PHYSIOLOGICAL AND IMMUNOLOGICAL ROLES OF ACETIC ACID FOR IMPROVING EGG PRODUCTION AND DECREASING POLLUTION AND AMMONIA LEVEL IN LOCAL LAYING HENS HOUSES.

By

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Abstract: *A total number of 320 pullets at 20 weeks of age, from two local strains (Dandrawi and Dokki4,160 birds each) were randomly distributed into four equal groups to study the effect of acetic acid supplementation in diets with on the physiological and immunological responses, egg production and ammonia level in local hens houses.*

The strains classificated into four groups of four replicates each: The first group was considered a control group and fed a diet without acetic acid supplementation; while groups 2, 3 and 4 were fed diets included 2, 4 and 6 % acetic acid, respectively.Some productive, environmental, physiological and immunological parameters were taken along the experimental period which lasted 16 weeks. The detained data revealed the following results:

- *Using 2, 4 and 6 % acetic acid gave higher body weight and lower feed consumption as compared with the control groups in both strains at all ages.*
- *Using 4% acetic acid delayed the age at sexual maturity, increased the weight of first egg and the egg mass in the two strains compared with other groups.*
- *At 32 and 36 weeks of age; the groups fed 2and 4% acetic acid, showed an increase in egg number and egg weight , an improvement in some egg quality parameters and a low mortality rate specially in Dokki4 strain than compared with the other groups.*
- *The groups fed 2, 4 and 6 % acetic acid in both strains led to a decrease in house humidity, ammonia in litter but they had no effects on body temperature, litter pH and respiratory rate as compared with control.*

- *Hens in the two strains, fed 2 and 4% acetic acid resulted in an increase in serum calcium , phosphorus , total protein , globulin , alkaline phosphates, ALT, AST enzymes, parathyroid and calcitonin hormones, but there was decrease in all serum ,yolk and liver cholesterol , LDL , HDL , total lipids and triglycerides, and also decrease in serum HMG-COA reductase as compared with other groups , but there were no effects on serum T3, T4 hormones and T3/T4 ratio in all groups of the two strains.*
- *Using 2, 4 and 6 % acetic acid for the two strains improved the titter immuno response for agent's avian Newcastle and Influenza diseases compared to the control groups.*
- *Using 2, 4 and 6 % acetic acid for the two strains increased some immuno internal organs such as spleen and thymus gland relative weight, ovary, oviduct organs relative weight and oviduct length and big and small ovarian follicles, while it decreased the abdominal fat weight. Also it had no effects on other internal organs weight compared with other groups in the two strains.*

INTRODUCTION

Organic acids are considered a promising option to replace antibiotic growth promoters in poultry production. Organic acids are widely used in feed hygiene programmers as they destroy pathogenic bacteria like Salmonella and Escherichia coli (Hinton et al., 2000).Acidification of diets with organic acids and their salts are widely used to secure feed safety by preventing microbial degradation of feed during storage and improving productive performance of poultry and rabbits (Panda et al., 2006and Radwan and Abdel- khalek, 2007).

There was a significant improvement in feed efficiency, protein retention; antibody titers against Newcastle (ND) and Infectious Bronchitis Disease (IBD) virus, reduced pH in ileum and reduced E. coli score in broiler chicks fed diets containing probiotic compared to those fed antimicrobial agents or organic acids. Also, there was an increase in antibody titers against ND and IBD virus, pH of the duodenum and reduction E. coli lesion score compared to those fed the antimicrobial compound (Waldroup et al., 1995, Engberg et al., 2001 and Panda et al., 2006).

Organic acids, have inhibiting action on the intestinal bacteria competing with the host for available nutrients (Hyden, 2000). That the efficiency of organic acids in improving the utilization of some feedstuffs was proved by Farran et al (2001) who reported that the total metabolisable energy (TMEn) and apparent amino acids availability of some feedstuffs increased as a result of soaking in 1% acetic acid. . Abdo (2004) found that using 3,6 and 9% acetic acid in diets improved productive performance and improved the utilization of low protein – low energy broiler diets. Also, Ibrahim (2006) found that there were an improvement in most characters and productive performance as a result of adding garlic and vinegar (acetic acid) extract with drinking water to broiler. Radwan and Abdel- khalek. (2007) found that using 0.5% acetic acid and lactic acid in rabbits feeds improved growth performance and decreased plasma cholesterol and total lipids, increased total protein and globulin compared with those in control group. Vinegar is a commonly used seasoning. Its main component is acetic acid at a concentration of 3- 9% for consumer use (Ren et al., 1997). Results concerning the inclusion of acetic acid in laying hens or local laying hens very limited.

The present work was designed to study the physiological and immunological roles of acetic acid for improving egg production and decreasing pollution and ammonia level in local hens' houses.

MATERIALS AND METHODS

The experimental work of the present study was carried out at Seds Poultry Breeding Research Station, Animal Production Research Institute, Agricultural Research Center, Ministry of Agriculture, Bani Swef Governorate. A total number of 320 Dandrawi and Dokki4 laying hens were used in this study .The experiment lasted for 16 weeks from 20 up to 36 weeks of age. This work was carried out during summer season (from June to September).The averages of ambient temperature 30 to 38 °C, whereas the averages relative humidity were 50 to 65 %.

Hens of each strain were divided equally into four different groups (40 hens/ group), each group had 4 sub-groups (10 hens of each), and they severed as replicates. The first group (control) was received the basal diet only without acetic acid. Whereas, the other groups were fed on a basal diet mixed daily with acetic acid at a rote of 20 (2%), 40(4%) and 60 (6%) ml / kg diet, respectively. The hens of both strains were randomly taken and housed in open system floor pens and submitted to the same managerial conditions throughout the experimental period. The nutrient compositions of the control diet fed to the birds is presented in Table (1). Water and the experimental diets were supplied *ad-libitum to* hens which were weighed at 20 weeks of age and then weighed at interval periods of 4 weeks .Feed consumption was determined each two weeks. The age at sexual maturity of hens and weight of first egg were recorded. Egg number, egg weight, mortality rate were recorded daily up to 36 weeks of age, while the egg quality was measured at the end of experimental period. Ten eggs from each group were collected, weighed, broken and separated into shells, yolks and albumens. The weights of yolk, albumen and shell (with membranes) were recorded and calculated as percentages of egg weight.

The body temperature, respiratory rate, litter pH, house humidity and litter ammonia were taken at monthly intervals. Indoors ambient temperature and humidity were recorded twice a day during the whole experimental period, and the averages were estimated.

At 32 weeks of age, hemagglutination-inhibition (HI) test was applied for determination of antibodies response in serum samples according to OIE manual (2005). After 30 days of immunization of the flock by Lasota vaccine against Newcastle Disease Virus (NDV) and against Avian Influenza Disease Virus (AIDV). Commercial ELISA kits were used for detection of antibodies against nucleoprotein and matrix antigens of NDV and AIDV (Biochek B.V, Gouda, and Holland). Hemagglutination-inhibition (HI) test titers regarded as positive if there is inhibition at a serum dilution of 1/16(4 log 2).

At the end of the experimental period, three hens per group were weighed, sacrificed for slaughtering, and their some internal organs (heart, liver, gizzard, stomach, gall bladder, kidney, intestines, pancreas, ovary, oviduct and abdominal fat) were weighed. The immuno internal organs (spleen and thymus gland) were weighed to the nearest 0.1 gm. In addition, the oviduct length, numbers of bigger and smaller ovarian follicles was also recorded. Relative weights of carcass and these organs to body weight were calculated.

Blood samples collected during slaughtering, then they were centrifuged and serum was separated and stored at -20°C until analyses. Serum calcium, phosphorus, total protein ,albumin ,globulin, cholesterol, LDL,HDL, total lipids , triglycerides , Alkaline phosphates, AST, ALT, HMG-CoAreductase, triiodothyronine(T3) and thyroxin (T4), parathyroid and calcitonin hormones were calorimetrically determined using the suitable commercial kits according to the recommendations of the manufactures.

After measuring the egg quality, yolk samples from each group were assigned to determine cholesterol, LDL, HDL, total lipids and triglycerides using the suitable commercial kits.

Liver was rapidly dissected out and chilled in ice, one gram of liver was put in glass containing 0.1 ml phosphate buffer solution (pH 7.4) and was homogenized using an electric motor. The homogenate solution was centrifuged at 2000 rpm. For 5 minutes according to Zollner and Kirsch (1962). Clear homogenate solution was separated, stored at -20°C until the time of analyses. Cholesterol, LDL, HDL, total lipids and triglycerides were determined using relevant commercial kits. All blood, yolk, liver and tests analyses were done in Animal Production Research Institute Laboratories and in the Central Laboratory of Poultry in Faculty of Agriculture, Cairo University.

Data were subjected to computerize one– way analysis of variance and Duncan's multiple range test procedures using SAS (1996). The percentage values were transferred to percentage angle using arcsine equation before subjected to statistical analysis.

