77 <sup>b</sup>	10.70 <sup>b</sup>
Pooled SEM	1.78	1.88	1.17	0.89
Acetic acid (A) effect:				
A <sub>0</sub> (zero acetic acid) control	77.38 <sup>c</sup>	65.87 <sup>c</sup>	18.68 <sup>a</sup>	15.46 <sup>a</sup>
A <sub>1</sub> (0.5 ml /liter) acetic acid	86.11 <sup>b</sup>	74.09 <sup>b</sup>	12.94 <sup>b</sup>	12.98 <sup>b</sup>
A <sub>2</sub> (1 ml /liter) acetic acid	88.49 <sup>a</sup>	78.38 <sup>a</sup>	11.67 <sup>b</sup>	9.95 <sup>c</sup>
Pooled SEM	1.317	1.75	0.95	1.00
Interactions between date residues (D) and acetic acid (A) :				
D <sub>0</sub> X A <sub>0</sub>	72.22 <sup>d</sup>	61.54 <sup>e</sup>	21.97 <sup>a</sup>	16.49 <sup>a</sup>
D <sub>0</sub> X A <sub>1</sub>	84.12 <sup>c</sup>	69.81 <sup>d</sup>	14.16 <sup>bc</sup>	16.03 <sup>a</sup>
D <sub>0</sub> X A <sub>2</sub>	84.92 <sup>c</sup>	75.71 <sup>c</sup>	12.14 <sup>cd</sup>	12.14 <sup>b</sup>
D <sub>1</sub> X A <sub>0</sub>	82.54 <sup>c</sup>	70.20 <sup>d</sup>	15.38 <sup>b</sup>	14.43 <sup>a</sup>
D <sub>1</sub> X A <sub>1</sub>	88.09 <sup>b</sup>	78.37 <sup>b</sup>	11.72 <sup>cd</sup>	9.92 <sup>c</sup>
D <sub>1</sub> X A <sub>2</sub>	92.07 <sup>a</sup>	81.04 <sup>a</sup>	11.20 <sup>d</sup>	7.76 <sup>d</sup>
Pooled SEM	0.89	0.75	0.77	0.51

Means with the same letters are not significantly differed at ( $P < 0.05$ ) according to Duncan's multiple range test.

**Table (5): Effects of date residues and acetic acid on hematological traits of quail during summer season.**

Trait	RBC (106/mm <sup>3</sup> )	HB (g/dl)	PCV (%)	WBC (10 <sup>3</sup> /mm <sup>3</sup> )	Lymphocytes (%)	Neutrophils (%)	Monocytes (%)	Eosinophils (%)
Date residues (D) effect:								
D <sub>0</sub> (zero date residues) control	2.77 <sup>b</sup>	13.31 <sup>b</sup>	32.58 <sup>b</sup>	45.06	50.94	43.16	3.59	2.31
D <sub>1</sub> (10% date residues)	3.33 <sup>a</sup>	14.50 <sup>a</sup>	35.02 <sup>a</sup>	45.26	51.43	43.18	3.38	2.00
Pooled SEM	0.11	0.27	0.61	0.06	0.19	0.21	0.15	0.21
Acetic acid (A) effect:								
A <sub>0</sub> (zero acetic acid) control	2.67 <sup>c</sup>	13.01 <sup>c</sup>	31.61 <sup>c</sup>	45.08	50.92	43.23	3.57	2.28
A <sub>1</sub> (0.5 ml /liter) acetic acid	3.04 <sup>b</sup>	13.92 <sup>b</sup>	34.06 <sup>b</sup>	45.20	51.32	43.32	3.55	1.82
A <sub>2</sub> (1 ml /liter) acetic acid	3.43 <sup>a</sup>	14.79 <sup>a</sup>	35.72 <sup>a</sup>	45.22	51.33	42.95	3.35	2.37
Pooled SEM	0.13	0.27	0.55	0.08	0.25	0.25	0.18	0.24
Interactions between date residues (D) and acetic acid (A) :								
D <sub>0</sub> X A <sub>0</sub>	2.63 <sup>f</sup>	12.42 <sup>e</sup>	31.16 <sup>f</sup>	44.99	50.77	43.06	3.60	2.56
D <sub>0</sub> X A <sub>1</sub>	2.76 <sup>d</sup>	13.66 <sup>d</sup>	32.25 <sup>d</sup>	45.15	51.20	43.50	3.50	1.80
D <sub>0</sub> X A <sub>2</sub>	2.91 <sup>c</sup>	13.84 <sup>c</sup>	34.32 <sup>c</sup>	45.05	50.86	42.90	3.67	2.56
D <sub>1</sub> X A <sub>0</sub>	2.71 <sup>e</sup>	13.59 <sup>d</sup>	32.08 <sup>e</sup>	45.15	51.07	43.40	3.53	2.00
D <sub>1</sub> X A <sub>1</sub>	3.32 <sup>b</sup>	14.17 <sup>b</sup>	35.86 <sup>b</sup>	45.25	51.43	43.13	3.60	1.83
D <sub>1</sub> X A <sub>2</sub>	3.95 <sup>a</sup>	15.74 <sup>a</sup>	37.11 <sup>a</sup>	45.39	51.80	43.00	3.03	2.17
Pooled SEM	0.01	0.02	0.03	0.09	0.30	0.30	0.23	0.35

