Egypt. J. Agric. Res., 76 (3), 1998.

INORGANIC ACIDIFICATION OF LAYER DIETS

G.A. ABD-ALLAH, A.H. ABD EL-MEGEED, M.Y. ATTIA, MERVAT.A. BREIKAA AND H.M. FAYEK

Animal Production Research Institute, Agricultural Reasrch Centre, Dokki, Egypt.

(Manuscript received 15 July 1997)

Abstract

Tow hundred and ten hens (24 weeks old) and 21 cocks of MATROUH breed were fed on seven treatments for 12 weeks to study the effect of layer diet acidification by HCl or H2SO4 on the productive performance, egg traits, fertility and hatchability. Treatments used were basal (without acidification), basal plus HCl at 0.21%, 0.42% and 0.84%, or H_2SO_4 at 0.6%, 1.2% and 2.4%.

Results showed that acidification did not show any mortality, diarrhea and evidence of dehydration. Also, no detrimental effect could be found on feed consumption, productive performance, egg traits, fertility, hatchability.

On the other hand, results revealed the effectiveness of HC1 at 0.21% and H_2SO_4 at 0.6%, equivalent to 0.06 Moles/kg of the feed, in improving FC with 24.4% and 16.8%, respectively. Insignificant effect of these treatments was found on egg traits, fertility and hatchability as compared to the basal. The effect of HCl was found to be better than H_2SO_4 in the term of the productive performance. Layers tolerated levels of the two acids up to 0.84% HCl and 2.4% H_2SO_4.

INTRODUCTION

The poultry industry needs new technology to enhance feed conversion and to protect birds against pathogens and enteric organisms. Antibiotics have provided these two benefits (Younis, 1987). However, the use of antibiotics is causing some concern about public health internationals, becuse of drug resistance and hazards of retention in edible products. (NRC, 1994). Therefore, there is a need to search for alternatives of antibiotics as growth promoting feed additives.

Microorganisms enter the digestive tract of the birds from the environment and the feed (Stuart, 1984). The purshase of good quality feeds or feed ingredients help to reduce the entering of microorganisms. However, with all precautions they still enter the bird.

Acidity has been used for centuries to control microbial growth and preserve food. Recntly, acidification of poultry diets may offer interesting possibility for improving feed utilization by controlling numbers of the microorganisms in the crop (Miller, 1987). Acidification of feed can speed the drop of pH of the crop content.

Benefits of acidification extends to be effective in reducing or eliminating Salmonella and other microorganisms from the processed carcass (Amy and Park, 1989).

Studies demonstrated that the addition of organic acids aids in improving feed utilization (Cave, 1989). Commercial feed additives based on organic acids or their salts are widely used in poultry industry as preservatives for the control of mold and microorganisms (Ronse *et al.*, 1989).

As organic acids, inorganic acids may have similar effect in reducing the pH of the crop when used through feed or water as acidifiers, therefore, the present study aimed to evaluate the effect of utilizing HC1 and H_2SO_4 as feed acidifiers on layers productive performance, egg traits, fertility and hatchability.

MATERIALS AND METHODS

The present study involved one experiment carried out at Bourg El-Arab poultry station, Animal production Research Institute, Agricultural Research Centre, Giza, ARE.

Two hundred and ten layers and twenty one cocks of "MATROUH" breed which is white leghornxDokki-4 (Mahmoud *et al.*, 1974), 24 weeks old were used. They have nearly similar weights. Birds were distributed randomly according to their weights into seven littered floor pens, each one was divided into two divisions.

Seven experimental treatments were given to layer groups in triplicate at random. Treatments were based on a basal layer diet (Table 1), designed to cover the nutrient requirement according to the Ministerial Decree No 554, 1984. Such diet was supplemented with hydrochloric acid or sulfuric acid at three different levels (2x3). The experimental treatments were as follows:

Treatment	1	Basal without acidification (0.0% acid).					
"	2	Basal	+ 0.06	Moles	Hcl/kg	Feed	(0.12%)
"	3		+ 0.12	Moles	"	"	(0.42%)
"	4		+ 0.24	Moles	"	"	(0.84%)
"	5		+ 0.06	H2SO4	"	"	(0.6%)

"	6	"	+ 0.12	"	"	" (1.2%)
"	7	"	+ 0.24	"	"	" (2.4%)

Acidification was carried out by mixing each 100 Kg of the basal diet with 4 liter of water containing the required quantity of acid to produce the desired concentration in the final feed. The basal diet was also mixed with water (4%) free of acids.

Birds were fed the experimental treatments for 12 weeks (24-36 weeks of age). Feed and water were provided ad lib. for 16 hours photo-period/day.

