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# Impact of Soymilk on Productive and Biochemical performances as well as Economic indices of Two Commercial Broiler Breeds

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**ABSTRACT**

A study was conducted to determine the effect of soymilk on growth performance, carcass traits, blood parameters, kidney and liver functions as well as economic indices. A total number of 40 of one day old chicks of two commercial broiler breeds (Cobb 500 and Avian 48) were randomly assigned to four equal groups (10 each), control and treated with soymilk for each breed. Results revealed non-significant differences between the two breeds for the studied parameters except Cobb 500 breed had significantly higher AST level than Avian 48. Regarding to the effect of treatment and the interactions, treated groups from both breeds revealed improved growth performance (final body weight, weight gain, feed conversion ratio and carcass traits), and decreased feed consumption and consequently decreased production costs and increased profit. Supplementation of soymilk elevated blood proteins, and reduced blood lipid profile. Kidney and liver function parameters significantly increased by supplementation of soymilk except for creatinine level. In conclusion, the present results suggest addition of soymilk to drinking water of broilers ages of 17-20, 27- 30 and 37-40 days would have positive effects on the productivity and lipid profile, as well as profitability.

## 1. INTRODUCTION

The demand on chicken meat has increased progressively as it always considered as one of the essential sources of protein. Broilers' producers always try to reduce feed conversion ratio as the aims of the modern broiler industry are to lower the production costs with conserving high production rates (Pelicano et al., 2002).

Many growth promoters (antibiotic feed additives) have been developed to improve broilers production, however the indiscriminate use of such drugs was questioned as the main problem the pathogenic bacteria and beneficial bacteria affected leading to undesirable unbalance between the desirable microflora and the bird (Mulder, 1991). To face such problems many researchers tried to develop growth promoters of natural origin to preserve normal inhabitant microflora as one of the natural defense mechanisms against pathogenic bacteria of GIT.

As a result of continuous trials, many probiotics and prebiotics had been developed and improved in the last years and widely used not only to improve broiler production without affecting normal gut flora but also lead to improving and increasing their counts (Pelicano et al., 2004).

Protein rich feed resources (soybean and fish meal) are the most favorable for broiler production but, with increasing their cost there is a need for cheaper protein resources. Soybeans and soybean products are presently utilized broadly in animal nutrition. They are used as a source of protein and oil for animal and human markets. Soybean is an excellent source for plant protein. Other plant protein resources are compared to soybean as a standard (Blair, 2008).

Anti-nutritional factors are present in the whole grain of soybean and affect the availability of nutrients for poultry and swine (Durigan, 1989). Processing of soybean is beneficial to improve nutrients palatability and accessibility. Many ways are used to destroy these factors for example, a combination or extraction, cooking and fermentation. Cooking is considered as a cheaper and effective way in reducing trypsin inhibitor activity. Residual trypsin inhibitor activity in edible-grade soy protein products is about 5-20% of the activity originally present in raw soybeans (Rackis and Gumbmann, 1981).

Soymilk and its products have been popular in some Asian countries for centuries (Kanawjia and Singh, 2000). Soymilk is a byproduct from soybeans (produced by soaking and cooking and then filtering of grinded whole soybeans). It is an emulsion containing water soluble proteins, carbohydrates and oil droplets, so that it is considered a good source of protein and energy. Few trials are made to assess the effect of soymilk as a growth promoter for broilers.

The aim of the present study was to experimentally investigate the effect of supplementation of soymilk on production performance, carcass traits, blood biochemical profiles, kidney and liver functions in addition to the economic indices of two broiler breeds.

## 2. MATERIALS AND METHODS:

### 2.1. Housing and management of birds:

Day old chicks are floor brooded with wood shaving litter for the first two weeks of age supplemented with feeders and drinkers, and heaters. The brooding temperature in first three days of age was 33°C and then temperature reduced gradually till room (25 °C) temperature at 21 days of age. Birds after two weeks were moved to cages, each replicate housed in separate pen (1 meter length, 90 cm width and 45 cm height). The cages provided with separate lines of nipple drinkers for each pen and separate feeders. Birds were exposed to 24 hours of 2 FC (Foot Candle) light during the first three days of brooding, then to 23 hours for the rest of rearing period. All birds were vaccinated against Newcastle disease, Infectious bronchitis, and Avian Influenza H5 during the cycle.

### 2.2. Feeding trials

Forty one day old chicks of two commercial broiler breeds were used in this study (20 Cobb 500 and 20 Avian 48). Cobb 500 chicks were obtained from El-Watania Hatcharies, Kilometer 59, Alexandria - Cairo Desert road, Alexandria, Egypt, while Avian 48 chicks were obtained from El-Sable Hatcheries, Tanta, Egypt. All birds were fed on El-Fagr starter ration (23% protein and 2900 kcal/kg) manufactured by El- Fagr Egypt for feed industry (Al Nubarya, El Behira, Egypt) for the first 3 weeks and EL-Fagr grower ration (21% protein and 3200 kcal/kg) for remaining period of the experiment.

