EFFECT OF SALKIL AND SALGARD AS ORGANIC ACID –DIETARY SUPPLEMENTS ON PERFORMANCE AND IMMUNE RESPONSE OF CHICKS*

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ABSTRACT

This work was conducted to study the effect of dietary salkil and/or salgard supplementation on viability of feed organisms, productive performance, nutrient digestibility and immune response of broiler chicks.

A total of 80 one-day old Arbor-Acres chicks were randomly allotted into 4 equal groups (20 chicks per each). Chicks of group 1 were fed basal diet (BD) without any supplementation. Chicks of groups 2, 3 and 4 were fed on BD containing 4 g Salkil/kg, 2 g Salgard/kg or 2 g Salkil + 1 g Salgard/kg basal diet, respectively. The results indicated that Salkil product is more efficient bactericidal than salgard in poultry ration and should be mixed with the diet for at least three days before feeding.

At the end of the experimental period (7 weeks), the final body weight, total body gain, daily weight gain, body weight gain % relative to the control group, feed conversion ratio, protein efficiency ratio, relative growth rate and performance index were the best in chicks of group 2 which were received diet supplemented with 4 g Salkil/kg diet (2177.0 g, 2134.91 g, 43.57 g, 108.44%, 2.15, 2.56, 103.70 and 192.44, respectively) when compared to chicks in other groups. Both Salkil and Salgard products had no significant effect on the immune response of broiler chicks against the Newcastle disease vaccine. Blood constituents indicated no significant differences between various chick groups.

It can be concluded that addition of Salkil (4 g/kg basal diet) as bactericide to the used diet of broiler chicks improves their growth performance and nutrient digestibility.

INTRODUCTION

Poultry production in Egypt has become one of the biggest agricultural industries and its improvement is one of the main objectives of both private and public sectors. A major problem in the worldwide industry is the frequency with which Gram negative infections such as *Salmonella, Campylobacter* and *Escherichia coli* are occurring in breeder and grower houses. Cross-infection between groups appears to be mainly through compounded feeding meals. Inhibition of *Salmonella* and other potential pathogen species in the diet will reduce the spread of infection.

Several methods to eliminate *Salmonella* from poultry feeds including pelleting or sterilizing feed components of animal origin before incorporation into feed have been reported by several authors. Heating have resulted in significant reductions in feed contamination (Himathongkham et al., 1996) and Matlho et al., (1997) who reported that a gradual decline of surviving *Salmonella* in the feed, as the heating time increaed feom 0 to 80 sec. While, pelleting does not always ensure destruction of *Salmonella* (McIlory et al., 1989).

Heat treatment systems have been shown to damage vitamin levels and offer no protection against reinfection after treatment. Therefore, several commercial companies and research institutes have been involved in producing of commercial preparations primarily propionic and formic acids to test their efficacy for killing feed organisms and increasing the growth of chicks. The inclusion of formic, propionic and lactic acids into a mixed feed significantly reduced the number of Enterobacteriaceae, when the feed was stored at 20 ^{o}C, formic acid was the most effective in reducing the number (Van der Wal, 1980; Hinton and Linton, 1988 and Prohaszka, 1988). While, Hall et al., (1990) who reported that Salkil failed to reduce the number of viable *Salmonella* organism in poultry feed.

The use of dietary organic acids has shown promise, presumably by altering intestinal microflora without impairing or with promoting growth rate and feed utilization. Gwara et al. (1986) who found that the dietary addition of sodium formate (0.15%) for broiler chicks increased the live body weight, also Driggers et al., (1988). The authors observed that dietary Lupraisl (mixture of propionic acid, ammonium hydroxide and propylene glycol) supplementation at 0.4 and 0.8% gave higher 47 – day weights with no adverse effects on feed utilization. But Izat et al., (1990). They found that live bird performance was not adversely affected by feeding formic acid or calcium formate.

El-Kholy et al., (1994) studied the effect of dietary Salkil (3 Kg/ton) supplementation on broiler performance and reported that Salkil treated group showed significant increase in body weight and feed conversion compared with control one, while Huff et al., (1994) observed that the dietary Mycocarb, propionic acid or calcium propionate supplementation did not show any effect on body weight in broiler chicks. Moreover, the inclusion of formic acid in broiler chick diets improved dry matter digestibility (O'loghoba et al., 1988), but there is no available literature dealing with the effect of organic acids on the immune response of broiler chicks.

