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URIC ACID CONCENTRATION IN BLOOD SERUM AND SOME ORGANS OF BROILERS AS AFFECTED BY FEEDING ALL-PLANT PROTEIN VERSUS ANIMAL- PROTEIN DIET

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ABSTRACT

The present work presents a study on the effect, of feeding broiler chickens on feeds supplemented with animal proteins sources compared to those fed on all plant protein diets, on the uric acid (UA) concentration in blood and some organs.

Serum UA showed the highest level, i.e. 11.98 mg/dl in broilers fed on meat and bone meal (MBM), followed by those fed on fish meal supplemented diet (F.M.) i.e. 10.88 mg/dl. The lowest UA value was obtained by those fed on all plant protein diet (PP), being 4.8 mg/dl. Liver UA concentration in birds fed FM and MBM were respectively 6.6 and 7.5 times those fed on PP diet. U.A. concentration in kidney of broiler fed on FM or MBM was almost 10 times that of birds fed on PP diet. With breast meat, thigh meat, skin and joints, UA concentrations were high in chicken fed on FM, MBM diets than those fed on PP diet. It is concluded that all- plant- protein diet produced chicken meat with low level of uric acid.

INTRODUCTION

Uric acid, in higher primates (e.g humans, apes,…) is essentially the end product of purine breakdown (mainly in the liver). In poultry, however U.A. is the main end product of nitrogen metabolism (Hartman, *et al.,* 2006).

In humans, gout is a disease caused by increased levels of uric acid mainly in joints due to U.A. precipitation as sodium urates. In general, elevated levels of U.A. in humans may result after ingestion of diet composed of animal protein sources rich in nucleic acid and purine(shell-fish, liver,. etc.).

In poultry, nitrogen metabolism end products are essentially U.A. so it may be believed that there is no problem of hyperuricemia. Also poultry may have gout mainly as visceral. This is caused by renal failure and the deposition of urate crystals, mainly, in joint and tendon sheaths (Siller 1981).

Miles and Featherston (1974) found that plasma uric acid level is an accurate method for determining the nutrition suitability of protein (in other words amino acid make up and balance) to the bird's requirements. The increase in U.A. production may be an indicator of breaking down of amino acids due to amino acid imbalances in dietary protein (O' Dell *et al.,* 1960).

Accordingly increased serum U.A., without any disease in poultry may be reasoned to one of the followings:

- Foods rich in nucleic acid (N.A.) and purins.
- Imbalances in the amino acid make up of the dietary protein.
- Protein level increase over that required.
- These three reasons are also hold true in human being.

The Regional Center for Food and Feed (RCFF), started research work on the production of broilers all-plant-protein diets (Akila *et al.,* 2004). Broiler meat produced under such regiments was preferable in taste. This encouraged the RCFF to produce broilers on commercial scale using all-plant-protein diets.

The local demand on the broiler meat production exceeded expectation especially for ARC personnel.

Therefore the present work was planned to study and compare feeding chicks on all- plant protein diet versus fish or meat and bone meal supplemented diets on the content of U.A. (which is mainly an end product of purins) in blood and some body tissues.

MATERIALS AND METHODS

The present work was planned to study the uric acid concentration in some broiler chickens' organs as affected by feeding on all –plant- protein diets, compared to those supplemented with animal protein source, i.e. fish meal or meat and bone meal, when the three diets were enriched with either vegetable oil or poultry fat.

The experimental work was carried-out at the Poultry Nutrition Section of the Regional Center for Food and Feed (RCFF) Agric. Res. Center, Egypt.

With three regiments (1-3), six treatments having six replicates each (11 chicks/ replicate), a total of 396 unsexed, day old Cobb broiler chicks were used.

The plan of the present work was as follows:

Regiment 1(Reg. 1): Tr.-1A: all plant protein diet+ vegetable oil
Tr.-1B: all plant protein diet+ poultry fat
Regiment 2(Reg. 2): Tr.-2A: fish meal supp. diet + vegetable oil
Tr.-2B: fish meal supp. diet + poultry fat
Regiment 3(Reg. 3): Tr.-3A: meat and bone meal supp. diet + vegetable oil
Tr.-3B: meat and bone meal supp. diet + poultry fat

Diets were formulated to satisfy the nutrition requirements (Table 1) for each growing stage as recommended by the Cobb management guide.

