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COMPARATIVE STUDIES ON GARLIC BULB, VIRGINIAMYCIN, COPPER SULFATE AND CITRIC ACID AS GROWTH PROMOTERS IN BROILER CHICKS DIET.

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ABSTRACT

The present study aimed to investigate the efficacy of garlic bulb as natural antimicrobial agents in improving the performance of broiler chicks compared to that of other antimicrobial growth promoters, virginiamycin, copper sulfate and citric acid. The effect on small intestine thickness, pH value of ileal content, some blood constituents and some internal organs were also, examined.

One hundred and fifty unsexed day old Arbor Acres broiler chicks were fed on basal diet supplemented with 150 mg/kg copper sulfate, 20 mg/kg virginiamycin, 6 g/kg citric acid or 15g/kg garlic bulb, while the fifth group was fed the control basal diet.

The result indicated that, average body gain was improved by 13%, 15%, 13% and 6% due to adding copper sulfate, virginiamycin, citric acid or garlic bulb to the diets respectively. Feed consumption values were significantly affected by including copper sulfate, virginiamycin or citric acid to the broiler diets. Feed efficiency ratio wasn't affected significantly by feeding diets supplemented with the different feed additives, however virginiamycin-supplemented diet tend to enhance feed efficiency ratio. Small intestine thickness didn't respond to different antimicrobial growth promoters. Bursa and spleen weights were positively affected by different dietary treatments. Both of citric acid and garlic bulb have a lowering effect on pH value of ileal content. Plasma cholesterol and total lipid decreased significantly due to feeding dietary copper sulfate or garlic.

The values of plasma total protein, albumin and globulin were not affected by different treatments.

It can be concluded that, garlic bulb is less effective than the other three growth promoters in promoting chicks growth. Virginiamycin, copper sulfate and citric acid have approximately the same effectiveness in improving poultry growth.

Kaywords: Growth promoters - Virginiamycin – Garlic – Copper sulfate – Citric acid – Broiler chicks diet – Body weight gain – Ileal pH – Cholesterol.

INTRODUCTION

The role of antibiotics, copper sulfate, organic acid and garlic bulb in improving the performance of broilers has been well documented. Mode of action of these growth promoters has received much attention.

In this connection, antibiotics have been used to improve the growth rate and feed efficiency of chicks (Braude *et al* 1953, Eyssen and De Somer 1967). Addition of virginiamycin to broilers chick diets improved body weight and feed efficiency (Miles et al 1984, Leeson 1984) Antibiotics stimulate the growth by eliminating undesirable microorganisms that irritate and increase the thickness of the intestine and as a result, decrease the absorption of nutrients (Stutz, *et al* 1983). Similarly copper sulfate has been established as growth promoter for poultry due to its bacteriostatic properties (Scott, *et al* 1982). Pesti and Bakalli (1996) stated that, broilers chick growth was improved by 4.9% due to adding 125mg/kg copper sulfate to the diet.

Citric acid (one of organic acids) supplementation to the diets promotes the growth of broiler chicks (El-Afifi, *et al* 2001). Citric acid addition had a

lowering effect on pH value of small intestine and thereby reducing the number of pathogenic coliforms bacteria, which is partly responsible for malabsorption syndrome (Tortuero, 1973).

Recently, much attention has been focused on garlic as a natural growth promoter for broiler chicks. El-Nwawy (1991) and El-Afifi (1997) reported that, garlic-supplemented diets enhanced the growth rate and feed efficiency of broiler chicks. The growth promoting effect of garlic was attributed mainly to its content of antimicrobial agent allicin (El-Afifi 1997, Ali *et al* 2000).

Because garlic bulb possess' antimicrobial properties, it is frequently suggested to function in a manner similar to that of antibiotics, copper sulfate and organic acids. Therefore, the current study aimed to investigate the efficacy of garlic compared to that of virginiamycin, copper sulfate and citric acid in improving the performance of broiler chicks. As well to study the effectiveness of these growth promoters in enhancing the growth of broiler chicks under same conditions of rearing of birds and same diet. Their effect on some internal organs, blood constituents and small intestine thickness also, were examined.

MATERIAL AND METHODS

The current study was carried out in poultry experimental laboratory, of the Poultry Production Department, Faculty of Agriculture Ain-Shams University. In this study, two diets were formulated (Table 1) to meet the nutrient requirements of broiler chicks during the starter (0-3 wks.) and grower (3-5 wks.) period according to NRC(1994).