Means with the same letters are not significantly differed at ( $P < 0.05$ ) according to Duncan's multiple range test.

There were significant interactions between adding dietary date residues into diets and acetic acid levels into water used in the present study on hematological traits, blood biochemical parameters, antioxidant indices, immune indices and hormones as shown in Tables (5,6 and 7). Result showed that bird treated by 1ml/liter acetic acid in water and date residues (10%) into diets had the higher ( $P < 0.05$ ) blood constituents but were no significant on the white blood cells (WBCs) and WBCs' fractions while serum cholesterol, glucose concentration, and AST and ALT were significantly ( $P < 0.05$ ) decreased compared with the control (zero date residues or acetic acid). The current results are consistent with the results of Donkoh (1989), Kutlu and Forbes (1993) and Khan *et al.* (2002) which had shown that heating increases the blood glucose.

**Table (6): Effects of date residues and acetic acid on biochemical blood constituents of quails during summer season.**

Trait	Total protein (g/dl)	Albumin (g/dl)	Total lipids (mg/dl)	Cholesterol (mg/dl)	HDL (mg/dl)	Glucose (mg/dl)	AST (U/L)	ALT (U/L)
Date residues (D) effect:								
D <sub>0</sub> (zero date residues) control	2.53 <sup>b</sup>	1.41 <sup>b</sup>	325.66 <sup>b</sup>	171.89 <sup>a</sup>	40.33 <sup>b</sup>	265.56 <sup>a</sup>	45.98 <sup>a</sup>	20.06 <sup>a</sup>
D <sub>1</sub> (10% date residues)	2.90 <sup>a</sup>	1.73 <sup>a</sup>	364.78 <sup>a</sup>	160.22 <sup>b</sup>	42.89 <sup>a</sup>	249.44 <sup>b</sup>	43.67 <sup>b</sup>	19.11 <sup>b</sup>
Pooled SEM	0.11	0.05	9.19	3.30	1.14	0.57	0.55	0.29
Acetic acid (A) effect:								
A <sub>0</sub> (zero acetic acid) control	2.31 <sup>c</sup>	1.34 <sup>c</sup>	310.33 <sup>c</sup>	178.83 <sup>a</sup>	37.50 <sup>c</sup>	271.00 <sup>a</sup>	46.50 <sup>a</sup>	20.53 <sup>a</sup>
A <sub>1</sub> (0.5 ml /liter) acetic acid	2.75 <sup>b</sup>	1.64 <sup>b</sup>	353.00 <sup>b</sup>	162.00 <sup>b</sup>	42.33 <sup>b</sup>	253.50 <sup>b</sup>	44.73 <sup>b</sup>	19.38 <sup>b</sup>
A <sub>2</sub> (1ml /liter) acetic acid	3.09 <sup>a</sup>	1.73 <sup>a</sup>	372.33 <sup>a</sup>	157.33 <sup>c</sup>	45.00 <sup>a</sup>	248.00 <sup>c</sup>	43.27 <sup>c</sup>	18.83 <sup>c</sup>
Pooled SEM	0.08	0.07	8.78	2.71	0.72	3.85	0.62	0.28
Interactions between date residues (D) and acetic acid (A):								
D <sub>0</sub> X A <sub>0</sub>	2.23 <sup>f</sup>	1.23 <sup>f</sup>	289.67 <sup>e</sup>	179.67 <sup>a</sup>	37.00 <sup>d</sup>	276.67 <sup>a</sup>	47.20 <sup>a</sup>	20.73 <sup>a</sup>
D <sub>0</sub> X A <sub>1</sub>	2.47 <sup>d</sup>	1.48 <sup>d</sup>	332.00 <sup>d</sup>	169.66 <sup>b</sup>	41.00 <sup>c</sup>	264.33 <sup>b</sup>	46.17 <sup>b</sup>	20.00 <sup>ab</sup>
D <sub>0</sub> X A <sub>2</sub>	2.89 <sup>c</sup>	1.52 <sup>c</sup>	355.33 <sup>c</sup>	166.33 <sup>c</sup>	43.00 <sup>c</sup>	255.66 <sup>c</sup>	44.60 <sup>bc</sup>	19.43 <sup>bc</sup>
D <sub>1</sub> X A <sub>0</sub>	2.39 <sup>e</sup>	1.44 <sup>e</sup>	331.00 <sup>d</sup>	178.00 <sup>a</sup>	38.00 <sup>d</sup>	265.33 <sup>b</sup>	45.80 <sup>ab</sup>	20.33 <sup>a</sup>
D <sub>1</sub> X A <sub>1</sub>	3.02 <sup>b</sup>	1.80 <sup>b</sup>	374.00 <sup>b</sup>	154.33 <sup>d</sup>	43.67 <sup>b</sup>	242.67 <sup>d</sup>	43.30 <sup>cd</sup>	18.76 <sup>cd</sup>
D <sub>1</sub> X A <sub>2</sub>	3.30 <sup>a</sup>	1.94 <sup>a</sup>	389.33 <sup>a</sup>	148.33 <sup>e</sup>	47.00 <sup>a</sup>	240.33 <sup>d</sup>	41.93 <sup>d</sup>	18.23 <sup>d</sup>
Pooled SEM	0.02	0.01	1.27	0.79	0.62	1.76	0.53	0.26