Each breed allotted to two groups one control (n=10) and the other treated with soymilk (n=10) each group allotted to 2 replicates (n=5). The product used in the experiment was for Silk Company, 12002 airport way, Broomfield, United states. The dose was one cm / liter of drinking water for 24 hours per day for three successive days at age intervals 17-20, 27-30 and 37-40 days for the treated groups.

### 2.3. Estimated parameters:

#### 2.3.1. Estimation of growth traits

Growth traits included body weight (BW), weight gain (WG) and feed conversion ratio (FCR). Different growth performance parameters were measured and calculated as follows:

**a. Body weight (BW):** Chicks were individually weighed from the beginning of the third week of age by a weekly interval until the $6^{th}$ week of age. Weighing of the birds was done every week at the early morning before receiving any feed.

**b. Weight gain (WG):** Subtraction the weights of two consecutive weeks

**c. Feed consumption:** Average weekly feed consumption in each group was calculated from total feed offered in particular week minus left feed on the first day morning of next week.

**d. Feed conversion ratio (FCR):** Feed conversion ratio was calculated by dividing the amount of feed intake (g) during the week by the gain in weight (g) during the same week (Lambert et al., 1936).

$$FCR = \frac{\text{Feed intake (g)/bird/week}}{\text{Weight again (g)/bird/week}}$$

**2.2.3. Carcass trait**

Prior to slaughtering the birds were deprived of feed for 12 hours and weighed. After slaughtering, birds were scalded, wet-plucked and eviscerated. Then technological division of the carcass was performed and calculated according to Wang (2000) Thus; the carcass was separated to the following cuts:

a. Breast: including the sternum and breast muscles.
b. Thigh: weighing two thighs and taking average.
c. Shoulder: weighing two shoulders and taking average.
d. Left filet: the de-skinned left breast muscle on the left side of sternum.
e. Liver, heart, spleen and gizzard were separately weighed to determine the dressed weight and the dressed percentage. The blood, viscera, lungs, limbs, head and neck were termed as the offal's and they were discarded.
f. The abdominal fats in pelvic and abdominal cavity were collected completely from carcass and weighted.

**Estimation of carcass traits:**

**a.** Dressing percentage: After weighing warm carcass, dressing percentage was calculated according to Price (1967) as follows:

$$\text{Dressing percentage} = \frac{\text{Hot carcass weight}}{\text{Fasted live body weight}} \text{X100}$$

**b.** Breast, thigh, shoulder, left filet, liver, heart, spleen, gizzard and abdominal fat were expressed as percentage of the carcass weight.

**2.2.4. Estimation of blood biochemical parameters**

Blood samples were collected from wing vein at 42$^{nd}$ day of experiment. After collecting blood samples tubes were left in slope position till serum samples were separated through centrifugation at 3000 rpm for 15 minutes. The sera were collected and preserved in a deep freezer at (-20°C) until the time of analysis. The following parameters were estimated:

**a. Serum Total lipids:** Using Total lipids kit of Bio-diagnostic according to the method of Zollner and Kirsch (1962).

**b. Serum Triglyceride:** Using Triacylglycerol kit of Bio- diagnostic according to the method of Fossati and Prencipe, (1982).

**c. Cholesterol:** According to the method of Allain et al. (1974)

**d. Total protein:** Following AST kit of Bio-diagnostic according to the method of Gornall et al. (1949).

**e. Albumin:** According to the method of Dumas et al. (1971).

**f. Globulin:** According to the method of Coles (1974).

**2.2.5. Estimation of kidney and liver functions:**

**a. Alanine Aminotransferase (ALT):** By ALT kit of Bio- diagnostic according to the method of Reitman and Frankel, (1957).

**b. Aspartate Aminotransferase (AST):** By AST kit of Bio- diagnostic according to the method of Reitman and Frankel, (1957).

**c. Creatinine:** According to the method of Bartels et al. (1972).

**d. Urea:** According to the method of Fawcett and Scott, (1960).

**2.4. Economic indices:**

The costs and returns are calculated according to the prevailing prices at the Egyptian market at the time of the experiment as follow:

**a. Cost**

**1. Total fixed costs:** Included building and equipment depreciation, where depreciation rates were calculated for building on 30 years and for cages on 15 years according to Cartuche et al., (2014). Also, veterinary services costs, bird price and other miscellaneous costs are considered fixed as the birds had the same management, consequently total fixed costs equal 14.9 EGP/ bird.