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

Ingredients	Starter diet 0-3 Wks. (%)	Grower diet 3-5 Wks %
Yellow corn	54.5	59.65
Soybean meal (44%)	30.15	32.50
Corn gluten meal	8.00	1.00
Vegetable Oil	3.5	3.50
Bone meal	3.0	2.70
Premix*	0.3	0.30
Common salt	0.25	0.25
Dl-Methionine	0.2	0.10
Lysine	0.1	---
Total	**100**	**100**
	Calculated analysis	
ME (kcal/kg)	3065	3069
Protein %	22.9	20.0
Calcium %	0.98	0.90
Av. Phosphorus %	0.49	0.48
Meth. + Cyst %	0.98	0.76
Lysine %	1.13	1.04

***Vitamins and minerals Premix: each 1kg of supplied the following per kilogram of diet; vit. A; 5500 Iu, vit. D_3; 1100 Iu, vit E 11 IU, vit B_{12} 6.6 mg, vit B_2 4.4 mg, Choline chloride 220 mg, Copper 3mg, Iron 30mg, Manganese 40mg, Zinc 45mg, and Selenium 3mg.**

The basal diets were supplemented with 15g/Kg garlic bulb (on dry matter basis), 150 mg / Kg copper sulfate, 20mg / Kg virginiamycin or 6g/kg citric acid while the fifth diet was represented the control basal diet.

One hundred and fifty unsexed day old Arbor Acres broiler chicks were used in this experiment. The chicks were wing banded and randomly allocated into five treatments of 30 chicks each. Each treatment was divided in three battery cages with 10 chicks to represent three replicate groups.

Electrical heaters were used and artificial lighting was provided constantly throughout the experimental period. Water and mash feed were provided ad lib.

The five weeks experimental period were divided into two stages, first from 0 to 3 weeks and second stage from 3 to 5 weeks. Weekly body weight in grams were recorded for each chick and average body weight gain was calculated for each replicate and treatment group either at week intervals or cumulative for each stage of growth. Feed consumption in grams was recorded weekly for each replicate and treatment group and calculated cumulatively for the two stages of growth. Feed efficiency ratio was calculated for the two stages as number of grams feed per gram gain.

Slaughter traits.

At the end of the first and the second stage, two birds of each replicate representing the average group weight, were slaughtered, allowed to bleed, defeathered, eviscerated and internal organs were separated. Liver, spleen and bursa of fabricius weights were recorded. Ileal content samples were collected and pH value was determined by using pH-meter.

Small intestine thickness.

Small intestine thickness was used as an indicator to the effect of the tested growth promoters on microorganisms' populations in eliminatory canal. Small intestine thickness was determined as the procedures described by Stutz *et al* (1983) and calculated as small intestine weight (g) / small intestine length (cm.).

Chemical analysis and blood parameters.

Blood samples were collected in a centrifuge tubes with EDTA and centrifuged immediately for 15 minutes to separate plasma that was decanted and frozen up to chemical analysis. Plasma total protein was determined according to Biuret method described by Henery (1964) and albumin was estimated according to Doumas *et al* (1972). Plasma globulin was obtained by subtracting albumin values from total protein values. Plasma total lipid was determined according to Knight *et al* (1972) and total cholesterol according to Watson (1960).

Statistical analysis.

Statistical analysis was computerized by statistical program SAS (1988). Duncan's multiple range tests were used to detect significant differences between means.

RESULTS AND DISCUSSION

1-Body weight gain.

The results of body weight gain of broiler chicks are shown in (Table2). It can be seen that, adding copper sulfate, virginiamycin, citric acid or garlic

bulb into broiler chicks' diets enhanced the final body weight gain by 13%, 15%, 13% and 6% respectively. This result is well accepted because these additives have been established as effective growth enhancers. Eyssen *et al* (1962) reported that, addition of 20mg/kg virginiamycin to the broiler diets, improved body weight gain by 22%. Fisher (1973), and Pesti and Bakalli (1996) observed an increase in body weight of broiler chicks fed copper sulfate-supplemented diet.

Table (2): Effect of feeding different growth promoters on average body weight gain at weeks intervals and cumulatively.

