Effect of Probiotic Supplementation on Productive Performance and Economic Efficiency of Arbor Acres and Cobb300 Broilers

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Key words

ABSTRACT:
A total of 198 day old Arbor acres chicks and 198 Cobb300 were allotted into six groups (n=66) three for each strain, group one fed commercial broiler ration with BioGaurd (0.5g/kg ration) feed additives, group two fed commercial broiler ration with Micro-BACLA (0.5g/kg ration) feed additive and last one fed commercial ration without additives and kept as control for the same strain. The obtained result showed that, Arbor acres strain was superior than Cobb300 strains in the final body weight (1970. vs. 1831.3g), total weight gain (1914.0vs. 1769.35g), total feed conversion ratio (1.72 vs. 1.78), total return per average bird body weight (27.88 vs. 25.93 L.E./bird), net return (2.97 vs. 1.80 L.E./bird) and net return/total cost ratio (11.92 vs. 7.45).

Regarding to the effect of feed additives, yeast and bacteria containing probiotic (BioGaurd) improved significantly (P < 0.05) total body weight (1988.67 g), total weight gain (1938.99 g), total feed conversion ratio (1.69), total return (28.14 L.E./bird), net return (3.48 L.E./bird) and net return/total cost ratio (14.11) bacterial probiotic plus enzyme mixture (Micro-BACLA) and control groups. Moreover, compared to control group, Micro-BACLA feed additives improved total body weight (1858.63 vs. g), total weight gain (1801.18 g), total feed conversion(1.78) and total return (26.32 L.E./bird), however, Micro-BACLA significantly increased total cost (24.75 L.E./bird) which in return significantly decreased net return (1.57 L.E./bird) and net return/total cost ratio (6.34 %).

The interaction between strain and dietary supplement showed that within each strain yeast and bacteria containing probiotic (BioGaurd) improved productive performance and economic efficiency than bacterial probiotic plus enzyme mixture (Micro-BACLA), while Micro-BACLA increased productive performance but not affect economic efficiency parameters even when compared to control group.

From our experimental work it could be concluded that Arbor acres broiler when fed commercial ration supplemented by yeast and bacteria containing probiotic (BioGaurd) had better productive performance, total return, net return and net return/total cost ratio than Arbor acres fed ration with bacterial probiotic plus enzyme mixture (Micro-BACLA) or control without feed additives. Moreover, Arbor acres broilers were better than Cobb 300 broilers in both productive performance and economic efficiency.

1. INTRODUCTION:

The high cost of monogastric livestock production in most developing countries resulted from high cost of feed ingredients like cereal grains and protein concentrates (Esonu et al, 2003 and Obih and Ekenyem, 2010). Consequently, many farmers are either producing below capacity or totally out of production (Nsa et al, 2007).

It is extremely important for the highly intensive broiler production sector to achieve performance optimization and minimize economic losses with ensuring safety of broiler meat via control and elimination of food borne pathogens (Mountzouris et al., 2010). Not only feed additives can affect efficiency but also, selected strain, season of rearing,
housing and hygienic status of the farm, size of operation, diseases and mortalities, localities, feed and its efficient utilization and veterinary management (Muhammad, 2002).

Ignatova et al., (2009) reported that administration of probiotic affected positively body weight (P<0.001), feed intake and feed conversion rate of chickens compared to control group. Probiotic can be used successfully in broiler and turkey productionas it maintain good gut health and reduce pathogenic bacteria, thereby reducing the incidence of disease in the poultry themselves (Kampf, 2012).

The most important advantage of a probiotic is that it neither has any residues in animal production nor exerts any antibiotic resistance by consumption. Probiotics are being considered to fill this gap and already some farmers use them in preference to antibiotics. Therefore, a lot of researchers have partially replaced antibiotics with probiotics as therapeutic and growth promoting agents (FAO/WHO, 2001).

Not only live organisms but also enzymes are used for improvement of the health condition of poultry and so their production where the research studies run to date in both challenged and non-challenged situations illustrate the opportunity for successfully using xylanase, amylase, and protease and bacillus strains in combination due to their complementary modes of action where Momtazan et al., (2011) found that combination of enzyme complex and probiotic can improve the performance more than either supplement used on its own.

Due to low researches which studied the difference between broiler strains on productive and economic efficiency this study aimed to through light on the effect of strain and some yeast and bacterial containing probiotics (BioGaurd) or containing bacterial probiotics plus enzyme mixture (Micro-BACLA) on productive performance and economic efficiency of Arbor acres and Cobb300 broiler chicks productive performance and economic efficiency of two broilers strains (Arbor acres and Cobb 300).