**2. Variable costs:** Included feed and growth promoter costs where, total feed costs equal total feed intake per bird multiplied by cost of one kg diet (6.40 EGP /kg diet).

**3. Total costs:** It was calculated from the summation of total fixed costs and total variable costs

**4. Feed cost/kg weight gain**= feed conversion × cost of one kg diet (Tag El-Din, 1999).

**b. Return**

**1. The total return:** considered was the income from selling the meat where, total return equal bird's live body weight multiplied by price of one kg meat (26 EGP/kg live body weight).

**2. Net return** = return-costs (Cartuche et al., 2014).

**3. Ratio of net return to feed cost** = net return / feed cost (Solomon et al., 2007).

**4. Economic efficiency (%) = net return/ total cost (Soliman, 1985).**

**2.5. Statistical analysis:**

All statistical procedures were performed using SAS statistical system package v9.2 (SAS Institute, version 9.2, 2009). Preliminary Levene's test was performed to ensure the homogeneity of variances among groups. GLM procedure was performed represented with the following statistical model:

$X_{ijk} = \mu + B_i + T_j + (BT)_{ij} + e_{ijk}$

$X_{ijk}$= Observational outcome, $\mu$= Overall mean, $B_i$= Effect of i breed of broilers i=1 and 2 (1= Cobb 500 and 2=Avian 48), $T_j$= Effect of j treatment with soymilk j=1, 2 (1= control, 2= treatment). $(BT)_{ij}$= Effect due to interaction between breed and treatment. $e_{ijk}$= Random error.

## 3. RESULTS AND DISCUSSION

The data showed in table (1) revealed that the two breeds showed no significant different in body weight. However supplementation of soymilk had significantly increased body weight especially at 3rd week and 6th week ages (709.7 and 2214.7 g/bird for treated birds vs. 644.7 and 2075.1 g/bird for control birds, respectively). Similarly within each breed treated birds with soymilk showed higher final body weights (2216.1 g vs. 2063.4 g for Cobb 500 and 2213.4 vs. 2086.8 g for Avian 48).

Similarly weekly weight gain showed no significant difference between the two breeds, while supplementation of soymilk had significantly increased weekly weight gain at 3rd week (412.5 vs. 345.2 g/bird), and the 6th week (519.3 vs. 428.1 g/bird) and the total weight gain were also significantly affected (1917.5 vs. 1775.5 g/bird). Within each breed supplementation of soymilk had improved weekly weight gain significantly during 3rd week for Cobb 500 (437.6 vs. 296 g/bird) and in the total weight gain (1905.8 vs. 1771.7 g/bird), however Avian 48 strain showed no significant difference except at the 6th week age (528.4 vs. 404.3 g/bird) and the total weight gain (1929.1 vs. 1779.4 g/bird). The obtained results may be attributed to the high nutritional values of soymilk specially protein content as soymilk contains about 36.5 % easily digestible protein as reported by Ismail, (2010). These findings are similar to those reported by Masum et al. (2009) as they concluded that soymilk had a desirable effect on growth performance and similar nutritional values to dairy milk. Also, Dono et al. (2017) suggested that dietary substitution of soybean meal with 10% soymilk waste might give positive effects in improving efficiency in protein utilization and growth performance.

Considering feed consumption, the data presented in table (2) revealed that the two breeds showed no significant difference in the consumption of the 3rd week, while in the 4th week Avian 48 consumed higher feed than Cobb 500 (816.1 vs. 735.1 g/bird), however Cobb 500 showed higher feed consumption in the 5th and 6th week of the experiment (904.4 vs. 874.5 g/bird in 5th week and 979.1 vs. 961.3 g/bird in the 6th week) but the Avian 48 showed higher total feed consumption but the difference was not significant. Supplementation of soymilk had favorable effect on reducing feed consumption significantly during all over the experimental period as the total feed consumption during the 4 weeks of the experiment reduced in the treated groups to 3040.4 vs. 3294.5 g/bird for control groups.

In the same way within each group supplementation of soymilk was significantly reduced feed consumption as the total feed consumption for Cobb 500 broilers during the last 4 weeks reduced to 2998.7 vs. 3301.3 g/bird for control group and similarly Avian 48 total feed consumption in the last 4 weeks reduced to 3082.1 vs. 3287.7 g/bird for control group. These results may be attributed to the high energy content of soymilk and high protein content as soymilk contains 36.5 % protein and 4160 kcal/ kg as reported by Ismail,(2010).