The organic acids are difficult to handle, strong reducing agents and caustic to the skin. However, some commercial products are a neutral free-flowing powder that blends easily into feed. Salkil is one of those products and composed of formic acid, ammonium formate, propionic acid and ammonium propionate with is a modified verxite base as a carrier. It is so formulated to release the more effective monomeric firms of the active ingredients, as mentioned in the recommendation book, and is used as a feed bactericidal additive for poultry at the rate of 4 kg/ton diet containing animal protein sources (from Agils, England). Salgard is another product and composed of formic acid, ammonium formate, propioinic acid , ammonium propionate, ammonium and magnesium silicate, anhydrous iron and mycoband which is a mixture of silicon

oxide 60.9%, magnesium oxide 19.5%, potassium oxide 1.3%, sodium oxide 0.5% and aluminum oxide 1.2%, as mentioned in the recommendation book, it is used as a feed bactericidal additive for poultry at the rate of 2 kg/ton diet (from Optivite).

The purpose of this study was to determine the effect of the dietary supplementation of Salkil and/or Salgard on the types and prevalence of Gram negative bacteria in poultry rations, growth performance, nutrient digestibility, some blood parameters and immune response of broiler chicks.

MATERIAL AND METHODS

This work was conducted to evaluate the effect of dietary supplementation of Salkil and/or Salgard on productive performance of broiler chicks.

Birds: A total of 80 one-day old Arbor-Acres chicks were used in this study. They were obtained from Cairo Food Company. The chicks were housed in a clean well-ventilated room provided with electrical heaters to adjust the environmental temperature according to the age of the chicks. The deep letter system was used for bedding the floor. The chicks were vaccinated against Newcastle (NC) disease at 7, 18 and 28 days by Hitchner B_1, Lasota and inactivated NC vaccine respectively and Gumboro disease vaccine at the 14th day of age.

Experimental design and feeding program: The chicks were randomly alloted into 4 equal groups (20 chicks per group) of mixed sex. Each group of chicks received one out of the different experimental diets during the starting and finishing periods (broiler starter-grower diet up to 4 weeks of age, then finisher diet until the end of the experiment at 7th week of age).

Both starter-grower and finisher diets were delivered from the Cairo Food Company. Both diets were composed of yellow corn, soybean meal, corn gluten, broiler concentrate, cottonseed meal, bone meal and mineral & vitamin premix at different percentages. Representative samples were taken from the basal diets for Proximate chemical analysis according to the methods described by AOAC (1985). The Proximate chemical analysis of the basal diets is illustrated in Table (1).

Table (1): Proximate chemical analysis (%) of the used basal diets

Items	Starter-grower diet	Finisher diet
Moisture	10.42	10.05
Crude protein	20.85	17.25
Ether extract	3.1	3.58
Crude fiber	3.2	3.3
Ash	6.2	6.5
Nitrogen free extract	56.23	59.32

The experimental design can be summarized as follows:

Group	Diet	
1	1	Basal diet without any supplement
2	2	Basal diet + 4 g Salkil/kg diet
3	3	Basal diet + 2 g Salgard/kg diet
4	4	Basal diet + (2 g Salkil + 1g Salgard/kg diet)

Measurements:

Bacterial count: The following experiment was carried out to determine the bactericidal efficiency of Salkil and Salgard in poultry feed.

Ten gram samples of starter-grower diet or feed concentrates were placed each in a sterile glass beaker (Pyrex 100 ml); 0.04 g Salkil, 0.02 g Salgard or 0.02 g Salkil + 0.01 g Salgard were added to the feed samples. Basal diet sample was used as a control. After adding the products to the feed samples, they were inoculated with *Bacillus subtillis* to about 16×10^7 bacteria/g. After different incubation periods (0, 6, 24 and 72 hours), one gram of each of the treated feed samples was subjected to total bacterial count. Where it was mixed with 10 ml sterile saline and then subjected to ten fold serial dilutions. One ml from each dilution was poured in 3 Petri dishes. A sterile nutrient agar medium (temperature was adjusted to 45-50 ^{o}C) was poured over the sample and mixed well. The plates were left to solidify and were incubated at 37 ^{o}C for 24 hours. Total bacterial colonies were counted and the total bacterial count was determined according to Katayama and Wagai (1959).

Growth performance measurements: Chicks were weighed individually at weekly intervals and body weight gain was calculated. Also, the feed intake per week was recorded and feed conversion ratio was then calculated. Protein efficiency ratio, relative growth rate and performance index were calculated according to McDonald et al., (1987); Crampton and Lioyed (1959) and North (1981), respectively.