RESULTS AND DISCUSSION

1- Productive traits:

1-1-Body weight and body weight gain:

Results in Table (2) show that strain had a significant effect on body weight (BW) and body gain (BWG). Hens of Dokki4 strain showed significantly ($P \leq 0.05$) higher BW in all treatments and control groups compared with those of Dandrawi strain. These differences in BW between the two strains may be due to the genetic differences. Treatments had significant ($P \leq 0.05$) effect on BW, since BW in all treatments was improved in the two strains compared with that in control groups during the experimental period. Also the values of BWG were increased in all groups fed 2, 4 and 6% acetic acid compared with the control groups for both strains during the whole experimental periods.

These results may be attributed not only to the different strains but also to the different treatments. These results agree with those of Abdo (2004) who found that acetic acid at concentration of 3 and 6 % in broiler diets significantly ($P \leq 0.05$) improved , BW and BWG at the 3 weeks of age when compared with the control diet (0 % acetic acid),but this effect during the total period (0-6 weeks) was insignificant. Also, several investigators found that adding acetic acid improved both BW and BWG (Syed et al, 1994; Garcia et al, 2000; Ibrahim, 2006) in broilers and Radwan and Abdel-khalek (2007) in rabbits. Fushimi et al. (2001) indicated that vinegar is believed to have several beneficial effects such as improving appetite.

1-2- Feed consumption:

Table (3) shows that feed consumption (FC) was significantly ($P \leq 0.05$) decreased with increasing of acetic acid level to 6% compared with the control groups at all periods in the two strains. The groups fed 4 and 6% acetic acid in Dandrawi laying hens had significantly ($P \leq 0.05$) lower FC compared with other groups during the 24- 36 weeks of experimental period.

These results agree with those of Syed et al (1994), Naidu (2000), Abdo (2004) and Ibrahim (2006) for broilers and Radwan and Abdel-khalek (2007) for rabbits using different levels of acetic acid. Also vinegar contains volatile fatty acids (VFA) such as acetic acid which decrease FC for poultry and this perhaps due to the unaccepted flavor (Ibrahim, 2006).

1-3-Age at sexual maturity , weight of first egg and egg production:

Data presented in Table (4) show that age at sexual maturity and weight of first egg were higher in groups fed 4% acetic acid in Dandrawi and Dokki4 hens compared with other groups.

It seemed likely that the increase in the weight of the first egg was associated with dilating sexual maturity.

Egg production traits (egg number, egg weight and egg mass) showed significant ($P \leq 0.05$) differences between the two strains (Table 5). Using 2 and 4% acetic acid gave higher egg production traits at 32 and 36 weeks of age especially Dokki4 strain with using 6% acetic acid and control groups.

The improvement in egg production may be due to that acetic acid retard microbial growth and contribute desirable sensory properties to a number of foods (Fushimi et al .,2001). They also, indicated that acetic acid historically diluted in the form of vinegar, has been utilized perhaps longer than any other preservative for its antimicrobial effect that influences food keeping-quality, wholesomeness, and safety. They also added that vinegar is used traditionally as a folk medicine and is believed to have several beneficial effects such as improving appetite, enhancing mineral absorption, speeding recovery from fatigue. The authors also indicated that using acetic acid improved the productive performance; also vinegar contents for some vitamins and minerals origins may be the reason for the increased egg production (Naidu, 2000, Fushimi et al., 2001and Ibrahim, 2006).

1-4- Mortality rate:

Table (6) show that using 2 and 4% acetic acid for Dandrawi and Dokki4 laying hens decreased total mortality rate (MR) compared to hens fed 6% acetic acid and control groups during all experimental periods. The reduction in MR may be attributed to that acetic acid is only recovered from the proximal part of the poultry GI-tract (stomach and small intestine). This is in agreement with observations of Hinton at al. (2000) who explained that the strongest effect of acetic acid regarding a pH and antimicrobial activity are found in stomach and the small intestine in poultry. Hume et al., (1993) and Thompson and Hinton; (1997) reported that pathogen bacteria e.g. Salmonella enter the GI-tract via the crop and the environment of the crop with respect to microbial composition and pH seems to be very important in relation to the resistance to pathogens; high amounts of Lactobacilli and low pH in crop have shown to decrease the occurrence of Salmonella in crop. Also the antimicrobial activity of dietary organic acids in poultry is beloved to take place mainly in the upper part of the digestive tract (crop and gizzard).

1-5-Egg quality:

Table (7) show significant differences in some egg quality parameters. Using 2 and 4% acetic acid for Dandrawi and Dokki4 laying hens significantly increased shape index, shell thickness and haugh unit, while other egg quality parameters were not affected by the dietary treatments in the two strains.

The increase in shell thickness of eggs laid by Dandrawi and Dokki4 laying hens fed 2 and 4 % acetic acid may be explained by the acetic acid content of some minerals (i.e. calcium and phosphorus) gave thickly shell compared with hens fed 6 % acetic acid which may be caused re-absorption for calcium and some minerals as reported by Ibrahim (2006) and Radwan and Abdel-khalik (2007).

2- Some physiological and environmental characteristics:

Results in Table (8) declared that using 2, 4 and 6% acetic acid in diets for Dandrawi and Dokki4 laying hens significantly decreased the indoor house humidity and litter ammonia, while the values of litter pH, body temperature and respiratory rate were not significantly affected compared with the control groups in all periods. These results agree with those of Ibrahim (2006) who found that using vinegar decreased in humidity, litter ammonia and growth bacteria in digestibility duct such as Salmonella, may be due to that acetic acid in vinegar decreased water pH in drinking water for broilers .In contrast, Radwan and Abdel-khalik (2007) showed that adding some organic acids have no effect on blood pH, cecum and ileum in rabbits.

3-Physiological traits:

3-1-Blood parameters:

Table (9) show that using 2 and 4% acetic acid in diets of Dandrawi and Dokki4 laying hens significantly increased serum calcium, phosphorus, total protein, globulin, alkaline phosphates, ALT, AST enzymes compared to those fed 6 and 0% acetic acid(control group) at the end of the experimental period.

On the other hand using 2, 4 and 6% acetic acid in diets for Dandrawi and Dokki4 laying hens significantly decreased serum cholesterol, LDL, HDL, total lipids and triglycerides compared with the control groups.

These results are in agreement with those of Abdo (2004) who showed that the addition of acetic acid gave increased blood calcium and AST enzyme levels and decreased blood total lipids. Similar results were found by EL-Kerdawy (1996) who found that serum total lipids were decreased with 4% acetic acid supplementation to broilers diets. Kishi et al., (1999) found that a diet containing acetic acid at a dietary concentration of 1.6 ml vinegar/100 g diet, for example, enhances the intestinal absorption of calcium. Ibrahim (2006) found that the supplementation vinegar (acetic acid) to broilers rations improved their productive performance, because vinegar contains some vitamins and minerals origins, also using vinegar gave low level of plasma cholesterol and high level of plasma total protein. Furthermore, Radwan and Abdel-khalik (2007) showed that using acetic acid in rabbit feeds increased total protein and globulin and decreased total lipids , cholesterol and albumin compared with the control group (not fed acetic acid).

The depression of serum cholesterol, LDL, HDL, total lipids and triglycerides may be due to the decrease in HMG-COA reductase enzyme level in groups fed 2 and 4% acetic acid.

Table (9) showed that, no significant differences were noted in serum T3, T4 and ratio of T3/T4 for Dandrawi and Dokki4 laying hens fed 2, 4 and 6% acetic acid compared with the control groups. While using 2 and 4% acetic acid significantly increased serum parathyroid and calcitonin hormones and decreased HMG-COA reductase enzyme compared with the other groups. It is work to mention that the available references were found in this connection are scarce therefore this result could not be assessed or discussed.

3-2-Yolk parameters:

Table (10) show significantly decreased in yolk cholesterol, LDL, HDL, total lipids and triglycerides in groups fed 2 and 4% acetic acid compared with those fed 6 % acetic acid and the control groups either for Dandrawi or Dokki4 laying hens at the end of the experimental period.

3-3-Liver parameters:

Table (11) demonstrated that using 2 and 4% acetic acid for Dandrawi and Dokki4 laying hens significantly decreased liver cholesterol, LDL, HDL, total lipids and triglycerides compared with other groups at the end of the experimental period. No relevant references could be found. The depression in yolk and liver cholesterol, LDL, HDL, total lipids and triglycerides may be due to the decrease of these parameters and HMG-COA reductase enzyme in serum and using acetic acid was depressed total lipids in serum and body tissues. It is work to mention that the available references were found in this connection are scarce therefore this result could not be assessed or discussed.

4-Immune response traits:

4-1-Antibody titters against avian Newcastle and Influenza diseases:

As shown in Table (12), significant differences were observed between groups fed 2, 4 and 6% acetic acid as compared with the control groups for Dandrawi and Dokki4 laying hens, since the antibody titters against avian Newcastle(NDV)and Influenza(AIDV) diseases of the re-vaccinated hens were higher in groups fed 2, 4 and 6% acetic acid in Dokki4 hens , respectively , while in Dandrawi hens were higher in groups fed 2, 6 and 4% acetic acid, respectively , compared with control groups.