**Table (1):** Body weight and body weight gain as affected by breed and treatment:

| Items | Body weight (g/week) | | | | | Body weight gain (g/week) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 2 | 3 | 4 | 5 | 6 | 2-3 | 3-4 | 4-5 | 5-6 | Total |
| **Breed:** | | | | | | | | | | |
| Cobb | 301 | 667.8 | 1185.7 | 1658.7 | 2139.7 | 366.8 | 517.9 | 472.9 | 481.1 | 1838.7 |
| Avian | 295.8 | 686.6 | 1209.6 | 1683.7 | 2150.1 | 390.8 | 523.0 | 474.1 | 466.3 | 1854.2 |
| SEM | 7.8 | 13.4 | 16.2 | 18.7 | 26.7 | 12.5 | 13.2 | 9.6 | 13.2 | 20.3 |
| p value | 0.747 | 0.562 | 0.469 | 0.505 | 0.834 | 0.328 | 0.811 | 0.939 | 0.508 | 0.739 |
| **Treatment:** | | | | | | | | | | |
| Control | 299.5 | 644.7$^{b}$ | 1179.6 | 1647.0 | 2075.1$^{b}$ | 345.2$^{b}$ | 534.9 | 467.4 | 428.1$^{b}$ | 1775.5$^{b}$ |
| Soymilk | 297.3 | 709.7$^{a}$ | 1215.7 | 1695.4 | 2214.7$^{a}$ | 412.5$^{a}$ | 506.0 | 479.7 | 519.3$^{a}$ | 1917.5$^{a}$ |
| SEM | 7.5 | 14.9 | 16.6 | 18.2 | 24.9 | 10.1 | 12.8 | 10.1 | 11.4 | 19.8 |
| p value | 0.888 | 0.040 | 0.272 | 0.194 | 0.003 | 0.004 | 0.165 | 0.408 | 0.000 | 0.001 |
| **Breed × treatment:** | | | | | | | | | | |
| Cobb × control | 291.7 | 587.7$^{b}$ | 1155.6 | 1611.5 | 2063.4$^{b}$ | 296.0$^{b}$ | 567.9$^{a}$ | 455.9 | 451.9$^{bc}$ | 1771.7$^{b}$ |
| Cobb × soymilk | 310.3 | 747.9$^{a}$ | 1215.9 | 1705.9 | 2216.1$^{a}$ | 437.6$^{a}$ | 468.0$^{b}$ | 490.0 | 510.2$^{ab}$ | 1905.8$^{a}$ |
| Avian × control | 307.4 | 701.7$^{a}$ | 1203.7 | 1682.5 | 2086.8$^{b}$ | 394.3$^{a}$ | 502.0$^{ab}$ | 478.8 | 404.3$^{c}$ | 1779.4$^{b}$ |
| Avian × soymilk | 284.3 | 671.6$^{ab}$ | 1215.6 | 1685 | 2213.4$^{a}$ | 387.3$^{a}$ | 544.0$^{a}$ | 469.4 | 528.4$^{a}$ | 1929.1$^{a}$ |
| SEM | 8.1 | 13.8 | 15.9 | 20.5 | 24.2 | 13.1 | 10.4 | 7.9 | 10.9 | 22.8 |
| p value | 0.610 | 0.002 | 0.523 | 0.310 | 0.031 | 0.000 | 0.001 | 0.420 | 0.000 | 0.014 |

Means within each column for each category with no common superscript letters are significantly different ($p \leq .05$).
SEM: Standard error of the mean.

The two breeds showed no significant difference in the feed conversion ratio all over the experimental period except at the 4th week of age (1.4 for Cobb 500 vs. 1.6 for Avian 48). Supplementation of soymilk for broilers had significantly improved feed conversion ratio during 3rd, 4th, 6th week and total conversion (1.2 vs. 1.7, 1.4 vs. 1.6, 1.8 vs. 2.3 and 1.5 vs. 1.8, respectively). In the same way supplementation of soymilk had improved feed conversion ratio with in each breed as in Cobb 500 feed conversion ratio improved significantly during 3rd and 6th week (1.2 vs. 2 and 1.9 vs. 2.2, respectively), however in Avian 48 the significant effect of supplementation of soymilk on improving feed conversion ratio was obvious in 6th week (1.8 vs. 2.4). Also, total feed conversion was improved in Cobb 500 and Avian treated groups (1.6) compared to control groups (1.9).These findings may be due to the nutritive values of soymilk which includes high energy and protein content resulted in lower feed consumption and higher body weights.