Immune response measurement: Three sets of blood samples were collected from the experimental birds of each group at 7, 14, 28 and 42 days of age. Blood samples were collected without anticoagulant for the separation of sera to detect the titer of antibodies to Newcastle disease vaccine using haemagglutination inhibition test as an indicative of the chick's immune response. Microtechnique of haemagglutination inhibition test was done according to Takatasy (1955). Geometric mean titer (GMT) was calculated following Brugh (1978).

Digestibility determination: At the end of the experimental period (7 weeks), four birds from each treatment were taken and each was put in individual cage which allowed a complete separation and collection of excreta and were assigned to each of the dietary treatments for 4 consecutive days, to allow them become adjusted to the cage. Then excreta were collected for a period of 6 days, during which the daily food intake was recorded and the daily output of excreta was collected uncontaminated and immediately weighed. Representative feed and excreta samples were taken for each

group and subjected to Proximate chemical analysis as described by AOAC (1985). The fecal nitrogen was determined following the procedure outlined by Jakobsen et al., (1960).

Blood analysis: At the end of the experimental period (7 weeks) blood samples were collected from four birds randomly chosen from each group and serum was separated by centrifugation of blood at 3000 rpm for 15 minutes and kept at - 20 ^{o}C until assayed. Serum glucose, total protein and albumin were measured according to Trinder (1969), Doumas et al., (1981) and Reinhold (1953) respectively. Serum globulin was calculated as the difference between serum total protein and albumin (Coles, 1974), also albumin to globulin ratio was calculated.

Statistical analysis: The analysis of variance for the obtained data was performed using Statistical Analysis System (SAS, 1987) to test the significancy of the differences.

RESULTS AND DISCUSSION

Total bacterial counts:

Total bacterial count of *Bacillus subtillis* in the commercial starter-grower ration and concentrates and their reduction percentages due to treating them with Salkil and/or Salgard are presented in Table (2). There was a gradual decline in bacterial number and reduction in viability percentages with the advancement of time after adding Salkil and Salgard. Moreover, the antibacterial activity of Salgard at a level of 2 g/kg diet was clearly lower than the effect of Salkil product.

The enhanced killing effect of Salkil may be attributed to the higher acid concentration which lowered the pH value of the feed sample and increased concentration of undissociated formic and propionic acids. This phenomenon is supported by Van der Wal (1980); Hinton and Linton (1988) and Prohaszka (1988) who reported that the antibacterial effect of acetic, propionic and butyric acid was disappeared when the pH of the samples was raised to 7.0. Meanwhile, the lower antibacterial effect of Salgard may be due to mycoband compound of the product which increment to the increase of pH value of the feed sample and to the lowered concentration of the active principles.

These results are in harmony with the findings of Westerfeld et al., (1970) and Hinton and Linton (1988) who noted that the addition of formic and propionic acids to poultry feeds reduced the incidence of *Salmonella* infection. Meanwhile, the results disagree with the findings of Hall et al., (1990).

There was no change in bacterial number or reduction of viability percentage after 6 and 24 hours when mixing 2 g Salkil + 1 g Salgard/kg diet. The only reduction was about 15% after 72 hours from their mixing, indicating that combining Salkil and Salgard resulted in negative interaction and so were not suitable to be mixed in the poultry rations as inhibitors of feed organisms.

From the previous results, we can conclude that, the Salkil product is more efficient bactericidal than Salgard in the poultry ration and should be mixed with the diet for at least three days before feeding.

Body weight developments:

The body weight development of broiler chicks in different groups during the experimental period is illustrated in Fig. (1), while the average values of the initial and final body weights, total body gain, daily gain, body weight gain % relative to the control group, total feed intake, feed conversion ratio, total protein intake, protein efficiency ratio, performance index and relative growth rate are presented in Table (3). Analysis of variance of the obtained data at the start of the experiment indicated no significant differences among the different chick groups. While at the end of the experimental period, body weight of chicks in group 2 (2177.0 g) which received diet supplemented with 4 g Salkil/kg diet showed the highest value followed by those in control group (2010.73), group 3 (2005.0 g) and finally group 4 (1980.0 g).