These results agree with those of Pasha et al. (2007) who found that using 0.5 and 1.0 % sodium bentonite plus acetic acid improved the titter against Newcastle disease (ND) as compared with control group for broilers chicks, Ibrahim (2006), found that using vinegar (acetic acid) in broilers drinking water did not cause respiratory diseases, improved general health and most characters of the productive performance. He also noticed that vinegar which contain acetic acid affected the growth of bacteria in digestion tract (e.g. Salmonella) may be vinegar decreased pH when was used it in broilers drinking water.

Acetic acid was studied in relation to the antibacterial activity (Cherrington et al., 1991 and Russell, 1992). The authors also reported that the antibacterial activity of organic acids is related to the reduction pH, as well as their ability to dissociate, which is determined by the PKa-value of the respective acid and the pH of the surrounding milieu. They also added that the antibacterial activity increased with decreasing pH-value and the acid anion seemed to be very important regarding the antibacterial effect of organic acids, generally Lactic acid bacteria are able to grow at relatively low PH, which means that they are more resistant to organic acids than other bacterial species (e.g. E coli).The same effect of acetic acid caused higher antibody titters against avian Newcastle and Influenza diseases for Dandrawi and Dokki4 laying hens.

An explanation for situation this may be that gram- positive bacteria have a high intracellular potassium concentration, which provides a counteraction for the acid anions (Russell and Diez-Gonzalez, 1998). In poultry production organic acids (e.g. acetic acid)that have mainly been used in order to sanities the feed considering problems with Salmonella infections, and some organic acids, to give the specific effects on the gut microflora considering health in poultry (Berchieri and Barrow, 1996, Thompson and Hinton,1997 and Hinton *et al.* , 2000).

4-2- Immuno organs weight:

Data in Table (13) show that using 2 and 4% acetic acid significantly resulted in bigger spleen and thymus gland weights compared with the other groups fed 6% acetic acid and the control for Dandrawi and Dokki4 laying hens at the end of the experimental period. It is work to mention that the available references were found in this connection are scarce therefore this result could not be assessed or discussed.

5-Internal organs weights:

Table (14) indicated that the effect of using 2 and 4% acetic acid for Dandrawi and Dokki4 laying hens on some internal organs weights at the end of the experimental period there were significantly increase in live body weight and carcass percentage.

This may due to that Dokki4 strain has genetically bigger size and heavier weight than Dandrawi strain. However, some internal organs were increased significantly by using 2 and 4% acetic acid for Dandrawi and Dokki4 laying hens such as ovary, oviduct weights and length, big and small follicular ovary number. While abdominal fat weights were significantly decreased in groups fed 2 and 4% acetic acid compared with other groups for Dandrawi and Dokki4 laying hens .No significant differences in other internal organ weights were found between all groups in the two strains. Ibrahim (2006) found that heart and gizzard weights percentage increased and the abdominal fat weight percentage decreased by adding vinegar (acetic acid) in drinking water compared with the control group for broilers.

These results agree with those of Pinchasov and ELmaliah (1995) showed that abdominal adipose tissue decreased significantly with the inclusion of acids, but the weight of the liver was unaffected by either acetic or propionic acids supplementation at 3% of broilers diets. Abdel-Azeem et al. (2000) reported that the best values for dressing percentage and hot carcass weight in broilers were observed in group receiving citric acid supplements. Radwan and Abdel-khalik (2007) who showed that using acetic acid for feeding rabbits increased slaughter weight, hot carcass, giblets and total edible parts and also decreased abdominal fat as compared with the control group.

On the other hand EL-Kerdawy (1996) found that carcass traits were not affected by organic acids treatments for broilers .Also, Abdo (2004) found no significant differences between carcass, liver, gizzard, heart, abdominal fat and spleen either due to the diets or the acetic acid concentrations (3, 6 and 12%), also found that the percentages of both bursa and thymus decreased due to addition of acetic acid to broilers diets.

In conclusion, the present study indicated that using 2 and 4% acetic acid in diets of Dandrawi and Dokki4 laying hens could improve egg production and decrease ammonia level in local hens houses and at the same time improve the productive performance, depuration of cholesterol and improved the general health and gave higher immuno response against avian Newcastle and Influenza diseases. It is worthy to note that using 6% acetic acid improved the productive performance, physiological and immuno response against avian Newcastle and Influenza diseases compared with control group fed 0% acetic acid, but with lower degree of success than the levels of 2 and 4%.

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

Ingredients	%
Yellow corn	66.00
Soybean meal 44%	23.00
Wheat bran	2.50
Di-calcium phosphate	1.50
Limestone	6.20
Salt (NaCl)	0.40
DL-Methionine	0.10
Vit.& Min. Mixture*	0.30
Total	**100.00**
Calculated analysis:	
Metabolizable energy (Kcal / Kg)	2747
Crude protein%	15.67

Supplied per kg of diet: Vit. A 10 000 IU; Vit. D3 2000IU; Vit. E 10 mg; Vit. K3 1mg; Vit B1 1mg; Vit. B2 5mg; Vit.B6 1.5 mg; Vit.B12 10 mg; Niacin 30mg ; Pantothenic acid 10mg ; Folic acid 1 mg ; Bioin 50 mg ; Choline chloride 520mg ; Copper 4mg ; Iron 30mg ; Manganese 60mg; Zinc 50mg ;Iodine 1.3mg ; Selenium 0.1mg ; Cobalt 0.1mg .

Table (2): Effect of adding different levels of acetic acid of two local strains on body weight (BW) and body weight gain(BWG) g.

Age (week)	Dandarawi					Dokki4				
	Control	2%	4%	6%	Overall	Control	2%	4%	6%	Overall
(BW) 20	*988.20^{b} ± 52.55	950.70^{b} ± 52.55	970.80^{b} ± 52.55	962.70^{b} ± 52.55	968.10^{b} ± 52.55	1226.19^{a} ± 52.55	1231.15^{a} ± 52.55	1205.35^{a} ± 52.55	1216.09^{a} ± 52.55	**1219.78^{a} ± 52.55**
24	998.72^{c} ± 63.72	1080.89^{b} ± 63.72	1114.37^{b} ± 63.72	1168.81^{b} ± 63.72	1090.70^{b} ± 63.72	1267.06^{ab} ± 63.72	1371.37^{a} ± 63.72	1311.00^{a} ± 63.72	1344.71^{a} ± 63.72	**1323.54^{a} ± 63.72**
28	1137.72^{c} ± 82.15	1228.11^{b} ± 82.15	1218.75^{b} ± 82.15	1284.37^{b} ± 82.15	1217.24^{b} ± 82.15	1356.75^{ab} ± 82.15	1483.69^{a} ± 82.15	1418.85^{a} ± 82.15	1425.46^{a} ± 82.15	**1421.19^{a} ± 82.15**
32	1260.06^{c} ± 90.32	1353.44^{b} ± 90.32	1374.50^{b} ± 90.32	1302.00^{b} ± 90.32	122.50^{b} ± 90.32	1419.57^{ab} ± 90.32	1518.67^{a} ± 90.32	1541.75^{a} ± 90.32	1520.45^{a} ± 90.32	**1500.11^{a} ± 90.32**
36	1304.26^{c} ± 97.70	1464.58^{b} ± 97.70	1492.08^{ab} ± 97.70	1457.66^{b} ± 97.70	1429.65^{b} ± 97.70	1510.75^{ab} ± 97.70	1665.33^{a} ± 97.70	1604.62^{a} ± 97.70	1641.77^{a} ± 97.70	**1605.62^{a} ± 97.70**
(BWG) 20-36	316.06^{b} ± 14.05	513.88^{a} ± 14.05	521.28^{a} ± 14.05	494.96^{a} ± 14.05	**461.55^{b} ± 14.05**	284.56^{b} ± 14.05	**434.18^{ab} ± 14.05**	399.24^{ab} ± 14.05	**425.68^{ab} ± 14.05**	**385.92^{a} ± 14.05**

* Values are means ± S.E , a, b and c in the same row between treatments and between means are significantly different (P≤ 0.05).

Table (3): Effect of adding different levels of acetic acid of two local strains on feed consumption (g/hen/day).