The data showed in table (3) revealed that the two breed had no significant difference in all carcass traits except in thighs percentage Avian 48 showed significantly higher thighs than Cobb 500 (17.4 vs. 15.5%), while Cobb 500 showed higher breast percentage (29.1 vs. 27.5%) but that difference was not significant. These findings may be attributed to the ability of Cobb 500 to retain breast meat than Avian 48 which produces larger thighs. These findings are similar to those obtained by Fernandes et al. (2013). Supplementation of soymilk has improved carcass traits as dressing percentage, liver percentage, breast percentage, thigh percentage, shoulder percentage and left fillet percentage had increased significantly by treatment (75 vs. 71%, 4.4 vs. 4%, 29.5 vs. 27.1%, 17.1 vs. 15.8%, 4.9 vs. 4.1% and 12.6 vs. 10.6%, respectively), while carcass fat percentage had decreased by treatment (1.2 vs. 1.8%). Cobb 500 was more affected by supplementation of soymilk as they showed significant improvement in dressing percentage (76.6 vs. 70.9%), while Avian 48 dressing percentage also improved by treatment but the difference was not significant. Also breast percentage was significantly improved in Cobb 500 (30.8 vs. 27.4%) but in Avian 48 the improvement was not significant. Both Cobb 500 and Avian 48 showed improved breast left fillet percentage (13.8 vs. 11% for Cobb 500 and 12.2 vs. 10.3% for Avian 48); however Avian 48 showed improvement in thighs percentage (18.2 vs. 16.6%). In similar way soymilk supplementation had significantly decreased carcass fat percentage in both breeds (1 vs. 2% for Cobb 500 and 1.3 vs. 1.7% for Avian 48).

**Table (2):** Feed consumption and feed conversion ratio as affected by breed and treatment:

| Items | Feed consumption (g/bird/week) | | | | | Feed conversion (g feed/g gain/week) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 3 | 4 | 5 | 6 | Total | 3 | 4 | 5 | 6 | Total |
| **Breed:** | | | | | | | | | | |
| Cobb | 531.3 | 735.1$^{b}$ | 904.4$^{a}$ | 979.1$^{a}$ | 3150.0 | 1.5 | 1.4$^{b}$ | 1.9 | 2.1 | 1.7 |
| Avian | 532.9 | 816.1$^{a}$ | 874.5$^{b}$ | 961.3$^{b}$ | 3184.9 | 1.3 | 1.6$^{a}$ | 1.8 | 2.1 | 1.7 |
| SEM | 7.2 | 16.2 | 3.5 | 2.8 | 20.9 | 0.11 | 0.07 | 0.02 | 0.05 | 0.01 |
| p value | 0.904 | 0.011 | 0.000 | 0.000 | 0.411 | 0.154 | 0.023 | 0.284 | 0.649 | 0.947 |
| **Treatment:** | | | | | | | | | | |
| Control | 569.3$^{a}$ | 849.4$^{a}$ | 898.1$^{a}$ | 977.6$^{a}$ | 3294.5$^{a}$ | 1.7$^{a}$ | 1.6$^{a}$ | 1.9 | 2.3$^{a}$ | 1.8$^{a}$ |
| Soymilk | 494.9$^{b}$ | 701.8$^{b}$ | 880.8$^{b}$ | 962.8$^{b}$ | 3040.4$^{b}$ | 1.2$^{b}$ | 1.4$^{b}$ | 1.8 | 1.8$^{b}$ | 1.5$^{b}$ |
| SEM | 6.3 | 18.5 | 3.9 | 2.3 | 21.3 | 0.06 | 0.04 | 0.04 | 0.09 | 0.04 |
| p value | 0.000 | 0.000 | 0.013 | 0.000 | 0.000 | 0.000 | 0.002 | 0.105 | 0.000 | 0.000 |
| **Breed × treatment:** | | | | | | | | | | |
| Cobb × control | 556.0$^{b}$ | 865.8$^{a}$ | 899.1$^{b}$ | 980.4$^{a}$ | 3301.3$^{a}$ | 2.0$^{a}$ | 1.5$^{ab}$ | 2.0 | 2.2$^{ab}$ | 1.9$^{a}$ |
| Cobb × soymilk | 506.7$^{c}$ | 604.4$^{d}$ | 909.7$^{a}$ | 977.9$^{b}$ | 2998.7$^{d}$ | 1.2$^{b}$ | 1.3$^{b}$ | 1.9 | 1.9$^{bc}$ | 1.6$^{b}$ |
| Avian × control | 582.6$^{a}$ | 833.1$^{b}$ | 897.1$^{b}$ | 974.9$^{b}$ | 3287.7$^{b}$ | 1.5$^{b}$ | 1.7$^{a}$ | 1.9 | 2.4$^{a}$ | 1.9$^{a}$ |
| Avian × soymilk | 483.2$^{d}$ | 799.2$^{c}$ | 852.0$^{c}$ | 947.7$^{c}$ | 3082.1$^{c}$ | 1.3$^{b}$ | 1.5$^{ab}$ | 1.8 | 1.8$^{c}$ | 1.6$^{b}$ |
| SEM | 6.8 | 16.4 | 3.2 | 3.1 | 23.0 | 0.08 | 0.03 | 0.01 | 0.02 | 0.02 |
| p value | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.001 | 0.274 | 0.000 | 0.000 |

Means within each column for each category with no common superscript letters are significantly different ($p \leq .05$).
SEM: Standard error of the mean.