Samples:

At 38 days of broiler age, when the average body weight of birds exceeded 1500g, which is suitable for market size, birds were fasted for 12 hrs. Twelve birds, having the average body weight of the treatment (2 birds/ replicate), were slaughtered, with a total of 72 chicksens.

Blood samples were collected from 6 birds per treatment (one bird/ replicate).Serum was separated from each sample and stored at -18◦C until analysis.

Samples of organs and tissues (freed from bones), i.e., breast, thigh, kidney, liver, joints and skin were taken from slaughtered birds (12 samples for each). The 12 samples of each organ or tissue were homogenized and minced, then kept in a deep freez at -18◦C until they were subjected to uric acid determination.

Uric acid determination:

Serum uric acid was determined, after being thawed, according to the uricase-POD enzymatic colorimetric method (Fossati 1980).

For the determination of uric acid in organs and tissues samples, after thawing, were extracted with 5% meta-phosphoric acid (Mark and Stanly, 1987) then filtered. Two determinations of uric acid were carried out in the filtrate for each organ or tissue, using Fossati (1980) technique.

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RESULTS AND DISCUSSION

Table 2 presents the serum uric acid (SUA) concentration in the three regiments under study. Birds of the first regiment, fed on all- plant protein diet, supplemented with either vegetable oil or poultry fat gave an average concentration of 4.80 and 4.83 mg/ dl, SUA for treatment 1A and 1B respectively. Both treatments have almost the same uric acid concentration indicating that fat sources had no effect of the serum uric acid level.

When birds were fed on fish meal supplemented diets, in the 2nd regiment, the uric acid values in blood serum were on average 10.20 and 10.33 mg/dl for chicks fed on diets enriched with vegetable oil or poultry fat respectively. The results show that no effect was noticed for the source of fat.

Chicks fed on diets supplemented with meat and bone meal, showed the highest SUA values of the three studied regiments. The source of fat seems to have no effect on SUA. The averages of SUA were 11.88 and 11.98 for diets with vegetable oil or poultry fat respectively.

From the forgoing discussion it is apparent that SUA concentration was affected by the source of protein. The lowest SUA concentration was encountered by all-plant- protein- diet fed chicks (4.82mg/dl), followed by those fed on fish meal supplemented diets, as they gave an average of (10.27 mg/dl). The highest SUA concentration was reported by chicks fed the meat and bone meal supplemented diets (regiment 3) being 11.93 mg/dl.

Table (2): Serum uric acid (mg/dl) in chicken

Samples	Serum uric acid levels (mg/dl)					
	1A	1B	2A	2B	3A	3B
1	6.00	4.53	10.31	10.71	11.17	11.19
2	5.56	4.96	10.61	9.87	12.38	12.21
3	4.15	4.46	9.71	10.58	11.15	11.77
4	4.83	4.61	10.52	10.94	12.31	12.92
5	4.58	4.32	10.77	10.48	11.80	11.18
6	4.26	6.10	9.38	9.41	12.48	12.61
Range	4.15-6.00	4.32-6.00	9.38-10.77	9.41-10.94	11.15-12.48	11.18-12.61
Mean	4.80	4.83	10.20	10.33	11.88	11.98

*** See foot note table 1**

Effect of feeding different regiments on uric acid (UA) content in some chicks' organs or tissues:

a- Effect on liver

Chicks fed on rations composed of all-plant-feedstuffs, (regiment 1), showed the lowest concentration of uric acid (Table 3) in their livers. Supplementing feed with fish meal (Reg.2) resulted in increased U.A. in liver to 0.525-0.530 µ mol/g, almost 5 times that of Reg 1. When meat and bone meal were supplemented to broiler feed (Reg 3), U.A. in liver increased almost 6 times as that in Reg1.

b- Effect on kidney

The lowest concentration of U.A. in kidney (Table 4) was shown by chicks under regiment 1, ranged between 0.050-0.060 µmol/ g. Supplementing feed with animal protein sources resulted in increased U.A. concentration almost 10 times.