Age (week)	Dandarawi					Dokki4				
	Control	2%	4%	6%	Overall	Control	2%	4%	6%	Overall
20-24	*94.89^{a} ± 6.91	91.07^{ab} ± 6.91	92.14^{ab} ± 6.91	89.57^{b} ± 6.91	91.92 ± 6.91	95.00^{a} ± 6.91	92.47^{ab} ± 6.91	91.70^{ab} ± 6.91	90.55^{b} ± 6.91	**92.43 ± 6.91**
24-28	106.81^{a} ± 8.80	101.37^{b} ± 8.80	98.97^{c} ± 8.80	97.62^{c} ± 8.80	101.19 ± 8.80	109.69^{a} ± 8.80	99.42^{c} ± 8.80	98.04^{c} ± 8.80	103.61^{b} ± 8.80	**102.69 ± 8.80**
28-32	113.91^{a} ± 9.64	108.18^{b} ± 9.64	105.72^{c} ± 9.64	104.32^{c} ± 9.64	108.03^{b} ± 9.64	115.86^{a} ± 9.64	110.52^{b} ± 9.64	107.29^{b} ± 9.64	108.78^{b} ± 9.64	**110.61^{a} ± 9.64**
32-36	119.59^{a} ± 11.32	115.26^{b} ± 11.32	112.00^{c} ±11.32	109.98^{c} ±11.32	114.21^{b} ± 11.32	120.51^{a} ± 11.32	116.66^{b} ± 11.32	117.33^{b} ± 11.32	116.05^{b} ± 11.32	**117.64^{a} ± 11.37**
20-36	108.80^{a} ± 9.06	103.97^{b} ± 9.06	102.21^{c} ± 9.06	100.37^{c} ± 9.06	103.84^{b} ± 9.06	110.27^{a} ± 9.06	104.77^{b} ± 9.06	103.59^{b} ± 9.06	104.75^{b} ± 9.06	**105.85^{a} ± 9.06**

** Values are means ± S.E , a, b and c in the same row between treatments and between means are significantly different (P ≤ 0.05).

Table (4): Effect of adding different levels of acetic acid of two local strains on age at sexual maturity (day) and weight of first egg (g).

Item	Dandarawi					Dokki4				
	Control	2%	4%	6%	Overall	Control	2%	4%	6%	Overall
Age at sexual maturity(day)	*168.40^{b} ± 11.48	167.20^{b} ± 11.48	174.70^{a} ±11.48	168.10^{b} ± 11.48	169.60^{b} ± 11.48	172.20^{a} ± 11.48	171.80^{a} ±11.48	175.40^{a} ±11.48	169.40^{b} ± 11.48	172.20^{a} ± 11.48
Weight of first egg (g)	37.34^{b} ± 3.77	35.64^{b} ± 3.77	38.35^{a} ± 3.77	35.76^{b} ± 3.77	36.77 ± 3.77	36.86^{b} ± 3.77	36.65^{b} ± 3.77	38.87^{a} ± 3.77	35.19^{b} ± 3.77	36.89 ± 3.77

* Values are means ± S.E. , a and b in the same row between treatments and between means are significantly different ($P \leq 0.05$).

Table (5): Effect of adding different levels of acetic acid of two local strains on egg production.

Age (week)	Item	Dandarawi					Dokki4				
		Control	2%	4%	6%	Overall	Control	2%	4%	6%	Overall
28	Egg number (egg)	*13.72^{a} ± 1.15	11.68^{b} ± 1.15	13.00^{ab} ± 1.15	14.25^{a} ± 1.15	13.16 ± 1.15	11.69^{b} ± 1.15	14.00^{a} ± 1.15	11.86^{b} ± 1.15	13.21^{ab} ± 1.15	12.69 ± 1.15
32		15.30^{ab} ± 1.70	16.37^{a} ± 1.70	17.63^{a} ± 1.70	14.19^{b} ± 1.70	15.87^{a} ± 1.70	14.92^{b} ± 1.70	15.64^{ab} ± 1.70	16.03^{a} ± 1.70	12.40^{c} ± 1.70	14.75^{b} ± 1.70
36		17.65^{ab} ± 1.94	20.11^{a} ± 1.94	19.82^{a} ± 1.94	15.29^{b} ± 1.94	18.22^{a} ± 1.94	16.43^{ab} ± 1.94	18.45^{a} ± 1.94	19.50^{a} ± 1.94	13.21^{b} ± 1.94	16.90^{b} ± 1.94
28	Egg weight (g)	39.17^{ab} ± 4.61	38.52^{b} ± 4.61	38.17^{b} ± 4.61	38.15^{b} ± 4.61	38.50^{b} ± 4.61	40.80^{a} ± 4.61	41.30^{a} ± 4.61	42.66^{a} ± 4.61	38.11^{b} ± 4.61	40.72^{a} ± 4.61
32		40.12^{b} ± 5.03	42.61^{ab} ± 5.03	41.75^{ab} ± 5.03	41.45^{b} ± 5.03	41.48^{b} ± 5.03	42.19^{ab} ± 5.03	44.65^{a} ± 5.03	44.15^{a} ± 5.03	41.30^{b} ± 5.03	43.07^{a} ± 5.03
36		41.65^{b} ± 5.62	42.09^{ab} ± 5.62	42.85^{ab} ± 5.62	40.81^{b} ± 5.62	41.85^{b} ± 5.62	41.77^{b} ± 5.62	46.17^{a} ± 5.62	43.70^{a} ± 5.62	42.81^{ab} ± 5.62	43.61^{a} ± 5.62
28	Egg mass (g)	537.41^{ab} ± 20.15	449.91^{c} ± 20.15	496.21^{b} ± 20.15	543.64^{ab} ± 20.15	506.79^{b} ±20.15	476.95^{c} ± 20.15	578.20^{a} ± 20.15	505.95^{b} ±20.15	503.43^{b} ± 20.15	516.13^{a} ±20.15
32		613.84^{b} ± 23.30	697.53^{ab} ± 23.30	736.05^{a} ± 23.30	671.08^{ab} ± 23.30	679.63^{a} ±23.30	623.21^{b} ± 23.30	698.33^{ab} ± 23.30	707.72^{ab} ±23.30	512.12^{c} ± 23.30	635.35^{b} ±23.30
36		735.12^{b} ± 41.42	846.43^{a} ±41.42	829.47^{a} ± 41.42	623.98^{bc} ± 41.42	758.75^{a} ±41.42	719.14^{b} ± 41.42	851.84^{a} ± 41.42	852.15^{a} ±41.42	565.52^{c} ± 41.42	747.16^{b} ±41.42

*Values are means ± S.E , a, b and c in the same row between treatments and between means are significantly different ($P \leq 0.05$).

Table (6): Effect of adding different levels of acetic acid of two local strains on mortality rate (%).

Age (week)	Dandarawi					Dokki4				
	Control	2%	4%	6%	Overall	Control	2%	4%	6%	**Overall**
20-24	*2 **(5)	1 (2.5)	1 (2.5)	2 (5)	1.5 (3.75)	3 (7.5)	1 (2.5)	1 (2.5)	3 (7.5)	**2 (5)**
24-28	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 0	1 (2.56)	0 (0)	1 (2.7)	**0.5 (2.63)**
28-32	2 (5.26)	1 (2.56)	1 (2.56)	2 (5.26)	1.5 (4.66)	2 (5.40)	0 (0)	1 (2.56)	1 (2.78)	**1 (3.58)**
32-36	2 (5.55)	1 (2.63)	0 (0)	1 (2.78)	1 (3.65)	1 (2.90)	1 (2.63)	1 (2.63)	2 (5.71)	**1.25 (3.47)**
20-36	6 (15.81)	3 (7.69)	2 (5.06)	5 (13.04)	4 (10.40)	6 (15.80)	3 (7.69)	3 (7.69)	7 (18.69)	**4.75 (12.47)**

* Number of dead hens
** Mortality rate (%) = number of dead hens / number of live hens x 100

Table (7): Effect of adding different levels of acetic acid of two local strains on egg quality at the end of the experimental period.