Means with the same letters are not significantly differed at (P<0.05) according to Duncan's multiple range test.

**Table (7): Effects of date residues and acetic acid on antioxidant indices, immune indices and hormones of quails during summer season.**

Trait	Antioxidant indices and immunity parameter			hormones			
	GPX (U/L)	GSH (U/L)	SOD (U/L)	IgG (mg/100 ml)	P <sub>4</sub> (ng/dl)	T <sub>3</sub> (ng/ml)	T <sub>4</sub> (ng/ml)
Date residues (D) effect:							
D <sub>0</sub> (zero date residues) control	38.34 <sup>b</sup>	974.55 <sup>b</sup>	235.11 <sup>b</sup>	967.22 <sup>b</sup>	1.49 <sup>b</sup>	2.18 <sup>a</sup>	11.61 <sup>b</sup>
D <sub>1</sub> (10% date residues)	40.27 <sup>a</sup>	981.00 <sup>a</sup>	240.67 <sup>a</sup>	973.11 <sup>a</sup>	1.86 <sup>a</sup>	1.96 <sup>b</sup>	12.74 <sup>a</sup>
Pooled SEM	0.51	1.58	1.34	1.85	0.08	0.07	0.35
Acetic acid (A) effect:							
A <sub>0</sub> (zero acetic acid) control	37.43 <sup>c</sup>	972.67 <sup>c</sup>	233.33 <sup>b</sup>	963.16 <sup>c</sup>	1.38 <sup>c</sup>	2.35 <sup>a</sup>	10.92 <sup>c</sup>
A <sub>1</sub> (0.5 ml /liter) acetic acid	39.85 <sup>b</sup>	978.33 <sup>b</sup>	239.16 <sup>a</sup>	972.17 <sup>b</sup>	1.73 <sup>b</sup>	2.05 <sup>b</sup>	12.33 <sup>b</sup>
A <sub>2</sub> (1ml /liter) acetic acid	40.65 <sup>a</sup>	982.33 <sup>a</sup>	241.17 <sup>a</sup>	975.16 <sup>a</sup>	1.91 <sup>a</sup>	1.82 <sup>c</sup>	13.28 <sup>a</sup>
Pooled SEM	0.47	1.73	1.52	1.42	0.08	0.05	0.26
Interactions between date residues (D) and acetic acid (A):							
D <sub>0</sub> X A <sub>0</sub>	37.13 <sup>d</sup>	971.67 <sup>d</sup>	232.33 <sup>c</sup>	961.00 <sup>e</sup>	1.35 <sup>e</sup>	2.41 <sup>a</sup>	10.56 <sup>e</sup>
D <sub>0</sub> X A <sub>1</sub>	38.40 <sup>c</sup>	974.33 <sup>cd</sup>	235.33 <sup>c</sup>	968.33 <sup>c</sup>	1.45 <sup>d</sup>	2.22 <sup>c</sup>	11.47 <sup>d</sup>
D <sub>0</sub> X A <sub>2</sub>	39.50 <sup>b</sup>	977.67 <sup>c</sup>	237.66 <sup>b</sup>	972.33 <sup>b</sup>	1.65 <sup>c</sup>	1.93 <sup>d</sup>	12.80 <sup>c</sup>
D <sub>1</sub> X A <sub>0</sub>	37.73 <sup>cd</sup>	973.66 <sup>cd</sup>	234.33 <sup>c</sup>	965.33 <sup>d</sup>	1.41 <sup>d</sup>	2.28 <sup>b</sup>	11.27 <sup>d</sup>
D <sub>1</sub> X A <sub>1</sub>	41.30 <sup>a</sup>	982.33 <sup>b</sup>	243.00 <sup>a</sup>	976.00 <sup>a</sup>	2.00 <sup>b</sup>	1.88 <sup>d</sup>	13.20 <sup>b</sup>
D <sub>1</sub> X A <sub>2</sub>	41.80 <sup>a</sup>	987.00 <sup>a</sup>	244.67 <sup>a</sup>	978.00 <sup>a</sup>	2.17 <sup>a</sup>	1.72 <sup>e</sup>	13.77 <sup>a</sup>
Pooled SEM	0.24	1.22	1.22	0.80	0.01	0.01	0.09