Table (3): Effect of feeding different regiments on the concentration of U.A. in liver

Treatment	(µmol/g) Determination value		Average
	1	2	
Regiment 1			
Tr. 1-A	0.090	0.070	0.080
Tr. 1-B	0.100	0.090	0.095
Regiment 2			
Tr. 2-A	0.520	0.539	0.525
Tr. 2-B	0.520	0.540	0.530
Regiment 3			
Tr. 3-A	0.590	0.600	0.595
Tr. 3-B	0.611	0.600	0.606

Table (4): Uric acid concentration in chick's kidney fed on different protein sources

Treatment	(µmol/g) Determination value		Average
	1	2	
Regiment 1			
Tr. 1-A	0.040	0.060	0.050
Tr. 1-B	0.070	0.050	0.060
Regiment 2			
Tr. 2-A	0.489	0.493	0.491
Tr. 2-B	0.511	0.500	0.505
Regiment 3			
Tr. 3-A	0.530	0.550	0.540
Tr. 3-B	0.540	0.560	0.550

c-Effect on breast meat

Breast meat is the most important and expensive (price wise) in processed chickens. Breast meat in the present work has the lowest U.A. level (Table 5) compared to all other edible organs or tissues under study. Breast meat of chicks grown on all-plant-protein-diet gave the lowest U.A. concentration, averaged in 0.0265 µmol/g. Diets containing fish meal or meat and bone meal gave higher U.A. concentration being 7.2 and 10.9 times that of birds fed on the plant protein diet, respectively.

Table (5): The effect of feeding plant proteins versus animal protein on concentration of U.A. in breast meat

Treatment	(µmol/g) Determination value		Average
	1	2	
Regiment 1			
Tr. 1-A	0.025	0.027	0.026
Tr. 1-B	0.026	0.028	0.027
Regiment 2			
Tr. 2-A	0.188	0.190	0.189
Tr. 2-B	0.190	0.194	0.192
Regiment 3			
Tr. 3-A	0.270	0.290	0.280
Tr. 3-B	0.290	0.310	0.300

d- Effect on thigh meat:

The U.A. concentration in thigh meat (Table 6) took almost the same trend as those of breast meat. Very low values of U.A. were recorded when

birds were fed on all plant protein diet. Supplementing diets with animal proteins, i.e. fish or meat and bone meal increased U.A. concentration up to 7.9 and 13.3 times those reported for chicks fed on plant protein diet.

It should be noted also than in general the U.A. values of breast meat under the three regiments were lower that those of thigh meat. It is more clear in regiment 2 and 3, where U.A. concentrations were 1.5 and 1.4 times higher respectively than those of breast meat.

Table (6) : Thigh meat U.A. concentration as affected by 3 feed regiments

Treatment	(µmol/g) Determination value		Average
	1	2	
Regiment 1			
Tr. 1-A	0.030	0.028	0.029
Tr. 1-B	0.030	0.033	0.030
Regiment 2			
Tr. 2-A	0.281	0.298	0.289
Tr. 2-B	0.280	0.301	0.291
Regiment 3			
Tr. 3-A	0.389	0.410	0.399
Tr. 3-B	0.391	0.430	0.410

e-Effect on skin

The U.A. values found in the skin (Table 7) tended to follow the trend of other studied organs or tissues, i.e., regiment 1 gave the lowest U.A. values followed by regiment 2 then 3.

Table (7): Changes in U.A. concentration in skin of chicks fed different regiments 3 feed regiments

Treatment	(µmol/g) Determination value		Average
	1	2	
Regiment 1			
Tr. 1-A	0.018	0.020	0.019
Tr. 1-B	0.025	0.020	0.023
Regiment 2			
Tr. 2-A	0.176	0.188	0.182
Tr. 2-B	0.180	0.191	0.185
Regiment 3			
Tr. 3-A	0.240	0.260	0.250
Tr. 3-B	0.260	0.280	0.270

f- Effect on joints

The concentration of uric acid in joints (Table 8) showed some changes in the pattern reported in other studied organs or tissues. While regiment 1 gave the lowest U.A. concentration the differences between U.A. concentration in joints of chicks fed regiment 2 and 3 was very small, almost negligible.