Additives	Age in weeks						
	(0-1)	(1-2)	(2-3)	(0-3)	(3-4)	(4-5)	(0-5)
	Body Weight Gain (g)						
Copper sulfate	76^{a}±1.0	180^{a}±5.8	328^{a}±8.4	585^{a}±14.8 **(122%)**	326^{a}±8.6	372±39 9	1282^{a}±54.8 **(113%)***
Virginiamycin	78.6^{a}±3.1	191.4^{a}±7.3	324^{a}±8.4	595^{a}±12.8 **(124%)**	327^{a}±8.4	387±12.3	1309^{a}±31.3 **(115%)**
Citric acid	73^{ab}±2.3	179^{a}±5.2	326^{a}±7.7	578^{a}±11.0 **(121%)**	308^{ab}±9.1	395±8.5	1281^{a}±23.9 **(113%)**
Garlic bulb	67^{b}±2.1	150^{b}±5.1	313^{a}±6.4	530^{b}±9.2 **(111%)**	321^{ab}±10	354±13.2	1205^{ab}±19.0 **(106%)**
Control	53^{c}±3.5	137^{b}±7.7	288^{b}±11.2	478^{c}±17.0 **(100%)**	298^{b}±9.7	361±15.0	1137^{b}±36.0 **(100%)**

Means ± STD Error.

a -b within columns, means with no common superscripts differ significantly ($p \leq 0.05$).

***( ) The values as percentage to control**

El-Afifi *et al* (2001) recorded an enhancement in body gain of broiler chicks by incorporating citric acid in their diets. El-Nwawy, (1991) and El-Afifi (1997) observed an improvement in body weight gain of broiler chicks by feeding diets supplemented with garlic bulb.

Also, the results indicated that copper sulfate, virginiamycin, and citric acid have approximately equivalent effectiveness in promoting chicks' growth (13%, 15% and 13% respectively). This result is in harmony with those stated by King (1972), and Scott *et al* (1982) that copper sulfate was effective as antibiotics in enhancing poultry growth. Johri *et al* (1987) reported that, addition of propionic acid (one of organic acids) had the same effective as copper sulfate in promoting the growth of chicks fed moldy or non-moldy diets.

As well as, garlic bulb was less efficacious in improving body weight of broiler chicks than the other three additives copper sulfate, virginiamycin and citric acid (6% vs. 13%, 15% and 13%). That may be due to garlic bulb as a natural growth promoter contains only 0.03% of antimicrobial agent, allicin (Sandl and Wagner, 1991) with other fibrous and water contents. While, the other three additives considered as pure active antimicrobial substances, thereby they are more effective than garlic bulb in enhancing broiler growth. The antimicrobial principle of garlic, allicin, has antimicrobial activity equivalent to 1% penicillin (El-Afifi, 1997).

2- Feed consumption.

Feed consumption values (Table 3) for the entire experimental period (0-5 weeks) were significantly affected by adding copper sulfate, virginiamycin, or citric acid to the diets of broiler chicks.

This result is partly in harmony with Stahly *et al* (1980) who noticed that dietary inclusion of supplemental copper sulfate or virginiamycin increased feed consumption of weanling pigs.

The result of citric acid disagreed with those obtained by El-Afifi *et al* (2001) who reported that dietary supplementation of citric acid had no effect on feed consumption value. This could be due to different raising conditions of the birds in the two experiments.

Table (3): Effect of feeding different growth promoters on feed consumption and feed efficiency ratio of broiler chicks.

Additives	Feed consumption. (g)		Feed efficiency (g feed/g gain)	
	(0-3) Weeks	(0-5) Weeks	(0-3) Weeks	(0-5) Weeks
Copper sulfate	$820^{a}\pm12$	$2125^{a}\pm15$	$1.40^{ab}\pm0.02$	1.65±0.01
Virginiamycin	$803^{a}\pm10$	$2089^{a}\pm21$	$1.35^{b}\pm0.02$	1.60±0.02
Citric acid	$807^{a}\pm13$	$2109^{a}\pm18$	$1.40^{ab}\pm0.01$	1.64±0.04
Garlic bulb	$755^{b}\pm11$	$1957^{b}\pm33$	$1.41^{ab}\pm0.03$	1.62±0.01
Control	$685^{c}\pm3.0$	$1850^{b}\pm26$	$1.43^{a}\pm0.02$	1.63±0.04

Means ± STD Error.

a -b within columns, means with no common superscripts differ significantly ($p\leq0.05$).

3- Feed efficiency ratio.