Means with the same letters are not significantly differed at (P<0.05) according to Duncan's multiple range test.

level of birds. They concluded that high glucose may be attributed to increased secretion of glucocorticoids which increases glucogenesis. Abramyan and Kostanyan (1990) reported that heat stress significantly reduced the concentration of total protein in the blood of birds. Guo *et al.* (1998) found that exposure to high temperatures led to a significant reduction in cholesterol. Sahin *et al.* (2001) showed a significant negative impact of heat stress on total proteins in broiler chickens. Significant adverse effects of

heat stress (32°C on serum concentration of some minerals and metabolites in broilers. Levels of serum T<sub>4</sub> and T<sub>3</sub> decreased significantly due to high level of adrenocorticotrophic hormone in control compared to values obtained in birds that received antioxidant feed supplements. Also, Novero *et al.* (1991) showed that progesterone levels were significantly lower in hens exposed to heat stress than control.

Organic acid supplementation showed no significant difference ( $P > 0.05$ ) in the concentration of blood glucose, cholesterol, triglycerides, creatinine, LDL and HDL among all groups (Hernández *et al.*, 2006 ( $P < 0.05$ ) Adil *et al.*, 2010). Abdel-Fattah *et al.* (2008) concluded that dietary supplements of organic acids could be reach a level of 3% in the diet of broiler chicken without causing any adverse effect on liver functions and kidney. On the other hand, Fouad and Saleh (2017) reported that date wastes had a significant effect on some biochemical parameters of blood and quail hormones, i.e., total protein, albumin, total lipids, HDL, progesterone and triiodothyronine hormones were increased, while serum cholesterol and glucose concentrations were decreased significantly ( $P < 0.05$ ) for birds compared to control group.

#### **Digestibility of nutrients:**

Data given in Table (8) shows that date residues irrespective of acetic acid and acetic acid irrespective date's by-product of level and interactions had a significantly ( $P < 0.05$ ) different effect on crude protein (CP) but were no significant on digestibility of ether extract (EE), crude fiber (CF), and NFE in compared with the control (zero date residues or acetic acid). Result showed that bird treated by 1ml/l acetic acid in water and date wastes (10%) into diets had the best digestibility of nutrients compared with the other dietary treatments.

**Table (8): Effects of date residues and acetic acid on digestibility values (DM, CP, EE, CF and NFE) of Japanese Quails during summer season.**