Item	Dendarawi					Dokki4				
	Control	2%	4%	6%	Overall	Control	2%	4%	6%	Overall
Egg length (cm)	*5.10 ± 0.50	5.03 ± 0.50	4.83 ± 0.50	4.93 ± 0.50	4.97 ± 0.50	5.13 ± 0.50	5.00 ± 0.50	5.04 ± 0.50	5.20 ± 0.50	5.09 ± 0.50
Egg breadth (cm)	3.83 ± 0.32	3.84 ± 0.32	3.87 ± 0.32	3.80 ± 0.32	3.84 ± 0.32	3.90 ± 0.32	4.13 ± 0.32	3.87 ± 0.32	3.93 ± 0.32	3.96 ± 0.32
Yolk height (mm)	15.50 ± 1.22	15.91 ± 1.22	15.93 ± 1.22	15.78 ± 1.22	15.78 ± 1.22	16.32 ± 1.22	16.80 ± 1.22	16.72 ± 1.22	16.55 ± 1.22	16.60 ± 1.22
Albumin height (mm)	6.55 ± 0.63	6.47 ± 0.63	6.43 ± 0.63	6.43 ± 0.63	6.47 ± 0.63	6.53 ± 0.63	6.50 ± 0.63	6.57 ± 0.63	6.65 ± 0.63	6.56 ± 0.63
Albumin weight (%)	53.76 ± 2.65	54.55 ± 2.65	54.70 ± 2.65	55.70 ± 2.65	54.68 ± 2.65	55.17 ± 2.65	53.16 ± 2.65	55.20 ± 2.65	54.27 ± 2.65	54.45 ± 2.65
Shell weight (%)	14.48 ± 0.83	15.36 ± 0.83	14.61 ± 0.83	15.03 ± 0.83	14.87 ± 0.83	14.81 ± 0.83	13.90 ± 0.83	15.30 ± 0.83	15.23 ± 0.83	14.81 ± 0.83
Yolk weight (%)	31.76 ± 1.82	30.09 ± 1.82	30.69 ± 1.82	29.27 ± 1.82	30.45 ± 1.82	30.02 ± 1.82	32.94 ± 1.82	29.50 ± 1.82	30.50 ± 1.82	30.74 ± 1.82
Shape index (%)	66.24[bc] ± 3.02	70.30[a] ± 3.02	71.19[a] ± 3.02	69.42[b] ± 3.02	69.29 ± 3.02	67.55[c] ± 3.02	71.13[a] ± 3.02	69.55[b] ± 3.02	70.90[a] ± 3.02	69.78 ± 3.02
Yolk index (%)	36.66 ± 1.72	35.70 ± 1.72	36.11 ± 1.72	35.92 ± 1.72	36.10 ± 1.72	35.42 ± 1.72	35.55 ± 1.72	35.90 ± 1.72	36.80 ± 1.72	35.92 ± 1.72
Shell thickness (mm)	31.32[b] ± 1.65	33.67[a] ± 1.65	32.50[ab] ± 1.65	31.17[b] ± 1.65	32.17 ± 1.65	31.50[b] ± 1.65	33.79[a] ± 1.65	34.01[a] ± 1.65	32.00[ab] ± 1.65	32.82 ± 1.65
Yolk color	6.70 ± 0.61	6.70 ± 0.61	6.20 ± 0.61	5.95 ± 0.61	6.39 ± 0.61	6.80 ± 0.61	6.95 ± 0.61	6.45 ± 0.61	6.20 ± 0.61	6.60 ± 0.61
Haugh unit (%)	74.13[c] ± 2.31	76.15[ab] ± 2.31	76.75[b] ± 2.31	75.50[c] ± 2.31	75.63 ± 2.31	75.11[c] ± 2.31	77.50[b] ± 2.31	78.89[a] ± 2.31	75.20[c] ± 2.31	76.68 ± 2.31

* Values are means ± S.E. , a, b and c in the same row between treatments and between means are significantly different ($P \leq 0.05$).

Table (8): Effect of adding different levels of acetic acid in two local strains on some physiological and environmental characteristics.

Age (week)	Item	Dandarawi					Dokki4				
		Control	2%	4%	6%	Overall	Control	2%	4%	6%	Overall
20-24	Body temperature(°C)	*41.32 ± 4.30	41.42 ± 4.30	41.60 ± 4.30	41.72 ± 4.30	**41.52 ± 4.30**	41.72 ± 4.30	42.11 ± 4.30	41.80 ± 4.30	41.55 ± 4.30	**41.80 ± 4.30**
24-28		41.78 ± 4.62	41.78 ± 4.62	41.52 ± 4.62	41.47 ± 4.62	**41.64 ± 4.62**	41.57 ± 4.62	41.62 ± 4.62	41.68 ± 4.62	41.98 ± 4.62	**41.71 ± 4.62**
28-32		41.90 ± 4.93	41.60 ± 4.93	41.20 ± 4.93	41.30 ± 4.93	**41.50 ± 4.93**	41.80 ± 4.93	41.70 ± 4.93	41.55 ± 4.93	41.35 ± 4.93	**41.60 ± 4.93**
32-36		41.66 ± 4.75	41.77 ± 4.75	41.77 ± 4.75	41.78 ± 4.75	**41.75 ± 4.75**	41.83 ± 4.75	41.82 ± 4.75	41.90 ± 4.75	41.90 ± 4.75	**41.86 ± 4.75**
20-24	Respiratory rate (count/ min)	102.15 ± 6.51	100.18 ± 6.51	102.51 ± 6.51	98.18 ± 6.51	**100.76 ± 6.51**	105.19 ± 6.51	102.00 ± 6.51	100.20 ± 6.51	98.15 ± 6.51	**101.39 ± 6.51**
24-28		100.50 ± 7.03	105.83 ± 7.03	102.17 ± 7.03	97.67 ± 7.03	**101.54 ± 7.03**	98.33 ± 7.03	98.00 ± 7.03	102.50 ± 7.03	101.00 ± 7.03	**99.96 ± 7.03**
28-32		106.18 ± 8.51	101.15 ± 8.51	103.30 ± 8.51	98.50 ± 8.51	**102.28 ± 8.51**	108.17 ± 8.51	102.50 ± 8.51	100.70 ± 8.51	98.15 ± 8.51	**102.38 ± 8.51**
32-36		100.60 ± 6.11	97.34 ± 6.11	95.00 ± 6.11	96.66 ± 6.11	**97.40[b] ± 6.11**	104.66 ± 6.11	105.34 ± 6.11	100.00 ± 6.11	106.66 ± 6.11	**104.17[a] ± 6.11**
20-24	Litter PH(degree)	8.22 ± 0.63	8.15 ± 0.63	8.04 ± 0.63	8.18 ± 0.63	**8.15 ± 0.63**	8.35 ± 0.63	8.11 ± 0.63	8.09 ± 0.63	8.15 ± 0.63	**8.18 ± 0.63**
24-28		8.36 ± 0.77	7.82 ± 0.77	8.00 ± 0.77	7.92 ± 0.77	**8.03 ± 0.77**	8.41 ± 0.77	7.92 ± 0.77	7.86 ± 0.77	8.01 ± 0.77	**8.05 ± 0.77**
28-32		8.30 ± 0.75	7.80 ± 0.75	7.82 ± 0.75	7.70 ± 0.75	**7.91 ± 0.75**	8.42 ± 0.75	7.83 ± 0.75	7.64 ± 0.75	7.92 ± 0.75	**7.95 ± 0.75**
32-36		8.45 ± 0.84	7.72 ± 0.84	7.75 ± 0.84	7.92 ± 0.84	**7.96 ± 0.84**	8.31 ± 0.84	7.65 ± 0.84	7.75 ± 0.84	7.80 ± 0.84	**7.88 ± 0.84**

* Values are means ± S.E., a, b and c in the same row between treatments and between means are significantly different ($P \leq 0.05$).

Table (8): Continued.

Age (week)	Item	Dandarawi					Dokki4				
		Control	2%	4%	6%	Overall	Control	2%	4%	6%	Overall
20-24	Litter ammonia (ppm)	34.06^{a} ± 2.52	30.50^{b} ± 2.52	32.11^{ab} ± 2.52	32.16^{ab} ± 2.52	32.21 ± 2.52	35.55^{a} ± 2.52	30.19^{b} ± 2.52	32.77^{ab} ± 2.52	32.11^{ab} ± 2.52	32.66 ± 2.52
24-28		39.15^{a} ± 4.17	28.80^{c} ± 4.17	33.55^{ab} ± 4.17	35.17^{ab} ± 4.17	34.17 ± 4.17	40.23^{a} ± 4.17	30.51^{c} ± 4.17	32.90^{b} ± 4.17	35.70^{ab} ± 4.17	34.84 ± 4.17
28-32		46.20^{a} ± 3.65	33.14^{bc} ± 3.65	30.60^{bc} ± 3.65	37.18^{b} ± 3.65	36.78 ± 3.65	45.70^{a} ± 3.65	28.88^{c} ± 3.65	31.11^{bc} ± 3.65	36.18^{b} ± 3.65	35.47 ± 3.65
32-36		52.50^{a} ± 5.90	30.80^{bc} ± 5.90	28.72^{bc} ± 5.90	35.70^{b} ± 5.90	36.93^{a} ± 5.90	50.11^{a} ± 5.90	25.70^{c} ± 5.90	30.73^{bc} ± 5.90	28.85^{bc} ± 5.90	33.85^{b} ± 5.90
20-24	House humidity (%)	57.50^{a} ± 4.88	52.81^{b} ± 4.88	50.17^{b} ± 4.88	48.60^{b} ± 4.88	52.27 ± 4.88	55.11^{ab} ± 4.88	49.15^{b} ± 4.88	48.70^{b} ± 4.88	50.50^{a} ± 4.88	50.87 ± 4.88
24-28		60.70^{a} ± 6.04	50.13^{b} ± 6.04	52.22^{b} ± 6.04	53.18^{b} ± 6.04	54.06 ± 6.04	58.88^{ab} ± 6.04	51.30^{b} ± 6.04	52.90^{b} ± 6.04	52.00^{b} ± 6.04	53.77 ± 6.04
28-32		58.36^{a} ± 5.77	51.08^{b} ± 5.77	53.80^{ab} ± 5.77	50.13^{b} ± 5.77	53.34 ± 5.77	60.12^{a} ± 5.77	50.75^{b} ± 5.77	50.16^{b} ± 5.77	48.16^{b} ± 5.77	52.30 ± 5.77
32-36		65.10^{a} ± 7.00	49.90^{b} ± 7.00	54.66^{ab} ± 7.00	51.20^{b} ± 7.00	55.22 ± 7.00	62.20^{a} ± 7.00	49.40^{b} ± 7.00	52.13^{b} ± 7.00	51.80^{b} ± 7.00	53.88 ± 7.00

* Values are means ± S.E., a, b and c in the same row between treatments and between means are significantly different ($P \le 0.05$)

Table (9): Effect of adding different levels of acetic acid of two local strains on some blood parameters at the end of the experimental period.