The values of feed efficiency ratio (Table 3) were not affected significantly by supplementing the diets with different antimicrobial feed additives. However, virginiamycin-supplemented diet tends to improve feed efficiency ratio, furthermore, it recorded a significant improvement at the first stage of growth (0-3 weeks). This result is in agreement with those obtained by Miles *et al* (1984), Leeson (1984) that, virginiamycin supplemented diet improve feed efficiency of broiler chicks.

The result of feed efficiency ratio of citric acid confirms the result of Brown and Lee (1985) who didn't find any effect on feed efficiency ratio due to feeding diets supplemented with citric acid. Concerning feed efficiency results of copper sulfate and garlic bulb, Konjufca *et al* (1997) stated that, the incorporation of neither garlic nor copper sulfate in the diets affected feed efficiency of broiler chicks.

Effect on small intestine thickness.

The thickness of intestinal wall is considered as a good indicator for the number of microbial populations in intestinal lumen. The presence of undesirable bacteria may induce a chronic inflammation, resulting in a thickening of the intestinal wall (Krinke and Jamroz, 1996).

The small intestine thickness (g. weight/ cm. length) wasn't affected by adding different antimicrobial feed additives to the broiler diets (Table 4) and the results lacked significance at the final stage of experimental period (0-5 weeks).

These results didn't agree with those obtained by the previous studies on antimicrobial growth promoters, who reported that, small intestine wall thickness can be reduced by adding copper sulfate (King ,1972), virginiamycin (Stutz and Lawton ,1984) or garlic bulb (El-Afifi ,1997). On the other hand the lacking effect of citric acid on small intestine thickness was in a good agreement with the results of Waldroup *et al* (1995) and El-Afifi *et al* (2001) who stated that, small intestine thickness was not affected by feeding dietary organic acids.

Table (4): Effect of feeding different growth promoters on small intestine thickness and weight of liver, spleen and bursa of slaughtered chicks at 3 and 5 weeks of age.

Additives	Liver	Spleen	Bursa	*Sm. Intes. Thick. g. /cm.
	At 3 weeks of age			
Copper sulfate	$22.8^{a}\pm1.6$	$0.63^{ab}\pm0.03$	$1.8^{ab}\pm0.13$	$0.104^{b}\pm0.001$
Virginiamycin	$20.1^{a}\pm1.5$	$0.88^{a}\pm0.14$	$1.7^{ab}\pm0.31$	$0.107^{ab}\pm0.002$
Citric acid	$21.2^{a}\pm1.7$	$0.73^{ab}\pm0.14$	$1.93^{a}\pm0.09$	$0.114^{ab}\pm0.006$
Garlic bulb	$21.3^{a}\pm1.4$	$0.66^{ab}\pm0.09$	$1.50^{ab}\pm0.11$	$0.116^{a}\pm0.005$
Control	$15.2^{b}\pm1.3$	$0.40^{b}\pm0.04$	$1.30^{b}\pm0.29$	$0.109^{ab}\pm0.003$
	At 5 weeks of age			
Copper sulfate	$30.4^{a}\pm2.0$	1.67±0.16	3.25±0.48	0.103±0.006
Virginiamycin	$28.8^{ab}\pm1.0$	1.33±0.17	2.07±0.23	0.093±0.005
Citric acid	$31.3^{a}\pm3.1$	1.52±0.11	2.13±0.32	0.095±0.007
Garlic bulb	$27.4^{ab}\pm0.8$	1.77±0.14	2.45±0.23	0.104±0.004
Control	$23.8^{b}\pm0.69$	1.37±0.06	2.00±0.31	0.101±0.004

Means ± STD Error.

a -b within columns, means with no common superscripts differ significantly ($p\leq0.05$).
***Small intestine thickness = small intestine wt. (g) / small intestine length (cm.).**

Effect on spleen, bursa and liver weight.

Both of bursa and spleen weights (Table 4) were positively affected by adding copper sulfate, virginiamycin, citric acid or garlic bulb into broiler diets. These results confirmed the results of the previous studies, which indicated that; bursa and spleen weights were increased by feeding different antimicrobial agents, antibiotics (Dafwang *et al.* ,1985), garlic bulb (El-Afifi ,1997). Dafwang *et al.* (1985) demonstrated that, the increase in bursa and spleen weight may reflect an improvement in chicks' immunity due to feeding antimicrobial agent.