Egg number and weight were recorded daily, whereas, feed consumption was recorded weekly. The productive performance parameters were: Egg Number (EN), Egg Weight, g (EW), Egg mass, kg ((EM), Feed Intake, kg (FI) and Feed Conversion, kg feed/kg egg (FC). Data were collected and calculated every 4 weeks. At the end of each 4 weeks experimental period, a number of six eggs was taken randomly from each treatment for determining egg traits parameters: Weight, g (EW) Albumin Weight, % (AW), Yolk Weight% (YW), Egg shell, % of egg weight (ES) and hell thickness, mm (ST).

Fertility and hatchability were also studied on three batches of eggs taken from the produced eggs representing the experimental treatments, every 4 weeks from the begining of the experiment. Fertility was calculated as % of total egg set, whereas, hatchability was calculated as % of egg set or % of fertile eggs.

Averages of results obtained in the three 4 week period were examined statisticaly using the computerised analysis of variance and Duncan's multiple range test procedures within the Statistical Analysis System, SAS (1987).

RESULTS AND DISCUSSION

Productive performance

The effect of dietary acidification on the productive performance of layers is shown in Table 2. Results presented show that the basal diet (without supplementation) gave 11.17, 48.35, 0.547, 3.986 and 7.688 in EN, EW, EM, FI and FC, respectively. As compared to the basal diet all levels of Hcl (0.20%, 0.42% and 0.84%) increased significantly EN. The highest relative increase (acid-tractment value/non acid-treatment value x100) was found to be 15.46% of level 1 followed by level 2 (6.45%) and level 3 (3.9%) without significant difference between the latter levels. The mean value of decrease was 8.75%.

Table 1 Dietary Composition and Chemical analysis of the basal layer diet.

Composition	%	Chemical analysis (Calculated)*	
Yellow corn	67	Crude protein (N X 6.25)	17.0
Protein concentrate **	10	Metabolizable energy (Kcal/kg)	2850
Lime stone	7.0		
Corn glutin	5.0	Calcium	3.54%
soya bean meal	5.0	Available phosphorus	0.4%
Sun flour meal	3.0	lysine	0.80%
Wheat bran	2.8	Methionine	0.44%
L.lysine	0.2		
Total	100.0		

* According to NRC. (1994) feed composition Tables

** Protein concentrate: Meat meal 35%, meat & bone meal 20%, fish meal 10%, soya bean meal 15%, sunflower meal 5%, lime stone 5% and vitamins & mineral premix 10%. Each kg of vitamin & mineral premix contains: vitamin A, 10.000IU; D3, 2500 IU; E, 10 mg; kg,k3, 2.5 mg; B1, 1.0 mg; B2 4 mg; Pantothenic acid, 10gm, niacin, 40 mg; choline chloride, 500 mg, B6, 1.5 mg; B12,20 ug; biotin, 50 mg; iron; 44 mg; iodine, 0.3 mg; zinc, 56 mg; manganese, 63 mg; copper, 5 mg and selenium, 1 mg.

The effect of acidification on EW was found to be insignificant. As regards to EM, the three levels of Hcl increased the value significantly relative to the basal value. Level 1 gave the highest relattive value, (23.03%) followed by level 2 (14.4%) and level 3 (9.5%). Level 2 did not differ significantly from level 3, whereas, difference was significant between level 1 and 3, the latter level decreased EM significantly, giving 10.9% relative to the former.

Layers were found to consume insignificantly different amounts of feed from Hcl treatment, as well as, from the basal. Values of FC resulting from level 1 is significantly lower than that of the basal (23.99), followd by level 2 (16, 4%) and 3 (11.45%). Difference between levels 1 and 2 or 3 was insignificant, whereas it was significant between 1 and 3. Level 3 increased FC 14.16% relative to level 1 of Hcl.

Concerning diet acidfication using H_2SO_4, EN increased significantly with the three levels as compared to the basal. Difference between the three levels in this parameter was insignificant. The mean value of such effect was found to be 12.5% which was 6.2% higher than that of the basal.

The three acid treatments did not affect EW significantly. However, they resulted in a significant increase in EM; level 1, 2 and 3 increased this parameter 15.5%, 14.6% and 12.2%, respectively, relative to the basal. Insignificant difference was found between these levels in this parameter. Level 1 of H_2SO_4 showed the highest value, numerically, as compared to other levels. Feed intake (FI) of all acid levels and the basal were insignificantly different. The effect of these treatments in term of FC was significant. Level 1 decreased the value of the basal 16.81%, level 2, 15.9% and level 3, 13.2%. Differences between these levels were insignificant in this parameter.