Trait	DM (%)	CP (%)	EE (%)	CF (%)	NFE (%)
Date residues (D) effect:					
D <sub>0</sub> (zero date residues) control	70.69	75.05 <sup>b</sup>	73.72	20.95	77.05
D <sub>1</sub> (10% date residues)	70.29	77.14 <sup>a</sup>	73.49	21.10	77.25
Pooled SEM	0.25	0.72	0.09	0.18	0.12
Acetic acid (A) effect:					
A <sub>0</sub> (zero acetic acid) control	70.96	73.41 <sup>c</sup>	73.69	21.20	77.00
A <sub>1</sub> (0.5 ml /liter) acetic acid	70.16	76.73 <sup>b</sup>	73.55	20.87	77.19
A <sub>2</sub> (1 ml /liter) acetic acid	70.40	78.15 <sup>a</sup>	73.58	21.01	77.26
Pooled SEM	0.29	0.50	0.11	0.23	0.15
Interactions between date residues (D) and acetic acid (A):					
D <sub>0</sub> X A <sub>0</sub>	71.10	72.99 <sup>e</sup>	73.95	21.27	76.92
D <sub>0</sub> X A <sub>1</sub>	70.27	75.20 <sup>d</sup>	73.63	20.65	76.97
D <sub>0</sub> X A <sub>2</sub>	70.84	76.95 <sup>c</sup>	73.59	20.94	77.27
D <sub>1</sub> X A <sub>0</sub>	70.87	73.82 <sup>e</sup>	73.43	21.14	77.08
D <sub>1</sub> X A <sub>1</sub>	70.04	78.26 <sup>b</sup>	73.47	21.09	77.42
D <sub>1</sub> X A <sub>2</sub>	69.96	79.35 <sup>a</sup>	73.59	21.07	77.26
Pooled SEM	0.37	0.26	0.14	0.33	0.21

Means with the same letters are not significantly differed at ( $P < 0.05$ ) according to Duncan's multiple range test.

Nutrient digestibility improved by adding laying hens quail diets with date residues or/and acetic acid in water could be due to various catalysts such as limiting *E.coli* population and change in the enteric flora, lowering gastric pH, synthesizing catabolic enzymes of favorable microorganisms that help in releasing sugar, cell compounds including amino acids and fatty acids in the intestinal environment and the involvement of active bacteria with digestion and absorption of nutrients in the digestive system (Wenk, 2000). In this regard, Fouad and Saleh (2017) reported improved nutrients digestibility by supplementing the quail diet with date waste.

**Bacteriological count :**

The intestinal microbial counts of laying Japanese quails are presented in (Table 9) shows that date residues irrespective of acetic acid and acetic acid irrespective date residues (date's by-product) of level and interactions had significantly ( $P < 0.05$ ) decreased the intestinal microbial counts, total aerobic and total coliform counts (in compared with the control (zero date residues or acetic acid)). Result showed that bird treated by 1ml/l acetic acid in water and date residues (10%) into diets had the best effective against many species of bacteria compared with the other dietary treatments. Organic acids have an antimicrobial effect because they spread through the bacterial cell membrane, and then separate into anions and protons, eventually inhibiting the balance of electrons within cells or actions by suppressing cellular enzymes and transport systems (Luckstadt, 2007; Ricke, 2003 and Strauss and Hayler, 2001). There are many researches refers to the fruitful use of organic acids as an alternative to antibiotics in poultry. For example Alzawqari *et al.* (2013) reported that the addition of acetic or citric acids to drinking water resulted in a significant decrease in clostridium and coliform in gizzard, cecal and fecal contents of birds with acidified water before slaughter compared with the control and feed withdrawal treatments. Also, Philipsen (2006) revealed the addition of organic acid to drinking water helps reduce the level of pathogens in the water and regulate the small intestine microflora

**Table (9): Effects of date residues and acetic acid on count of aerobic, anaerobic and total coliform bacteria in intestine of Japanese quail during summer season.**

Trait	Aerobic plate count $\times 10^3$	Total anaerobic count $\times 10^2$	tal coliform Count $\times 10^3$
Date residues (D) effect :			
D <sub>0</sub> (zero date residues) control	8.00 <sup>a</sup>	0.64 <sup>a</sup>	24.66 <sup>a</sup>
D <sub>1</sub> (10% date residues)	3.88 <sup>b</sup>	0.47 <sup>b</sup>	10.89 <sup>b</sup>
Pooled SEM	0.78	0.06	2.14
Acetic acid (A) effect :			
A <sub>0</sub> (zero acetic acid) control	8.83 <sup>a</sup>	0.76 <sup>a</sup>	26.00 <sup>a</sup>
A <sub>1</sub> (0.5 ml /liter) acetic acid	5.33 <sup>b</sup>	0.53 <sup>b</sup>	14.66 <sup>b</sup>
A <sub>2</sub> (1 ml /liter) acetic acid	3.67 <sup>c</sup>	0.38 <sup>c</sup>	12.67 <sup>c</sup>
Pooled SEM	0.96	0.05	3.16
Interactions between date residues (D) and acetic acid ( A) :			
D <sub>0</sub> X A <sub>0</sub>	9.33 <sup>a</sup>	0.80 <sup>a</sup>	26.66 <sup>a</sup>
D <sub>0</sub> X A <sub>1</sub>	8.00 <sup>b</sup>	0.63 <sup>bc</sup>	24.33 <sup>bc</sup>
D <sub>0</sub> X A <sub>2</sub>	6.66 <sup>c</sup>	0.50 <sup>cd</sup>	23.00 <sup>c</sup>
D <sub>1</sub> X A <sub>0</sub>	8.33 <sup>ab</sup>	0.73 <sup>ab</sup>	25.33 <sup>ab</sup>
D <sub>1</sub> X A <sub>1</sub>	2.66 <sup>d</sup>	0.43 <sup>d</sup>	5.00 <sup>d</sup>
D <sub>1</sub> X A <sub>2</sub>	0.67 <sup>e</sup>	0.27 <sup>e</sup>	2.33 <sup>e</sup>
Pooled SEM	0.35	0.04	0.56