Absolute liver weight increased significantly by feeding different antimicrobial growth promoters. The increment in liver weight may be related to the proportional increase in body weights of growth promoters feeding groups.

Effect on ileal pH.

The pH values of ileal content were illustrated in Table (5). It is evidence that, the pH value of ileal content were significantly reduced by adding citric acid into diet. Burnell *et al* (1988) reported that, supplementation of citric acid into diet lowered the pH value in small intestine. The reduction in ileal pH may be responsible for promoting the growth of broiler chicks due to its modification effect on microbial populations in intestinal lumen (Patten and Waldroup, 1988). Also, the ileal pH value of garlic feeding group was significantly lower at the first stage of experiment (0-3weeks). This result confirms the result of El-Afifi (1997) who observed a significant reduction in pH value of ileal content by adding minced garlic to the broiler chicks diet.

Neither copper sulfate nor virginiamycin affected pH value of ileal content, this result confirms the result of Leeson *et al* (1997) who reported that, copper sulfate had no effect on pH value of cecal content.

Effect on some blood constituents.

Table (5) included data of blood total cholesterol, total lipid, total protein, albumin and globulin.

It is clear that, plasma cholesterol was reduced significantly by incorporating both copper and garlic bulb (131, 135 vs. 168mg/100ml for the control) to the broilers chick diets.

Table (5): Effect of feeding different growth promoters on ileal pH and some blood constituents of slaughtered chicks at 3 and 5 weeks of age.

Additives	Ileal pH	Cholesterol mg/100ml	Total lipid g/100ml	Total protein g. /100ml	Albumin g/100ml	Globulin g/100ml
	At 3 weeks of age					
Copper sulfate	5.77^{ab}±0.09	117^{b}±14.2	5.70±0.56	3.85±0.22	1.96±0.22	1.89±0.40
Virginiamycin	5.84^{a}±0.02	157^{ab}±2.90	6.85±0.33	3.82±0.24	1.93±0.17	1.89±0.36
Citric acid	5.25^{c}±0.10	148^{ab}±9.70	5.70±0.35	3.73±0.21	1.96±0.05	1.77±0.18
Garlic bulb	5.62^{b}±0.03	137^{ab}±10.4	5.53±0.26	3.92±0.52	1.89±0.14	2.03±0.51
Control	6.00^{a}±0.06	165^{a}±4.90	6.23±0.34	3.50±0.22	1.93±0.19	1.57±0.19
	At 5 weeks of age					
Copper sulfate	5.56^{ab}±0.14	131^{b}±7.7	6.17±0.17	4.35^{a}±0.13	2.17±0.15	2.19±0.24
Virginiamycin	5.63^{ab}±0.05	152^{ab}±9.5	6.92±0.12	3.97^{ab}±0.16	2.07±0.11	1.91±0.21
Citric acid	5.24^{b}±0.11	145^{ab}±6.2	6.20±0.19	3.83^{ab}±0.12	2.00±0.07	1.83±0.14
Garlic bulb	5.41^{ab}±0.10	135^{b}±4.6	6.14±0.39	4.16^{ab}±0.15	1.99±0.06	2.17±0.19
Control	5.83^{a}±0.11	168^{a}±9.2	7.25±0.21	3.70^{b}±0.23	2.02±0.06	1.68±0.26

Means ± STD Error.

a -b within columns, means with no common superscripts differ significantly ($p \leq 0.05$).

Virginiamycin and citric acid didn't affect plasma cholesterol level. Konjufca *et al* (1997) reported that feeding copper sulfate and garlic resulted in lower levels of cholesterol in the plasma.

This reduction in plasma cholesterol of copper sulfate and garlic feeding groups may be related to the reduction of 3hydroxy-3methylglutaryl (HMG-COA) reductase and cholesterol 7α hydroxylase enzyme activities, which are responsible for cholesterol biosynthesis in chicken liver (Konjufca *et al* 1997). Similarly, plasma total lipid values were reduced by adding copper sulfate, garlic bulb and citric acid to the diets. Konjufca et al (1997) stated that the activity of fatty acid synthesis was decreased in birds fed copper sulfate. Qureshi *et al* (1983) observed a reduction in blood total lipid due to adding garlic to the diet. El-Kerdawy (1996) reported that, blood total lipids reduced by including citric acid into rabbits diet.