It is apparent that the highest U.A. concentration in the studied organs and tissues was shown in the liver. Low concentration of uric acid was recorded in chicken's organs receiving all-plant- protein diet regiments. The

source of fat did not affect positively the U.A. concentration. Regiments with animal protein supplement showed higher values for U.A. Meat and bone meal supplementation was the highest in that respect.

Table (8): Chicks' joint U.A. concentration as affected by different regiments

Treatment	(µmol/g) Determination value		Average
	1	2	
Regiment 1			
Tr. 1-A	0.030	0.030	0.030
Tr. 1-B	0.036	0.034	0.035
Regiment 2			
Tr. 2-A	0.435	0.449	0.442
Tr. 2-B	0.440	0.460	0.450
Regiment 3			
Tr. 3-A	0.437	0.452	0.444
Tr. 3-B	0.472	0.480	0.476

Table 9 presents the average weight of liver, kidney and joints of the studied organs. The lowest weights of these organs were encountered with birds fed the 1st regiment, while those fed on meat and bone meal supplemented diets showed the highest weight. The birds followed regiments 2 were in-between.

Table (9): Average weight of liver, kidney and joint for experimental treatments

Treatment	Weight/g		
	Liver	Kidney	joint
1-A	36.26	0.38	1.95
1-B	36.38	0.39	2.00
2-A	37.20	0.48	3.00
2-B	37.26	0.49	3.10
3-A	38.19	0.50	3.30
3-B	38.39	0.52	3.40

From the foregoing discussion, birds of the three regiments were fed on diets having almost the same concentration of protein and energy. The amino acid make up of the experimental diets was almost similar and as recommended by the Cobb Co., accordingly, the uric acid concentration in blood and organs especially in regiment 2 and 3, cannot be due to of the breakdown of amino acids causing unbalanced protein. (Mark and Stanly, 1987). It is, therefore, rational to state that the high uric acid content in blood and organs of regiment 2 and 3 (fed on feeds supplemented with fish meal or meat and bone meal) was originated partly from purines.

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تركيز حامض البوليك (حامض اليوريك) فى سيرم الدم وبعض أعضاء الدواجن المغذاة على غذاء نباتى البروتين بالمقارنة بالدواجن التى تمت تغذيتها على بروتين حيوانى المصدر.

هادى فتحى عباس مطاوع ، زينب خليل العوامرى وأشرف هاشم محمد جمعة
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أجريت هذه التجربة لدراسة تأثير تغذية الدواجن على علائق تحتوى على البروتين الحيوانى بالمقارنة بالدواجن المغذاة على علائق ذات مصدر بروتين نباتى على تركيز حامض البوليك (حامض اليوريك) فى الدم وبعض الأعضاء ومن النتائج التى تم الحصول عليها وجد أن :-

أعلى تركيز لحامض البوليك (١١,٩٨ مللجم/ ديسيليتر) فى الدواجن المغذاة على مسحوق لحم وعظم ، ثم الدواجن المغذاة على مسحوق سمك (١٠,٨٨ مللجم/ ديسيليتر). ووجد أن أقل تركيز لحامض البوليك (٤,٨ مللجم/ ديسيليتر) فى الدواجن المغذاة على بروتين نباتى. وأظهرت النتائج أن تركيز حامض البوليك فى كبد الدواجن المغذاة على مسحوق السمك ومسحوق اللحم والعظم أعلى من الدواجن المغذاة على بروتين نباتى بحوالى ٦,٦ و ٧,٥ مرة ، على التوالى. وكان تركيز حامض البوليك فى كلى الدواجن يزيد عشرة أضعاف عن الدواجن المغذاة على بروتين نباتى. ووجد أن تركيز حامض البوليك فى لحم الصدر، الأوراك ، الجلد والمفاصل فى الدواجن المغذاة على مسحوق السمك ومسحوق اللحم والعظم أعلى من الدواجن المغذاة على بروتين نباتى.