Item	Dandarawi					Dokki4				
	Control	2%	4%	6%	Overall	Control	2%	4%	6%	Overall
Calcium (mg/dl)	*10.79^{b} ± 1.23	13.88^{a} ± 1.23	13.40^{a} ± 1.23	11.76^{ab} ± 1.23	12.46 ± 1.23	10.36^{b} ± 1.23	13.99^{a} ± 1.23	13.37^{a} ± 1.23	12.00^{ab} ± 1.23	**12.43 ± 1.23**
Phosphorus (mg/dl)	3.12^{b} ± 0.36	4.48^{a} ± 0.36	4.16^{a} ± 0.36	3.66^{ab} ± 0.36	3.86 ± 0.36	2.70^{c} ± 0.36	4.12^{a} ± 0.36	3.95^{a} ± 0.36	3.59^{ab} ± 0.36	**3.59 ± 0.36**
Total protein (mg/100ml)	5.16^{c} ± 0.45	6.01^{ab} ± 0.45	6.31^{a} ± 0.45	5.61^{b} ± 0.45	5.77 ± 0.45	5.59^{b} ± 0.45	6.19^{a} ± 0.45	6.00^{ab} ± 0.45	6.08^{ab} ± 0.45	**5.97 ± 0.45**
Albumin (mg/100ml)	3.28 ± 0.34	3.53 ± 0.34	3.78 ± 0.34	3.42 ± 0.34	3.50 ± 0.34	3.55 ± 0.34	3.85 ± 0.34	3.62 ± 0.34	3.51 ± 0.34	**3.63 ± 0.34**
Globulin (mg/100ml)	1.88^{b} ± 0.13	2.48^{a} ± 0.13	2.53^{a} ± 0.13	2.19^{ab} ± 0.13	2.27 ± 0.13	2.04^{ab} ± 0.13	2.34^{a} ± 0.13	2.38^{a} ± 0.13	2.57^{a} ± 0.13	**2.33 ± 0.13**
Cholesterol (mg/dl)	193.66^{a} ±10.15	141.87^{c} ±10.15	148.21^{c} ±10.15	175.00^{ab} ±10.15	164.69^{b} ±10.15	198.21^{a} ±10.15	172.01^{b} ±10.15	156.05^{c} ±10.15	178.23^{ab} ±10.15	**176.13^{a} ±10.15**
LDL (mg/dl)	125.87^{a} ±7.92	92.21^{d} ±7.92	96.34^{d} ±7.92	113.81^{b} ±7.92	107.06^{b} ±7.92	128.83^{a} ±7.92	111.78^{c} ±7.92	107.42^{c} ±7.92	115.84^{b} ±7.92	**115.97^{a} ±7.92**
HDL (mg/dl)	67.79^{a} ±5.55	49.66^{c} ±5.55	51.87^{c} ±5.55	61.19^{b} ±5.55	57.63^{b} ±5.55	69.38^{a} ±5.55	60.25^{b} ±5.55	48.63^{c} ±5.55	62.39^{b} ±5.55	**60.16^{a} ±5.55**
Total lipids (mg/dl)	702.33^{a} ±23.17	604.99^{d} ±23.17	647.61^{b} ±23.17	657.90^{b} ±23.17	653.21^{b} ±23.17	691.89^{a} ±23.17	637.11^{c} ±23.17	655.11^{b} ±23.17	660.35^{b} ±23.17	**661.12^{a} ±23.17**
Triglycerides (mg/dl)	139.15^{a} ±8.26	97.80^{c} ±8.26	89.17^{d} ±8.26	117.15^{b} ±8.26	110.82^{b} ±8.26	143.16^{a} ±8.26	102.11^{c} ±8.26	90.66^{d} ±8.26	122.07^{b} ±8.26	**114.50^{a} ±8.26**
HMG -CoA Reductase(IU)	254.11^{a} ±10.39	202.55^{d} ±10.39	215.13^{c} ±10.39	226.40^{b} ±10.39	224.55^{b} ±10.39	250.00^{a} ±10.39	217.08^{c} ±10.39	219.16^{c} ±10.39	227.70^{b} ±10.39	**228.49^{a} ±10.39**

* Values are means ± S.E , a, b, c and d in the same row between treatments and between means are significantly different ($P \leq 0.05$).

Table (9): Continued.

Item	Dandarawi					Dokki4				
	Control	2%	4%	6%	Overall	Control	2%	4%	6%	Overall
Alkaline Phosphatese (U/L)	14.78^{c} ±2.05	19.94^{a} ±2.05	17.88^{b} ±2.05	19.07^{a} ±2.05	17.92 ±2.05	15.52^{c} ±2.05	18.74^{b} ±2.05	19.55^{a} ±2.05	19.04^{a} ±2.05	18.21 ±2.05
AST(IU/L)	89.75^{c} ±8.91	118.25^{b} ±8.91	122.00^{ab} ±8.91	126.0^{ab} ±8.91	114.00^{b} ±8.91	83.75^{c} ±8.91	128.04^{ab} ±8.91	125.00^{ab} ±8.91	133.76^{a} ±8.91	117.64^{a} ±8.91
ALT(IU/L)	13.60^{c} ±1.86	17.05^{ab} ±1.86	19.92^{a} ±1.86	14.97^{b} ±1.86	16.39 ±1.86	13.02^{c} ±1.86	16.35^{ab} ±1.86	21.10^{a} ±1.86	15.70^{b} ±1.86	16.54 ±1.86
T3hormone (ng/ml)	4.28 ± 0.31	5.15 ± 0.31	4.82 ± 0.31	4.75 ± 0.31	4.75 ± 0.31	4.68 ± 0.31	5.00 ± 0.31	4.92 ± 0.31	5.13 ± 0.31	4.93 ± 0.31
T4hormon (ng/ml)	14.16 ± 1.65	15.32 ± 1.65	15.45 ± 1.65	14.68 ± 1.65	14.90 ± 1.65	13.78 ± 1.65	14.75 ± 1.65	14.90 ± 1.65	14.19 ± 1.65	14.41 ± 1.65
Ritio T3/T4	0.302 ± 0.01	0.336 ± 0.01	0.312 ± 0.01	0.323 ± 0.01	0.318 ± 0.01	0.340 ± 0.01	0.339 ± 0.01	0.330 ± 0.01	0.362 ± 0.01	0.342 ± 1.23
Parathyroid Hormone (pg/ml)	73.18^{c} ±8.52	88.50^{ab} ±8.52	90.11^{a} ±8.52	73.50^{c} ±8.52	81.32^{b} ±8.52	75.11^{b} ±8.52	91.19^{a} ±8.52	86.80^{ab} ±8.52	78.55^{b} ±8.52	82.91^{a} ± 0.36
Calcitonin hormone (pg/ml)	218.70^{c} ±12.63	252.15^{a} ±12.63	255.50^{a} ±12.63	220.20^{c} ±12.63	236.64^{b} ±12.63	230.11^{b} ±12.63	261.18^{a} ±12.63	253.00^{a} ±12.63	228.13^{b} ±12.63	243.11^{a} ± 0.45

* Values are means ± S.E., a, b, c and d in the same row between treatments and between means are significantly different ($P \leq 0.05$).

Table (10): Effect of adding different levels of acetic acid of two local strains on some yolk parameters at the end of the experimental period.

Item	Dandarawi					Dokki4				
	Control	2%	4%	6%	Overall	Control	2%	4%	6%	Overall
Cholesterol (mg/g)	*19.43^{a} ±2.71	13.17^{d} ±2.71	13.01^{d} ±2.71	14.96^{b} ±2.71	15.14^{a} ±2.71	17.78^{ab} ±2.71	12.47^{d} ±2.71	12.04^{d} ±2.71	14.50^{c} ±2.71	14.20 ±2.71
LDL (mg/g)	12.65^{a} ± 1.84	9.81^{b} ± 1.84	8.66^{c} ± 1.84	10.73^{ab} ± 1.84	10.46^{a} ± 1.84	10.95^{ab} ± 1.84	8.54^{c} ± 1.84	8.00^{c} ± 1.84	9.27^{b} ± 1.84	9.19^{b} ± 1.84
HDL (mg/g)	6.78^{a} ± 0.63	4.36^{c} ± 0.63	4.35^{c} ± 0.63	4.35^{c} ± 0.63	4.96 ± 0.63	5.83^{ab} ± 0.63	3.93^{c} ± 0.63	4.04^{c} ± 0.63	5.23^{b} ± 0.63	4.76 ± 0.63
Total lipids (mg/g)	332.43^{a} ±16.71	290.63^{c} ±16.71	305.02^{b} ±16.71	303.02^{b} ±16.71	307.78^{b} ±16.71	330.85^{a} ±16.71	283.64^{c} ±16.71	314.25^{b} ±16.71	310.95^{b} ±16.71	309.92^{a} ±16.71
Triglycerides (mg/g)	442.55^{a} ±17.64	372.11^{c} ±17.64	351.00^{d} ±17.64	403.09^{b} ±17.64	392.19^{b} ±17.64	438.80^{a} ±17.64	375.16^{c} ±17.64	407.18^{b} ±17.64	409.11^{b} ±17.64	407.56^{a} ±17.64

* Values are means ± S.E. a, b, c and d in the same row between treatments and between means are significantly different ($P \leq 0.05$).