**Table (3):** Carcass traits percentage as affected by breed and treatment:

| Items | Carcass traits % | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Dressed | Liver | Gizzard | Heart | Spleen | Fat | Breast | Thigh | Shoulder | Left fillet |
| **Breed:** | | | | | | | | | | |
| Cobb | 73.8 | 4.2 | 3.0 | 0.8 | 0.2 | 1.5 | 29.1 | 15.5$^{b}$ | 4.8 | 12.4 |
| Avian | 72.2 | 4.3 | 2.9 | 0.9 | 0.2 | 1.5 | 27.5 | 17.4$^{a}$ | 4.2 | 11.3 |
| SEM | 0.63 | 0.06 | 0.09 | 0.05 | 0.02 | 0.09 | 0.48 | 0.30 | 0.10 | 0.35 |
| p value | 0.252 | 0.985 | 0.852 | 0.116 | 0.672 | 0.97 | 0.095 | 0.001 | 0.061 | 0.106 |
| **Treatment:** | | | | | | | | | | |
| Control | 71.0$^{b}$ | 4.0$^{b}$ | 2.8 | 0.8 | 0.2 | 1.8$^{a}$ | 27.1$^{b}$ | 15.8$^{b}$ | 4.1$^{b}$ | 10.6$^{b}$ |
| Soymilk | 75.0$^{a}$ | 4.4$^{a}$ | 3.0 | 0.8 | 0.2 | 1.2$^{b}$ | 29.5$^{a}$ | 17.1$^{a}$ | 4.9$^{a}$ | 12.6$^{a}$ |
| SEM | 0.67 | 0.04 | 0.07 | 0.03 | 0.05 | 0.05 | 0.47 | 0.33 | 0.14 | 0.34 |
| p value | 0.001 | 0.023 | 0.274 | 0.387 | 0.066 | 0.000 | 0.007 | 0.039 | 0.011 | 0.000 |
| **Breed × treatment:** | | | | | | | | | | |
| Cobb × control | 70.9$^{b}$ | 4.1 | 2.9 | 0.8 | 0.2 | 2.0$^{a}$ | 27.4$^{b}$ | 15.1$^{b}$ | 4.5$^{ab}$ | 11.0$^{bc}$ |
| Cobb × soymilk | 76.6$^{a}$ | 4.4 | 3.0 | 0.9 | 0.2 | 1.0$^{d}$ | 30.8$^{a}$ | 16.0$^{b}$ | 5.1$^{a}$ | 13.8$^{a}$ |
| Avian × control | 71.1$^{b}$ | 4.1 | 2.8 | 0.9 | 0.2 | 1.7$^{b}$ | 26.7$^{b}$ | 16.6$^{b}$ | 3.7$^{b}$ | 10.3$^{c}$ |
| Avian × soymilk | 73.3$^{ab}$ | 4.5 | 3.0 | 0.9 | 0.2 | 1.3$^{c}$ | 28.2$^{ab}$ | 18.2$^{a}$ | 4.7$^{a}$ | 12.2$^{ab}$ |
| SEM | 0.61 | 0.07 | 0.02 | 0.02 | 0.04 | 0.07 | 0.50 | 0.32 | 0.13 | 0.32 |
| p value | 0.002 | 0.168 | 0.762 | 0.349 | 0.292 | 0.000 | 0.005 | 0.000 | 0.007 | 0.000 |

Means within each column for each category with no common superscript letters are significantly different ($p \leq .05$).
SEM: Standard error of the mean.

The effects of breed, soymilk supplementation and their interaction on blood biochemical parameters were presented in table (4) and the obtained data showed that the two breeds showed no significant difference in all blood biochemical parameters. While, using soymilk for broilers had significantly increased blood albumin, globulin, albumin/globulin ratio and total protein (2.6 vs. 1.8 g/dl, 2 vs. 1.7 g/dl, 1.3 vs. 1.1, and 4.6 vs. 3.5 g/dl, respectively) and significantly deceased total blood lipids, triglyceride and cholesterol (487.9 vs. 644.2 mg/dl, 116.9 vs. 157.3 mg/dl and 133.9 vs. 168.4 mg/dl, respectively). Within each breed supplementation with soymilk showed the same effect as in both Cobb 500 and Avian 48 albumin, globulin, albumin/globulin ratio, and total protein were significantly increased in treated groups while total lipids, triglyceride and cholesterol were significantly decreased. These findings may be attributed to the high easily digestible protein content in soymilk. The obtained results are in agreement with those reported by Min et al. (2009) as they reported that using fermented soy in piglets had increased blood protein.