The total body gain, daily gain, body weight gain % relative to the control group, feed conversion, protein efficiency ratio, performance index and relative growth rate were best for broiler chicks in group 2 (2134.91 g, 43.57 g, 108.44%, 2.15, 2.56, 103.70 and 192.44, respectively) when compared to the other chick groups. The addition of 4 g Salkil/kg diet improved growth performance of broiler chicks. These results are in agreement with the findings of Gwara et al., (1986); Driggers et al., (1988) and El-Kholy et al., (1994) who recorded that the dietary Salkil supplemented group showed significant improvement in different growth performance parameters compared with the control one. While, chicks fed diet supplemented by Salgard (group 3) showed a non-significant difference of their body weight with control one, but a non-significant depression with the Salkil treated group.

Broiler chicks which were fed on diet supplemented with 2 g Salkil + 1 g Salgard/kg diet (group 4) showed significant decrease in body weight at the 7th week of age and feed conversion ratio compared with chicks in group 2 and a non-significant decrease with the chicks in the control group (group, 1). The depression in body weight development is in agreement with the results obtained by Schleideler and Brewer (1988). They reported a depression in body weight of birds which were fed diets contained 1 and 3% perlite (alumino-silicate) compared with the control one.

Digestibility:

Feed utilization parameters of broiler chicks which were fed on different diets are presented in Table (4). Improvement in the digestibility coefficients of nutrients was observed between treatments. Chicks which were fed diet supplemented by 4 g Salkil/kg diet (group 2) were slightly more efficient in digestion of dry matter, crude protein and ether extract than the chicks in the control group and other treatments. While the addition of Salgard alone or combined with Salkil (groups 3 and 4, respectively) resulted in nearly similar digestion compared with the control. These results are in agreement with O'loghoba et al. (1988). They reported that using 80 kg of fish offal treated with formic acid and ensiling for 3 days improved the dry matter digestibility of broiler chickens.

Blood chemistry:

The effect of dietary Salkil and/or Salgard supplementation on some blood constituents of broiler chickens is presented in Table (5). It is shown that serum glucose concentration was non-significantly reduced in groups 2, 3 and 4 when compared with the control group. Reductions were about 14.56, 19.18 and 12.52%, respectively in relation to the control group. The present results are in harmony with those of Donaldson et al. (1994) who reported that supplementation of propionate in both drinking water and feed had no significant effects on blood glucose concentration of turkey chicks.

Total protein and albumin concentrations were non-significantly affected by the different treatments. Also, albumin to globulin ratio was non-significantly reduced in chicks of group 3 but significantly decreased in group 2 and non-significantly increased in group 4. These variations in albumin to globulin ratio may be attributed to the variety in the globulin concentration of these groups as affected by different treatments.

Immune response:

Table (6) illustrates the geometric mean titer (GMT) against Newcastle disease vaccine in different experimental chick groups. Higher maternal HI titers were observed at the 7th day of age of different experimental groups. The vaaccination through drinking water did not show high HI titer against Newcastle disease of different chick groups, while vaccination through inactivated vaccine by intra-muscular injection at 28 day of chick age showed slight depression of GMT at 14 days post-vaccination (9.33, 9.0 and 8.33) for groups 2 , 3 and 4 , fed on the basal diet supplemented by Salkil, Salgard or Salkil with Salgard, respectively compared with the control (10.0) which fed the basal diet without supplement.

From the results of this study, it could be concluded that the dietary Salkil (4 g/kg diet) supplementation improves the growth performance and nutrient digestibility of broiler chickens, but slightly reduces the immune response against Newcastle disease vaccine. While dietary Salgard with or without Salkil supplementation slightly depresses growth performance and immune response of broiler chicks. Moreover, the Salkil was more efficient in reducing the viable bacterial count in poultry rations than Salgard and should be mixed with feeds before feeding by not less than 3 days.

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Table (2): Effect of Salkil and Salgard on total bacterial count (*Bacillus subtillis*) of commercial starter- grower ration and protein concentrate

Ration	Dietary supplement					
	Salkil		**Salgard**		**Salkil + Salgard**	
	Count	R*	Count	R*	Count	R*
Starter-grower ration:						
Period: At the beginning	16×10^7	0	16×10^7	0	16×10^7	0
After 6 hrs	16×10^6	15	16×10^7	0	16×10^7	0
After 24 hrs	8×10^5	30	60×10^6	15	16×10^7	0
After 72 hrs	2×10^4	50	30×10^5	30	60×10^6	15
Concentrates:						
Period: At the beginning	16×10^7	0	16×10^7	0	16×10^7	0
After 6 hrs	5×10^6	15	16×10^7	0	16×10^7	0
After 24 hrs	4×10^4	50	8×10^8	15	16×10^7	0
After 72 hrs	2×10^3	60	4×10^5	35	60×10^6	15