ومن النتائج التى تم الحصول عليها أمكن إستنتاج أن التغذية على علائق ذات مصدر بروتين نباتى ينتج منها لحوم منخفضة المستوى من حامض البوليك (حامض اليوريك).

Table (1): Experimental diets and their calculated composition.

Ingredients	Starter rations						Grower rations						Finisher rations					
	1A	1B	2A	2B	3A	3B	1A	1B	2A	2B	3A	3B	1A	1B	2A	2B	3A	3B
Yellow Corn	58.994	58.804	61.790	61.600	60.410	60.220	63.436	63.166	66.470	66.280	65.000	64.660	63.692	63.149	66.200	65.740	65.065	64.545
Soybean meal 44%	29.200	29.200	25.000	25.000	28.800	28.800	25.000	25.000	21.000	21.000	24.500	24.500	24.260	24.260	20.500	20.500	23.669	23.669
Gluten meal	5.860	5.860	3.339	3.339	2.200	2.200	5.000	5.000	2.000	2.000	1.500	1.500	3.746	3.746	1.000	1.000	0.500	0.500
Meat & bone meal	---	---	---	---	**5.000**	**5.000**	---	---	---	---	**5.000**	**5.000**	---	---	---	---	**5.000**	**5.000**
Fish meal	---	---	**5.000**	**5.000**	---	---	---	---	**5.000**	**5.000**	---	---	---	---	**5.000**	**5.000**	---	---
Vegetable oil	1.609	---	**1.004**	---	**1.726**	---	2.299	---	**1.735**	---	**2.205**	---	3.967	---	**3.435**	---	**3.901**	---
Poultry fat	---	**1.799**	---	**1.193**	---	**1.915**	---	**2.569**	---	**1.925**	---	**2.545**	---	**4.510**	---	**3.895**	---	**4.421**
Di-Ca-P	1.975	1.975	2.040	2.040	0.399	0.399	1.910	1.910	1.980	1.980	0.340	0.340	1.930	1.930	2.000	2.000	0.360	0.360
Limestone	1.142	1.142	0.842	0.842	0.336	0.336	1.110	1.110	0.800	0.800	0.300	0.300	1.100	1.100	0.800	0.800	0.290	0.290
Salt	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400
Choline chloride	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075
Vit & Min mixture	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400
L-Lysine	0.258	0.258	0.074	0.075	0.147	0.147	0.270	0.270	0.090	0.090	0.160	0.160	0.310	0.310	0.120	0.120	0.200	0.200
DL-Meth	0.087	0.087	0.036	0.036	0.107	0.108	0.100	0.100	0.050	0.050	0.120	0.120	0.120	0.120	0.070	0.070	0.140	0.140
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
Calculated values:																		
CP%	21.561	21.546	21.548	21.534	21.362	21.307	19.540	19.522	19.340	19.330	19.463	19.440	18.513	18.470	18.526	18.497	18.538	18.505
ME Kcal/kg	3002	3000	3004	3006	3008	3005	3087	3083	3088	3090	3084	3084	3182	3179	3182	3179	3182	3178

1A: all plant protein diet + vegetable oil **2A: fishmeal supplement diet + vegetable oil**

3A: meat & bone meal diet + vegetable oil **1B: all plant protein diet+ poultry fat**

2B: fishmeal supplement diet + poultry fat **3B: meat & bone meal diet + poultry fat**

***Vitamin-mineral mixture supplied per kg of diet: Vit A=12000 IU; Vit D3= 2000 IU; Vit E=10mg; Vit K3=2mg; Vit B1=1mg; Vit B2=5mg; B6=1.5mg;VitB12=10µg; Biotin=50µg; Choline chloride=500mg; Pantothenic acid=10mg; Niacin=30mg; Folic acid=1mg; Manganese=60mg; zinc=50mg;Iron=30mg;Copper=10mg;Iodine=1mg; Selenium=0.1mg and Cobalt=0.1mg.**