Data presented in table (5) showed that the two breeds showed no significant difference in serum urea, creatinine and ALT while only AST showed significant difference within the normal range (75.2 U/L for Cobb 500 vs. 69.9 U/L for Avian 48). Supplementation of broilers with soymilk had significantly increased serum urea (32.9 vs. 28.9 U/L) and ALT (38.7 vs. 30.2 U/L) but all was within the normal reference ranges. Similarly, within each breed, supplementation of broilers with soymilk resulted in significant increase in serum urea and ALT within the normal reference ranges. These may be attributed to the high protein content in soymilk.

**Table (4):** Some blood chemical parameters as affected by breed and treatment:

| Items | Blood parameters | | | | | | |
|---|---|---|---|---|---|---|---|
| | Albumin (g/dl) | Globulin (g/dl) | Total protein (g/dl) | AG ratio | Total lipid (mg/dl) | TG (mg/dl) | Cholesterol (mg/dl) |
| **Breed:** | | | | | | | |
| Cobb | 2.2 | 1.8 | 4.1 | 1.2 | 553.9 | 135.3 | 149.2 |
| Avian | 2.2 | 1.9 | 4.1 | 1.2 | 578.3 | 138.9 | 151.1 |
| SEM | 0.09 | 0.07 | 0.13 | 0.02 | 20.0 | 5.6 | 4.9 |
| p value | 0.816 | 0.365 | 0.893 | 0.226 | 0.557 | 0.755 | 0.704 |
| **Treatment:** | | | | | | | |
| Control | $1.8^{b}$ | $1.7^{b}$ | $3.5^{b}$ | $1.1^{b}$ | $644.2^{a}$ | $157.3^{a}$ | $168.4^{a}$ |
| Soymilk | $2.6^{a}$ | $2.0^{a}$ | $4.6^{a}$ | $1.3^{a}$ | $487.9^{b}$ | $116.9^{b}$ | $133.9^{b}$ |
| SEM | 0.14 | 0.04 | 0.10 | 0.03 | 20.1 | 5.6 | 5.1 |
| p value | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| **Breed × treatment:** | | | | | | | |
| Cobb × control | $1.8^{b}$ | $1.7^{b}$ | $3.6^{b}$ | $1.1^{b}$ | $616.1^{a}$ | $151.6^{a}$ | $163.4^{a}$ |
| Cobb × soymilk | $2.6^{a}$ | $1.9^{a}$ | $4.6^{a}$ | $1.3^{a}$ | $491.7^{b}$ | $118.9^{b}$ | $134.9^{b}$ |
| Avian × control | $1.8^{b}$ | $1.7^{b}$ | $3.5^{b}$ | $1.1^{b}$ | $672.4^{a}$ | $162.8^{a}$ | $173.3^{a}$ |
| Avian × soymilk | $2.6^{a}$ | $2.1^{a}$ | $4.7^{a}$ | $1.3^{a}$ | $484.2^{b}$ | $115.01^{b}$ | $132.8^{b}$ |
| SEM | 0.11 | 0.03 | 0.09 | 0.08 | 21.0 | 6.2 | 4.9 |
| p value | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

Means within each column for each category with no common superscript letters are significantly different ($p \leq .05$). AG Ratio: Albumin/Globulin ratio. TG: Triglycerides, SEM: Standard error of the mean.

**Table (5):** Kidney and liver function parameters as affected by breed and treatment:

| Items | Kidney function(mg/dl) | | Liver function(U/L) | |
|---|---|---|---|---|
| | Urea | Creatinine | ALT | AST |
| **Breed:** | | | | |
| Cobb | 30.7 | 0.50 | 34.2 | 75.2[a] |
| Avian | 31.1 | 0.40 | 34.7 | 69.9[b] |
| SEM | 0.51 | 0.03 | 4.0 | 1.4 |
| p value | 0.707 | 0.141 | 0.822 | 0.051 |
| **Treatment:** | | | | |
| Control | 28.9[b] | 0.50 | 30.2[b] | 70.0 |
| Soymilk | 32.9[a] | 0.40 | 38.7[a] | 75.1 |
| SEM | 0.50 | 0.01 | 3.1 | 1.6 |
| p value | 0.000 | 0.461 | 0.000 | 0.061 |
| **Breed × treatment:** | | | | |
| Cobb × control | 28.6[b] | 0.48 | 29.4[b] | 73.6[ab] |
| Cobb × soymilk | 32.8[a] | 0.44 | 39.0[a] | 76.8[a] |
| Avian × control | 29.3[b] | 0.42 | 31.0[b] | 66.4[b] |
| Avian × soymilk | 32.9[a] | 0.42 | 38.4[a] | 73.4[ab] |
| SEM | 0.47 | 0.04 | 3.0 | 1.3 |
| p value | 0.000 | 0.359 | 0.000 | 0.000 |

Means within each column for each category with no common superscript letters are significantly different (p ≤ .05). SEM: Standard error of the mean.