* R= Reduction %

Table (3): Performance of chicks in the different experimental groups

Items	Groups			
	1	2	3	4
Initial B.Wt. (g)	41.97 ± 1.16 a	42.09 ± 1.76 a	41.36 ± 1.76 a	41.73 ± 1.19 a
Final B.Wt. (g)	2010.73 ± 50.34 ab	2177.00 ± 64.01 a	2005.00 ± 71.64 ab	1980.00 ± 62.59 b
Total B.G. (g)	1968.82 ± 49.22 ab	2134.91 ± 62.39 a	1963.64 ± 70.85 ab	1938.27 ± 61.49 b
Daily body gain	40.18	43.57	40.07	39.56
Relative to control	100	108.44	99.73	98.46
TFI (g)/bird [1]	4426.96	4538.98	4907.67	4933.68
FCR [2]	2.27 ± 0.05 b	2.15 ± 0.06 b	2.54 ± 0.09 a	2.58 ± 0.06 a
TPI (g)/bird [3]	812.75	833.73	905.17	910.62
PER [4]	2.42 ± 0.06 a	2.56 ± 0.07 a	2.17 ± 0.08 b	2.13 ± 0.07 b
PI [5]	90.15 ± 4.49 ab	103.7 ± 6.06 a	81.65 ± 6.01 b	78.80 ± 4.90 b
RGR [6]	191.84 ± 0.05 b	192.44 ± 0.12 a	191.85 ± 0.14 b	191.72 ± 0.10 b

Values are means ± standard errors.
Means within the same row with the same letter are not significantly different (P>0.05).
1)Total feed intake. 2) food conversion ratio. 3) total protein intake
4) Protein efficiency ratio 5) Performance index {PI = live weight (Kg) X 100 / Feed conversion} 6) relative growth rate

Table (4): Effect of dietary Salkil and Salgard supplementation on the nutrient digestibility of broiler chickens

	Groups			
	1	2	3	4
Dry matter	85.15 ± 3.03	88.43 ± 0.85	85.41 ± 1.79	84.46 ± 1.97
Organic matter	85.94 ± 2.90	87.66 ± 3.21	86.80 ± 0.61	86.01 ± 2.02
Crude protein	78.73 ± 4.50	81.72 ± 3.60	79.04 ± 1.06	77.46 ± 2.83
Ether extract	86.20 ± 2.58	88.39 ± 3.26	85.99 ± 0.21	79.04 ± 1.06

Values are means ± standard errors.

Table (5): Effect of dietary Salkil and Salgard supplementation on some blood parameters of broiler chickens

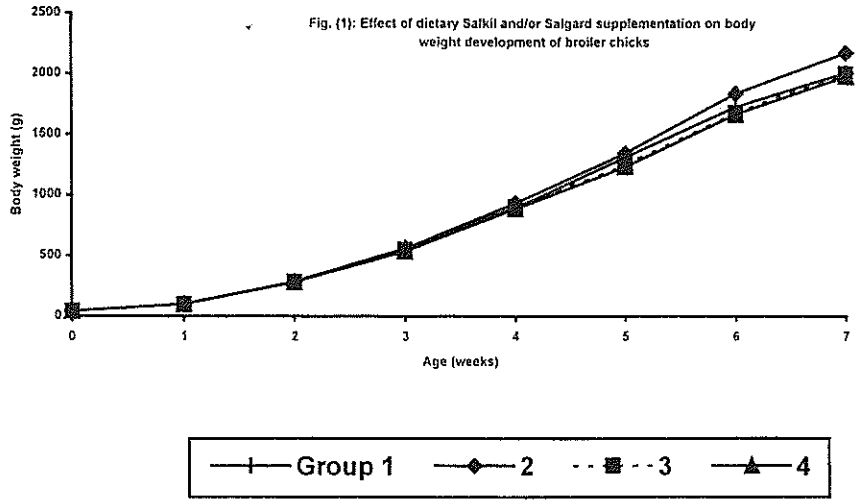
Item	Groups			
	1	2	3	4
Glucose (mg/100 ml serum) Relative to control	245.0 ± 20.20 100	209.3 ± 58.14 85.44	198.0 ± 10.39 80.82	214.3 ± 20.22 87.48
Total protein (g/100 ml serum) Relative to control	2.67 ± 0.2 100	2.40 ± 0.11 89.89	2.73 ± 0.17 102.25	2.60 ± 0.17 97.39
Albumin (g/100 ml serum) Relative to control	1.60 ± 0.11 100	1.27 ± 0.87 79.38	1.53 ± 0.20 95.63	1.69 ± 0.09 105.63
Globulin (g/100 ml serum) Relative to control	1.07 ± 0.07 100	1.13 ± 0.0 105.61	1.20 ± 0.11 112.15	0.91 ± 0.1 85.05
A/G ratio Relative to control	1.50 ± 0.03 ^{ab} 100	1.12 ± 0.06 ^{b} 74.67	1.32 ± 0.030 ^{ab} 88.0	1.89 ± 0.21 ^{a} 126.0