Plasma total protein, albumin and globulin were not affected by feeding diets supplemented with copper sulfate, virginiamycin, citric acid and garlic bulb. These results didn't agree with those obtained by El-Sherbiny *et al* (1990) who reported that, supplementation of antibiotics to the diet tended to increase plasma total protein, albumin and globulin. El-Afifi *et al* (2001) observed a significant reduction in blood total protein and albumin due to feeding dietary citric acid. Concerning garlic bulb the result obtained confirms the finding of El-Afifi (1997) who didn't find any affect on plasma total protein, albumin and globulin due to feeding garlic.

CONCLUSION

In spite of the findings that, garlic bulb enhance the growth of broiler chicks, but it is still less effective than virginiamycin, copper sulfate or citric acid in promoting broiler chicks' growth.

Virginiamycin, copper sulfate and citric acid have approximately equivalent effectiveness in promoting the growth of broiler chicks.

However, addition of garlic bulb in chicks diet is more effective in lowering blood cholesterol and total lipid compared to virginiamycin and citric acid.

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دراسة مقارنه على الثوم والفرجينياميسين وكبريتات النحاس وحامض الستريك كمنشطات للنمو فى علائق كتاكيت اللحم

شعبان فتوح العفيفى

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أجريت هذه الدراسة بغرض قياس قدرة وكفاءة الثوم كمضاد للبكتريا على تحسين النمو فى كتاكيت اللحم عند إضافتة للعلائق مقارنة بمنشطات النمو الأخرى التى لها نفس ألية التأثير على الميكروبات مثل المضاد الحيوى الفرجينياميسين وكبريتات النحاس وحامض الستريك. كذلك تم دراسة التأثير على سمك جدار الأمعاء ودرجة الحموضة فى الأمعاء وبعض الأعضاء الداخلية فى الكتاكيت كذلك التأثير على بعض مكونات الدم.

أستخدمت الدراسة عدد ١٥٠ كتكوت عمر يوم من سلالة أربرأيكرز حيث قسمت على خمس معاملات وغذيت على عليقة قاعدية مضاف إليها ١٥٠مجم/كجم كبريتات النحاس أو ٢٠ مجم/كجم فيرجنياميسين أو ٦جم/كجم حامض الستريك أو ١٥جم/كم ثوم بينما غذيت المجموعة الخامسة على عليقة كونترول خاليه من أى إضافات.

وقد أشارت النتائج إلى تحسن وزن الجسم بمعدل ١٣? و ١٥? و ١٣? و ٦? عن الكونترول نتيجة للتغذية على علائق تحتوى كبريتات نحاس والفرجينياميسين أوحامض الستريك أو الثوم على التوالى. كذلك تحسن الإستهلاك الغذائى معنويا فى المجاميع المغذاة على كبريتات نحاس أوالفرجينياميسين أوحامض الستريك. ولم يتأثر معدل التحويل الغذائى معنويا

سمك جدار الأمعاء لم يتأثر بإضافة منشطات النمو المضادة للبكتريا بالعلائق بالرغم من أن هذا المقياس يعتبر إحدى الدلالات الهامة على النشاط الميكروبى فى أمعاء الكتاكيت. كان هناك تحسن فى وزن غدة البرزا والطحال نتيجة للمعاملات المختلفة وهذا قد يشير إلى تحسن فى الجهاز المناعى للطيور.

إنخفض معدل الحموضة فى محتويات الأمعاء بإضافة حامض الستريك والثوم للعلائق.

محتوى الدم من الكوليستيرول والليبيدات الكلية إنخفض معنويا نتيجة لإضافة كبريتات نحاس والثوم لعلائق الكتاكيت.

لم يتأثر محتوى الدم من البروتينات الكلية أو الألبيومين أو الجلوبيولين نتيجة المعاملات المختلفة.

أشارت النتائج إلى:-

بالرغم من أن إضافة الثوم أدى لتحسن النمو بمعدل ٦? إلا أنه لايزال أقل كفاءة من المضاد الحيوى الفرجينياميسين وكبريتات النحاس وحامض الستريك فى تنشيط نمو كتاكيت اللحم.

كفاءة الفرجينياميسين وكبريتات النحاس وحامض الستريك كانت متساوية فى تحسن نمو الكتاكيت.

ومن النتائج الواضحه فى التجربة أن الثوم يقلل كولستيرول الدم بكفاءة أعلى بالمقارنه مع الكونترول والفرجينياميسين وحامض الستريك.