**Table (6).** Some economic indices as affected by breed and treatment:

| Items | Cost indices | | | | Return indices | | | |
|---|---|---|---|---|---|---|---|---|
| | Feed cost (EGP/bird) | Total variable costs (EGP/bird) | Total cost (EGP/bird) | Feed cost /kg gain (EGP/kg) | Total return (EGP/bird) | Net return (EGP/bird) | Net return per feed cost (EGP/bird) | Economic efficiency (%) |
| **Breed:** | | | | | | | | |
| Cobb | 20.2 | 20.3 | 35.2 | 11.1 | 55.6 | 20.4 | 1.0 | 57.9 |
| Avian | 20.4 | 20.5 | 35.4 | 11.1 | 55.9 | 20.5 | 1.0 | 57.9 |
| SEM | 0.15 | 0.10 | 0.14 | 0.21 | 0.63 | 0.72 | 0.11 | 3.1 |
| p value | 0.411 | 0.390 | 0.390 | 0.947 | 0.834 | 0.974 | 0.864 | 0.931 |
| **Treatment:** | | | | | | | | |
| Control | 21.1[a] | 21.1[a] | 36.0[a] | 11.9[a] | 54.0[b] | 18.0[b] | 0.85[b] | 50.0[b] |
| Soymilk | 19.5[b] | 19.5[b] | 34.4[b] | 10.2[b] | 57.6[a] | 23.2[a] | 1.2[a] | 67.4[a] |
| SEM | 0.16 | 0.13 | 0.12 | 0.24 | 0.6 | 0.78 | 0.09 | 1.9 |
| p value | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| **Breed × treatment:** | | | | | | | | |
| Cobb × control | 21.1[a] | 21.1[a] | 36.0[a] | 11.9[a] | 53.6[b] | 17.6[b] | 0.83[b] | 48.9[b] |
| Cobb × soymilk | 19.2[b] | 19.3[b] | 34.2[b] | 10.1[b] | 57.6[a] | 23.4[a] | 1.2[a] | 68.4[a] |
| Avian × control | 21.0[a] | 21.0[a] | 35.9[a] | 11.8[a] | 54.3[b] | 18.4[b] | 0.87[b] | 51.2[b] |
| Avian × soymilk | 19.7[b] | 19.8[b] | 34.7[b] | 10.2[b] | 57.5[a] | 22.8[a] | 1.2[a] | 65.7[a] |
| SEM | 0.13 | 0.11 | 0.10 | 0.22 | 0.59 | 0.75 | 0.10 | 2.1 |
| p value | 0.000 | 0.000 | 0.000 | 0.000 | 0.031 | 0.001 | 0.000 | 0.000 |

Means within each column for each category with no common superscript letters are significantly different (p≤.05). EGP: Egyptian pound. Total fixed cost equal 14.9 EGP/ bird. SEM: Standard error of the mean.

The effect of breed and supplementation of soymilk and their interaction on economic indices were presented in table (6) and the obtained data revealed that the two breeds showed no significant difference in any of the economic indices. However, supplementation of soymilk had significantly reduced feed costs/bird (19.5 vs. 21.1 EGP), total variable cost (19.5 vs. 21.1 EGP), total cost (34.4 vs. 36.0 EGP) and feed cost/ kg gain (10.2 vs. 11.9 EGP), this reduction in costs may be attributed to reduction in feed consumption as feed cost represent about 70% of total cost of poultry (Willems et al., 2013), while soymilk improved significantly total return (57.6 vs. 54.0 EGP), net return (23.2 vs. 18.0 EGP), net return per feed cost (1.2 vs. 0.85 EGP) and economic efficiency (67.4 vs. 50.0 %). In the same way supplementation of soymilk within each breed had significantly lowered production costs and significantly increased profitability measures in both Cobb 500 and Avian 48.This may be as a result of improvement of growth performance in treated group compared to control ones.

## 4. CONCLUSION

From the obtained data it had been concluded that supplementation of soymilk in drinking water as a growth promoter for broilers had a desirable effect of improving productive performance, carcass traits and the economic indices without any undesirable effect on broiler's health.

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