Table (11): Effect of adding different levels of acetic acid of two local strains on some liver parameters at the end of the experimental period.

Item	Dandarawi					Dokki4				
	Control	2%	4%	6%	Overall	Control	2%	4%	6%	Overall
Cholesterol (mg/g)	158.73^{a} ±11.04	133.08^{c} ±11.04	116.96^{d} ±11.04	140.43^{b} ±11.04	137.30 ±11.04	160.81^{a} ±11.04	121.45^{d} ±11.04	130.00^{c} ±11.04	137.29^{b} ±11.04	137.39 ±11.04
LDL (mg/g)	103.17^{a} ±8.61	86.50^{c} ±8.61	72.81^{d} ±8.61	92.73^{b} ±8.61	88.80 ±8.61	100.57^{a} ±8.61	84.53^{c} ±8.61	80.66^{c} ±8.61	85.95^{c} ±8.61	87.93 ±8.61
HDL (mg/g)	55.56^{ab} ±4.26	46.58^{c} ±4.26	42.85^{d} ±4.26	47.70^{c} ±4.26	48.17^{b} ±4.26	60.30^{a} ±4.26	47.47^{c} ±4.26	49.34^{b} ±4.26	51.34^{b} ±4.26	52.11^{a} ±4.26
Total lipids (mg/g)	272.35^{a} ±27.31	211.02^{c} ±27.31	214.82^{c} ±27.31	237.88^{b} ±27.31	234.02 ±27.31	267.61^{a} ±27.31	230.31^{b} ±27.31	210.86^{c} ±27.31	233.21^{b} ±27.31	235.50 ±27.31
Triglycerides (mg/g)	457.15^{a} ±43.44	406.50^{c} ±43.44	393.33^{c} ±43.44	429.19^{b} ±43.44	421.54 ±43.44	451.19^{a} ±43.44	386.06^{d} ±43.44	400.13^{c} ±43.44	422.57^{b} ±43.44	414.[illegible]9 ±43.44

* Values are means ± S.E. a, b, c and d in the same row between treatments and between means are significantly different ($P \leq 0.05$).

Table (12): Effect of adding different levels of acetic acid of two local strains on antibody titters against avian Newcastle and Influenza diseases at the end of the experimental period.

Item	Dandarawi					Dokki4				
	Control	2%	4%	6%	Overall	Control	2%	4%	6%	Overall
Newcastle titter against	*153.16^{c} ± 9.21	175.15^{b} ± 9.21	210.12^{a} ± 9.21	182.00^{ab} ± 9.21	180.11^{a} ± 9.21	140.11^{d} ± 9.21	169.60^{b} ± 9.21	183.15^{ab} ± 9.21	203.26^{a} ± 9.21	174.03^{b} ± 9.21
Influenza titter against	4.65^{c} ± 0.91	6.20^{b} ± 0.91	8.90^{a} ± 0.91	7.00^{ab} ± 0.91	6.69 ± 0.91	4.71^{c} ± 0.91	5.82^{b} ± 0.91	7.32^{ab} ± 0.91	8.01^{a} ± 0.91	6.47 ± 0.91

* Values are means ± S.E., a, b, c and d in the same row between treatments and between means are significantly different (P 0.05).

Table (13): Effect of adding different levels of acetic acid of two local strains on immuno organs relative weight at the end of the experimental period.

Item	Dandarawi					Dokki4				
	Control	2%	4%	6%	Overall	Control	2%	4%	6%	Overall
*spleen	**0.15^{c} ± 0.04	0.24^{a} ±0.04	0.18^{b} ±0.04	0.19^{b} ±0.04	0.19 ± 0.04	0.13^{c} ± 0.04	0.26^{a} ±0.04	0.19^{b} ±0.04	0.19^{b} ±0.04	0.19 ± 0.04
thymus gland	0.27^{c} ± 0.06	0.35^{a} ±0.06	0.34^{a} ±0.06	0.32^{ab} ±0.06	0.32 ± 0.06	0.28^{c} ± 0.06	0.31^{b} ±0.06	0.32^{ab} ±0.06	0.33^{a} ±0.06	0.31 ± 0.06

* Relative weight= organ weight / body weight × 100

** Values are means ± S.E, a, b, c and d in the same row between treatments and between means are significantly different (P 0.05).

Table (14): Effect of adding different levels of acetic acid of two local strains on some internal organs relative weight at the end of the experimental period.

Item	Dandarawi					Dokki4				
	Control	2%	4%	6%	Overall	Control	2%	4%	6%	Overall
Body weight (g)	*1317.70^{c} ± 67.15	1475.22^{b} ± 67.15	1478.55^{ab} ± 67.15	1442.60^{b} ± 67.15	1428.52^{b} ± 67.15	1522.33^{ab} ± 67.15	1658.90^{a} ± 67.15	1623.77^{a} ± 67.15	1635.50^{a} ± 67.15	1610.13^{a} ± 67.15
Carcass %	58.76^{b} ± 5.12	65.81^{a} ± 5.12	66.52^{a} ± 5.12	63.71^{ab} ± 5.12	63.70 ± 5.12	59.91^{b} ± 5.12	64.70^{a} ± 5.12	65.66^{a} ± 5.12	62.80^{ab} ± 5.12	63.27 ± 5.12
Heart %	0.38 ± 0.05	0.38 ± 0.05	0.40 ± 0.05	0.38 ± 0.05	0.39 ± 0.05	0.37 ± 0.05	0.38 ± 0.05	0.40 ± 0.05	0.39 ± 0.05	0.39 ± 0.05
Liver %	2.77 ± 0.35	2.82 ± 0.35	2.85 ± 0.35	2.91 ± 0.35	2.84 ± 0.35	2.81 ± 0.35	2.93 ± 0.35	2.80 ± 0.35	2.94 ± 0.35	2.87 ± 0.35
Gizzard %	1.33 ± 0.14	1.38 ± 0.14	1.35 ± 0.14	1.38 ± 0.14	1.36 ± 0.14	1.31 ± 0.14	1.37 ± 0.14	1.38 ± 0.14	1.34 ± 0.14	1.35 ± 0.14
Stomach gland %	0.40 ± 0.06	0.39 ± 0.06	0.42 ± 0.06	0.39 ± 0.06	0.40 ± 0.06	0.38 ± 0.06	0.41 ± 0.06	0.39 ± 0.06	0.42 ± 0.06	0.40 ± 0.06
Gall bladder %	0.17 ± 0.01	0.18 ± 0.01	0.18 ± 0.01	0.17 ± 0.01	0.18 ± 0.01	0.17 ± 0.01	0.18 ± 0.01	0.16 ± 0.01	0.19 ± 0.01	0.18 ± 0.01
Kidney %	0.43 ± 0.07	0.49 ± 0.07	0.46 ± 0.07	0.47 ± 0.07	0.46 ± 0.07	0.44 ± 0.07	0.48 ± 0.07	0.49 ± 0.07	0.47 ± 0.07	0.47 ± 0.07
Intestines %	5.02 ± 0.62	4.86 ± 0.62	4.90 ± 0.62	4.92 ± 0.62	4.93 ± 0.62	5.11 ± 0.62	4.76 ± 0.62	4.60 ± 0.62	4.81 ± 0.62	4.82 ± 0.62
Pancreas %	0.15 ± 0.01	0.16 ± 0.01	0.17 ± 0.01	0.17 ± 0.01	0.16 ± 0.01	0.14 ± 0.01	0.16 ± 0.01	0.16 ± 0.01	0.16 ± 0.01	0.16 ± 0.01
Ovary %	1.88^{c} ± 0.35	2.45^{ab} ± 0.35	2.74^{a} ± 0.35	2.70^{a} ± 0.35	2.44 ± 0.35	1.74^{c} ± 0.35	2.57^{ab} ± 0.35	2.00^{b} ± 0.35	2.80^{a} ± 0.35	2.28 ± 0.35
Oviduct %	3.13^{c} ± 0.55	4.71^{a} ± 0.55	4.23^{ab} ± 0.55	3.76^{b} ± 0.55	3.96 ± 0.55	3.22^{c} ± 0.55	4.60^{a} ± 0.55	4.40^{ab} ± 0.55	3.67^{b} ± 0.55	3.98 ± 0.55
Oviduct length (cm)	33.00^{d} ± 4.05	56.00^{a} ± 4.05	45.00^{b} ± 4.05	47.50^{b} ± 4.05	45.38^{b} ± 4.05	36.60^{c} ± 4.05	57.30^{a} ± 4.05	51.50^{ab} ± 4.05	51.00^{ab} ± 4.05	49.10^{a} ± 4.05
Abdominal fat	2.67^{a} ± 0.38	1.51^{b} ± 0.38	0.94^{c} ± 0.38	1.95^{ab} ± 0.38	1.77^{a} ± 0.38	2.51^{a} ± 0.38	1.08^{c} ± 0.38	0.79^{d} ± 0.38	1.60^{b} ± 0.38	1.50^{b} ± 0.38
No. of bigger follicular	3.00^{c} ± 0.72	5.00^{a} ± 0.72	6.00^{a} ± 0.72	5.00^{a} ± 0.72	4.75 ± 0.72	4.00^{b} ± 0.72	6.00^{a} ± 0.72	5.00^{a} ± 0.72	5.00^{a} ± 0.72	5.00 ± 0.72
No. of smaller follicular	14.00^{b} ± 2.03	16.00^{a} ± 2.03	15.00^{ab} ± 2.03	16.00^{a} ± 2.03	15.25 ± 2.03	13.00^{c} ± 2.03	17.00^{a} ± 2.03	16.00^{a} ± 2.03	17.00^{a} ± 2.03	15.75 ± 2.03