Means with the same letters are not significantly differed at ( $P < 0.05$ ) according to Duncan's multiple range test.

**CONCLUSION**

It may be the application of date residues 10% (in feed) with (1ml /leter) vinegar (acetic acid) in drinking water improved the productive performance such as egg production, fertility, hatchability percentages, some physiological parameters, blood constituents, hormones and immunity, nutrient digestibilities and lowering the intestinal microbial counts of laying Japanese quail during summer season.

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## تأثير حامض الخليك ومخلفات التمور على بعض الخصائص الفسيولوجية والانتاجية والتناسلية للسمان خلال فصل الصيف

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تم توزيع مائة وثمانية من السمان الياباني عمر 8 أسابيع عشوائياً على ستة معاملات ( $P < 0.05$ ) غذائية مختلفة واستخدم تصميم Factorial ( $3 \times 2$ ) مع ثلاث مكررات كل منها يحتوي على 6 طيور (2 ذكور و4 إناث) ، لدراسة تأثير إضافة الخل (حامض الخليك) ومخلفات التمور (مخلفات التصنيع) على إنتاج البيض ونسب الخصوبة والفقس، وبعض الخصائص الفسيولوجية، وخواص الدم، والهرمونات والمناعة تحت ظروف الجو الحار وكانت درجة الحرارة تتراوح بين 40 – 43 درجة مئوية ورطوبه نسبيه 50 % خلال فتره التجربه من عمر 8 الى 14 أسبوع .

وكانت المعاملات عبارة عن مستويان من مخلفات التمور مضافة للعليقة الأساسية وهي صفر، 10% من العلف و ثلاث مستويات مختلفة من الخل (0 ، 0.5 و 1 مل / لتر) في مياه الشرب. ووضحت النتائج المتحصل عليها أن كل من مستويات الخل و مخلفات التمور والتفاعل بينهم أحدث تحسن معنوي في وزن البيض، إنتاج البيض وكتله البيض والتحويل الغذائي ونسب الخصوبة والفقس بينما انخفض بشكل كبير البيض الكابس وعدد الاجنة الميتة كما سجلت تحسن معنويه في بعض صفات الدم الهيماتولوجيه الكيموحيويه ومضادات الأكسدة والمناعة وبعض الهرمونات مثل (البروتين الكلى والالبومين، الليبيدات الكلية، HDL، إنزيم SOD والجلوتاثيون GSH والجلوتاثيون بيروكسيداز ، IgG، البروجيسترون ، T3, T4) ولكن عدد كرات الدم البيضاء في جميع المعاملات زادت زيادة طفيفة في العدد، في حين انخفضت نسبة الكوليسترول في الدم وتركيز الجلوكوز، AST و ALT بشكل ملحوظ ( $P < 0.05$ ) للطيور المعاملة مقارنة مع مجموعة الكنترول. وكذلك تحسن الهضم في مجموعات المعاملات والتفاعل بينهم. وانخفض عدد البكتيريا الهوائية واللاهوائية في الأمعاء الدقيقة وعدد البكتيريا الكلى بسبب إضافة المعاملات المختلفة مقارنة مع مجموعة الكنترول .

مما سبق وجد إن استخدام 10% مخلفات التمور في العلف مع 1 مل خل / لتر ماء شرب أدى إلى تحسن الأداء الإنتاجي مثل إنتاج البيض، الخصوبة، نسب الفقس، بعض المعايير الفسيولوجية وصفات الدم والهرمونات والمناعة و الهضم في السمان الياباني خلال فصل الصيف الحار.