A/G = Albumin/Globulin ratio. Values are means ± standard errors.
Values within the same row with different letter are significantly different ($P < 0.05$).

Table (6):Effect of dietary Salkil and Salgard supplementation on geometric mean titer (GMT) against Newcastle disease vaccine in different broiler groups

Age at sampling (days)	Groups			
	1	2	3	4
7 (just before vaccination)	3.00 ± 1.0	4.00 ± 0.0	4.00 ± 0.0	3.00 ± 1.0
14 (8 days after vaccination)	4.33 ± 0.33	4.33 ± 0.33	3.33 ± 0.88	2.67 ± 0.33
28 (just before I.M. vaccination) *	3.00 ± 1.53	1.00 ± 0.0	3.67 ± 1.76	5.00 ± 2.00
42 (14 days after I.M. vaccination)	10.0 ± 0.58	9.33 ± 0.88	9.00 ± 0.58	8.33 ± 0.33

Values are means ± standard errors. Just before intra-muscular vaccination.



الملخص العربى

تـــأثير اضـــافة الســـالكل و الســـالجارد كأحمـــاض عضوية على الأداء والأستجابة المناعية لدجـــاج التسمين

عبدالله الانصارى , مسـعد سـلطان , محمد القطشـة

استهدفت هذة الدراسة فحص ودراسة تأثير بعض مضادات البكتيريا (الســـالكل و الســـالجارد) فى علائق الدواجن على كفاءة القضاء على البكتيريا المتواجدة فى العليقة وصحة واداء دجـــاج التسمين, اجريت التجربة على ٨٠ كتكوت عمر يوم من نوع أربور ايكرز, قســـمت عشوائيا الى أربعة مجاميع متساوية وغذيت على النحو التالى.

المجموعة الاولى: غذيت على العليقة الاساسية واعتبرت كمجموعة ضابطة.

المجموعة الثانية: غذيت على العليقة الاساسية مضافا اليها ٤ جرام سالكل لكل ١ كجم

المجموعة الثالثة: غذيت على العليقة الاساسية مضافا اليها ٢جرام سالجارد لكل ١ كجم

المجموعة الرابعة: غذيت على العليقة الاساسية مضافا اليها ٢ جرام سالكل + ١ جرام سالجارد /١ كجم

-وقـد اتضح ان اضافة السالكل كان اكثر فاعلية للقضاء على البكتيريا المتواجدة فى العليقة عنه بالنسبة للسالجارد ويجب اضافتة فى عليقة الدواجن بفترة لا تقل عن ثلاثة ايام قبل التغذية.

-لوحظ ان اضافة السالكل بنسبة ٤ جرام لكل ١ كجم من العليقة الاساسية (مجموعة ٢) ادى الى تحسن ملحوظ فى وزن الدجاج, متوسط معامل التحول الغذائى, كفاءة استخدام البروتين، وهضم البروتين والمواد العضوية والجافة بالمقارنة مع باقى مجاميع الطيور المختلفة.

-لوحظ ان اضافة كلا من السالكل والسالجارد لم يؤثر تاثيراً معنويا فى الاستجابة المناعية للطيور ضد مرض النيوكاسل.

-لوحظ انه لم يكن هناك فروق معنوية فى الوزن الصافى للدجاج ووزن الاعضاء وبعض مكونات الدم للطيور (نسبة الجلوكوز, البروتين, الألبيومين والجلوبيولين).

-من الدراسة يتضح ان استخدام السالكل قد حسن من الكفاءة الاقتصادية للدجاج بينما السالجارد قد ادى الى انخفاض الكفاءة الاقتصادية للدجاج بنسبة عالية عنه فى المجموعة الضابطة.