* Values are means ± S.E. , a, b, c and d in the same row between treatments and between means are significantly different ($P \leq 0.05$).

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الملخص العربى

الدور الفسيولوجى والمناعى لحامض الخليك لتحسين إنتاج البيض وخفض التلوث ومستوى الأمونيا فى عنابر الدجاج البياض المحلى

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أجريت هذة الدراسة فى محطة بحوث الدواجن بسدس – معهد بحوث الإنتاج الحيوانى بهدف دراسة الدور الفسيولوجى والمناعى لحامض الخليك لتحسين إنتاج البيض وتقليل مستوى الامونيا والتلوث بعنابر الدجاج البياض المحلى. استخدم في هذه الدراسة عدد٣٢٠ دجاجة عمر ٢٠ اسبوع من سلالتين هما الدندراوى ودقى٤(١٦٠ دجاجة بكل سلالة) وقسمت الى اربع مجاميع بكل سلالة(٤٠ دجاجة / مجموعة) وكل مجموعة ٤ مكررات بكل منها ١٠ دجاجات. وقد أعتبرت المجموعة الأولى للمقارنة، بينما أعتبرت المجاميع ٢ ،٣ ثم٤ للمعاملات وكانت على النحو التالى :

١- المجموعة الأولى تم فيها تغذية الدجاج على عليقة المقارنة اى بدون إضافة حمض الخليك للعليقة .

٢- المجموعة الثانية (المعاملة الأولى) تم فيها تغذية الدجاج على نفس عليقة المقارنة مع إضافة ٢% حمض الخليك للعليقة .

٣- المجموعة الثالثة (المعاملة الثانية) تم فيها تغذية الدجاج على نفس عليقة المقارنة مع إضافة ٤% حمض الخليك للعليقة .

٤- المجموعة الرابعة (المعاملة الثالثة) تم فيها تغذية الدجاج على نفس عليقة المقارنة مع إضافة ٦% حمض الخليك للعليقة .

ولقد أ ستمرت التجربة لمدة ٤ شهور مع اتباع نظام التغذية الحرة وتم تربية الدجاج فى كل المجاميع تحت نفس ظروف التهوية والإضاءة والحرارة فى عنابر مفتوحة على الأرض وأثناء فترة التجربة تم تقدير بعض الصفات الإنتاجية مثل وزن الجسم واستهلاك العليقة و العمر عند النضج الجنسى ووزن أول بيضة وعدد ووزن البيض وجودة البيض و لقد تم قياس درجة حرارة الجسم ومعدل التنفس ونسبة الامونيا بالفرشة ودرجة الرطوبة وpH الفرشة وكذلك تم عمل بعض التقديرات الفسيولوجية والمناعية بالدم والبيض والكبد كما تم ذبح عدد من الدجاج لتقدير بعض مقاييس الذبيحة . وكانت أهم النتائج المتحصل عليها :-

- كانت سلالة دقى٤ أعلى فى وزن الجسم من سلالة الدندراوى وهذا يرجع لاختلاف السلالة ، بينما وجد لإضافة حمض الخليك بأى مستوى للعليقة تأثير معنوى واضح على زيادة وزن الجسم للسلالتين بالمقارنة بمجموعتى الكنترول .
- لوحظ انخفاض واضح فى الغذاء المستهلك لكل المجاميع التى أضيف لها ٢،٤،٦% حمض خليك فى كلا السلالتين بالمقارنة بمجموعتى الكنترول .
- حدثت زيادة فى عمر النضج الجنسى ووزن أول بيضة وكتلة البيض فى كل المجاميع التى تغذت على ٤% حمض خليك بالمقارنة بباقى المجاميع فى كلا السلالتين .
- وجدت زيادة واضحة فى عدد ووزن البيض لكل المجاميع التى تغذت على ٢،٤% حمض خليك وخاصة فى سلالة دقى٤ وكان ذلك أكثر وضوحا فى الأسبوعين ٣٢ و٣٦ بالمقارنة بالمجاميع التى تغذت على ٦% حمض خليك و الكنترول .
- وجد انخفاض فى اجمالى نسبة النفوق بكل المجاميع التى تغذت على ٢،٤% حمض خليك فى كلا السلالتين بالمقارنة بالمجاميع التى تغذت على ٦% حمض خليك و الكنترول .
- ازدادت قيم كل من دليل الشكل ووحدات هاو وسمك القشرة فى كلا المجاميع التى تغذت على ٢،٤% حمض خليك فى كلا السلالتين بالمقارنة بالمجاميع التى تغذت على ٦% حمض خليك و الكنترول ولم تتأثر باقى صفات جودة البيض.
- لوحظ انخفاض كلا من نسبة الامونيا والرطوبة بالفرشة بشكل معنوى ، بينما لم يتأثر كلا من pH الفرشة ومعدل التنفس و درجة حرارة الجسم نتيجة لإضافة حمض الخليك بأى مستوى بالمقارنة بالمجاميع الكنترول فى كلا السلالتين .
- وجد ارتفاع فى كل من الكالسيوم و الفوسفور والبروتين الكلى والجلوبيولين وإنزيمات الألكالين فوسفاتيزوAST وALT وكلا من هرمونات الجار درقية والكالسيتونين بسيرم الدم وذلك لكل المجاميع التى غذيت على ٢،٤% حمض خليك بالمقارنة بباقى المجاميع فى كلا السلالتين .
- وجد انخفاض واضح فى نسبة إنزيم تخليق الكوليستيرول HMG-CoAreductase بسيرم الدم وكذلك فى كل من مستوى الكوليستيرول وLDL وHDL والدهون الكلية والجلسريدات الثلاثية بكل من سيرم الدم والبيض والكبد لكل المجاميع التى غذيت على ٢،٤% حمض خليك بالمقارنة بباقى المجاميع فى كلا السلالتين .
- لم يكن هناك فروق معنوية فى مستوى كلا من هرمونىT3 وT4 ولا فى النسبة بينهما بسيرم الدم بكل المجاميع فى كلا السلالتين .
- وجد أرتفاع فى مستوى الاستجابة المناعية ضد أمراض النيوكاسيل والأنفلونزا وذلك لكل المجاميع التى غذيت على ٢،٤،٦% حمض خليك بالمقارنة بمجموعتى الكنترول فى السلالتين .

- ازداد الوزن النسبي لكلا من الطحال والغدة التيموسية كأعضاء مناعية ثانوية ،كما زادت نسبة تصافى الذبيحة ووزن كلا من المبيض وقناة المبيض وطول قناة المبيض . كذلك زاد عدد الحويصلات المبيضية الكبيرة والصغيرة كما انخفض وزن دهن البطن بكل المجاميع التى تغذت على ٢,٤,٦% حمض خليك فى كلا السلالتين بالمقارنة بمجموعتى الكنترول.

وتوصى الدراسة بأستخدام حمض الخليك بنسبة ٢ ، ٤ % للسلالات المحلية لتحسين إنتاج البيض وتقليل التلوث بالامونيا فى عنابر الدجاج البياض المحلى وكذلك لتحسين الأداء الانتاجى والفسيولوجى والمناعى وخاصة إنتاج بيض منخفض فى محتوى الكوليستيرول وأيضا أرتفاع مستوى المناعة ضد أمراض النيوكاسيل والأنفلونزا الشائعة ، ويمكن استخدام حمض الخليك حتى ٦%أيضا يؤدى نفس التأثير السابق ولكن بشكل أقل بالمقارنة بالدجاج المحلى المغذى على علائق خالية من حمض الخليك .