Comparing the effect of HCl and H_2SO_4 treatments irrespective to acid levels, showed insignificant difference in all utilized parameters. However, with level 1 of Hcl and H_2SO_4, the most effective acidification treatment in EN, EM and FC were significantly different in EN only. Level 1 of Hcl gave 7.857% more eggs than the same level of H_2SO_4.

Egg traits:

The effect of acidification one egg traits parameters is shown in Table 3. Results of YW, AW, SW and ST were found to be 32.49, 53.95, 13.86 and 0.348 for the basal diet, respectively. Acidification by Hcl or H_2SO_4 affected these parameters at the three experimental levels.

Irrespective to the type or the level of acid, the values ranged from 32.61 - 33.86 in YW (mean, 33.24), 53.24), 53.01-54.36 in AW (mean, 53.69), 12.8-13.7 in SW (mean, 12.89) and 0.348-0.360 in ST (mean, 0.354). No particular trend could be observed among treatments in any of the present parameters. Statistical analysis of results did not show significant difference between acids treatment values or between each of these treatments and those without acidification.

Fertility and hatchability

The effect of acidification on fertility and hatchability is shown in Table 4. Results revealed that, layers fed on the diets without acidification laid eggs 90.06% fertile with 70.36% hatchability on the total number of egg and 78.74% of the fertile eggs.

Acidification by HCl gave a small numerical increase than the basal in the percentge fertility. Level 3 showed relatively the highest value (93 %). Hatchability percentagefor total eggs or hatched eggs of the previous level was also found to be higher than the basal, 74.14 and 83.48 versus 70.36 and 78.14, respectively.

As regards to H_2SO_4 acidification, level 2 gave numerically higher value than for the basal in the three parameters. Fertility was 90.73%, hatchability 75.48 and hatchability fertile eggs 83.10%. The differences found between treatments in these parameters were insignificant.

From the present results, it was obvious that, acidification by HC1 or H_2SO_4 up to 0.81% and 2.4% (equivalent to 0.24 Mole/Kg feed), respectively, did not cause any mortality. Furthermore, layers fed on acid treatments did not show outward signs of impairment. Faeces moisture content was found to be quite normal reltive to that of the basal (30-32%), giving an indication that acids utilized in acidification did not cause diarrhoea or dehydration. Data of feed consumption did not reveal under or over consumption of acidified diets even with high levels of the acids. However, in this respect, it was concluded, from the study of Pritzl and Kienholz (1973) that, high levels of HCl and H_2SO_4 resulted in an increase in feed consumption in broiler chicks.

It could be concluded from the present study that dietary acidification may have a beneficial effect on the productive performance of layers. In particular, it seemed that, there was an effect of the type and level of acid. Hydrochloric acid at 0.2% which was equivalent to 0.06 Mole/Kg feed and sulphuric acid 0.6% with the

same molarity in the feed improved productivity and feed conversion. However, H_2SO_4 could reduce the pH of feed 1.1 units, whereas, HCl reduced it 0.5 units, the effect of HCl surpassed that of H_2SO_4 in improving FC.

Studies on the inorganic acidification of layer diets were not found in the available liteture. Pritzl and Kienholz (1973) conducted the only study in this respect with broilers. They indicated that, no detrimental effect is observed on chicks. They did not grow well as the control diet. The presented results of layer experiment may be promising as compared to those of broilers reported by the previous authors. Their note that the adverse effect seemed to be alevated as the birds grow older, may give an explanation of hen tolerance to acidification of diets applied in the present study.

Table 2 The effect of acidification on the productive performance parameters

Treatments	EN	EW	EM	FI	EM
Basal	11.77 c	48.35 a	0.547 c	3.986 a	7.688 a
HCl levels :					
1	13.59 a	49.37 a	0.673 a	3.866a	5.813 b
2	12.58 b	49.79 a	0.626 ab	3.895 a	6.420 bc
3	12.28 b	48.51 a	0.599 b	3.878 a	6.807 b
means	12.80 A	49.17 A	0.632 A	3.879 A	6.356 A
H_2SO_4 levels:					
1	12.60 b	49.91 a	0.632 ab	3.980 a	6.395 bc
2	12.38 b	50.85 a	0.624 ab	3.892 a	6.46 bc
3	12.53 b	50.30 a	0.614 b	3.895 a	6.672 b
means	12.47 A	50.25 A	0.624 A	3.892 A	6.51 A

- Averages in the same column having the same small superscript are insignificantly different (P>0.05).
- Means in the same column having the same capital superscript are insignificantly different (P>0.05).

Table 3. The effect of acidification on egg traits parameters.

Treatments	EN	YW	AW	SW	ST
Basal	50.43	32.49	53.95	13.56	0.348
HCl levels :					
1	50.72	32.60	54.36	13.04	0.357
2	50.07	33.26	53.62	13.12	0.360
3	44.40	33.29	53.01	13.70	0.345
mean	50.23	33.05	53.66	13.20	0.354
H_2SO_4 levels:					
1	49.50	33.19	53.98	12.83	0.350
2	44.29	33.61	53.36	13.03	0.351
3	49.87	32.94	53.49	13.19	0351
mean	49.55	33.24	53.61	12.99	0.351

- As reported below Table 2.

Table 4. Effect of acidification on egg fertility and hatchability.

Treatments	Fertility %	Hatchability %	
		Total eggs	fertile eggs
Basal	90.06	70.36	78.14
HCl levels :			
1	91.27	69.79	78.14
2	91.67	76.50	76.46
3	93.00	76.14	83.48
mean	91.98	74.14	79.36
H2SO4 levels:			
1	87.87	73.56	82.19
2	90.73	75.48	83.10
3	87.18	74.18	80.58
mean	88.59	74.4	81.96

- As reported below Table 2.

REFERENCES

1. Amy, L.I. and W.W Park. 1989. Feed additives reduce salmonella on processed broilers. Feedstuffs, October, 16: 12 .

2. Cave, N.A.G. 1984. Effect of dietary propionic and lactic acids on feed intake by chicks. Poul. Sci., 63: 131-134 .

3. Miller, B.F. 1987. Acidified poultry diets and their implications for poultry industry. Biotech. in feed industry. Allteh, Inc, Nicholasille.

4. Mahmoud T.H., Y.H. Madkour, I.F. Sayed and K.M. Harrirah. 1974. Matrouh "new breed of chicks. Agric. Res. Rev., 52: 87-96 .

5. National Research Council (NRC). 1994. Nutrient Requirement of Domestic animals. Nutrient Requirement of poultry. 9th ed, Revised.

6. Pritzl, M.C. and E.W. Kienholz. 1973. The effect of hydrochloric, sulfuric, phosphoric and nitric acids in diets for broiler chicks. Poul. sci., 52: 1979-1981.

7. Ronse, J., A. Rolow and G.E. Nelson. 1988. Research Note: Effect of chemical treatment of poultry feed on survival of salmonella. Poultry sci., 67: 1225-1228.

8. Statistical Analysis System (SAS). 1987. SAS Users Guide, Statistics SAS Institute Inc. Cary, NC.

9. Stuart, J.C. 1984. Agriculture group symposium : Prospects for the control of salmonella in poultry industry. J. Sci. Food Agric., 35: 632-639.

10. Younis, T.M. 1987. Effect of feed additives on broiler performance. Thesis Ph. D., El-Azhar Univ., Fac. Agric., Cairo .

تحميض علائق الدجاج البياض بالأحماض الغير عضوية

جابر أحمد محمد عبد الله، أحمد حسين عبد المجيد ، مصطفى يوسف عطية،
مرفت على بريقع، حمدى محمد فائق

معهد بحوث الانتاج الحيوانى- مركز البحوث الزراعية - جيزة - مصر.

أجريت تجربة باستخدام ٢١٠ دجاجة بياض، ٢١ ديك ربابة مطروح غذيت على ٧ معاملات لمدة ١٢ اسبوعا من عمر ٢٤ حتى ٣٦ اسبوعا لدراسة تأثير تحميض علائق الدجاج البياض بواسطة حمض الهيدروكلوريك او الكبرتيك على الاداء الانتاجى ومواصفات البيضة والخصوبه والفقس. وقد كانت هذه المعاملات كما يلى: عليقة اساسية (غير محمضة) عليقة اساسية يضاف لها ٠,٢١٪، ٠,٤٢٪، ٠,٨٤٪ حمض هيدروكلوريك أو ٠,٦٪ ، ١,٢٪ ، ٢,٤٪ حمض كبرتيك.

أوضحت النتائج عموما ان التحميض لم يسبب نفوقا أو إسهالا أو جفافا كما أنه لم يحدث تأثيرا سلبيا على استهلاك العلف. وقد كان واضحا ان الدجاج يتحمل التحميض بمستويات حمض الهيدروكلوريك تصل الى ٠,٨٤ ٪ وحمض كبرتيك تصل الى ٢,٤٪.

من ناحية اخرى أثر المستوى الأول من حمض الهيدروكلوريك (٠,٢١ ٪) وحمض الكبريتيك (٠,٠٦ ٪) واللذان يكافئان ٠,٠٦ مول/كجم علف تحسنا فى معامل التحويل الغذائى قدره ٢٤,٤٪ ، ١٦,٨٪ على التوالى، إلا أن هذه المعاملات والمعاملات الاخرى لم تظهر تأثيرا معنويا على مواصفات البيضة او نسبة الخصوبة والفقس.