BioGaurd is commercial growth promotors contain $1 \times 10^{10}$ CFU of *Saccharomyces cerevisiae*, $1 \times 10^{11}$ CFU *Bacillus subtilis*, $1 \times 10^{11}$ *Bacillus Licheniformis*, $1,000,000$ mg/kg amino acid, $90,000$ mg/kg mineral complex, $58,000$ mg/kg combined fatty acids (Product of SCI. CO., Ltd. Korea) at rate of $500$ g/ton as recommended by the company. While, Micro-BACLA: contains $2$ million CFU/gm *Lactobacillus acidophilus* $100$ gm, *Bacillus subtilis* fermentation extract $50$ gm (Alpha amylase $25000$ unit, Beta-glucanase $2250$ unit), *Aspergillus oryzae* fermentation extract $50$ g (Alpha amylase $25000$ unit, Protease $12500$ unit, Cellulase $4500$ unit and Dextrase carrier up to $1$ kg) (Product of Probyn International, Inc – USA) at rate of $500$ g/ton as recommended by the company.

**Birds and experimental design:**

A total of 198 day old Arbor acres chicks and 198 Cobb300 obtained from El-Sherouk Company, Egypt were allotted into six groups (n=66) three for each strain, group one fed commercial broiler ration with BioGaurd (0.5g/kg ration), group two fed commercial broiler ration with Micro-BACLA (0.5g/kg ration) and last one fed commercial ration without additives and kept as control.

**1. Management:**

**A. Housing:**

Broiler chicks were housed in a clean well ventilated room that previously disinfected by burning followed by formalin disinfection. The room was partitioned into 6 partitions, each one $2$ m$^2$ during first 10 days increased to $8$ m$^2$ later on. Each partition was provided by fresh, clean bedding material of wheat straw (4cm depth).

Chicks were brooded at $33 \pm 1$°C starting temperature during 1$\text{st}$ week then decrease gradually until reach $25 \pm 1$°Cat 5$\text{th}$ week by gas heater and 200 watt electric lamp. Birds were subjected to continuous lighting program (natural and artificial).

**B. Feeding:**

Each partition was provided by a suitable two water troughs and two feeders. Birds were fed a starter commercial mash ration from El-Fagr company (Egypt) contains $22.5\%$ protein and metabolized energy $3050$ kcal/kg (during the first 3 weeks) then grower ration $21.5\%$ of protein and metabolized energy $3150$ kcal/kg until the end of experiment (5$\text{th}$ week).
The birds were vaccinated against New Castle disease by Hitchner B1 live virus intra-ocular at 7th day, ND plus AI killed virus S/C at 9th day, Gumboro E228 live virus in drinking water at 14th day and ND Colon 79 live virus in drinking water at 19th day.

**D. Estimation of productive performance:**

**a. Feed intake:** Feed intake was estimated by regularly providing known amount of ration at 9 O’clock AM and at the end of the week the remaining part was weighed. The average daily feed intake was estimated.

**b. Body weight:** Chicks were wing banded and weekly weighed.

**c. Weight gain:** estimated by differences between two successive weights.

**d. Feed conversion:** estimated by dividing feed intake/g/bird over weight gain/g/bird according to Wanger et al., (1983).

\[
FCR = \frac{\text{Feed intake (g)/bird/week}}{\text{Body weight gain (g)/bird/week}}
\]

**E. Estimation of economic efficiency:**

**a. Total cost** (L.E/bird) was calculated according to El-Tahawy (2004) from summation of total fixed cost and total variable cost.

\[
\text{Total costs} = \text{Total fixed costs} + \text{Total variable costs.}
\]

**b. Total return** (L.E/bird) was calculated through summation of Litter sale plus broiler sale of group.

\[
\text{Total returns} = \text{Litter sale} + \text{Broiler sale}
\]

**c. Net return** (L.E./bird) calculated by subtraction of total cost from total return. Net return = Total returns – Total costs.

**F. Statistical analysis:**


**3. RESULTS AND DISCUSSION**

**1. Productive performance:**

**a. Body Weight:**

The data presented in Table (1) showed that, although by the end of the 1st week Cobb300 broiler were significantly heavier than Arbor acres (195.43±1.22 vs. 190.93±1.35 g) the Arbor acres were significantly (P<0.05) heavier during 2nd week (495.61±3.31 vs. 482.45±3.00 g), 3rd week (979.23±6.21 g), 4th week (1466.34±9.80 vs. 1362.51±8.57 g) and 5th week (1970.00±14.24 vs. 1831.30±12.89 g). The superiority of Arbor acres over Cobb300 broiler could be attributed to genetic makeup of the strain, similarly Saki et al.,(2010) who stated that better body weight appeared by Arbor acres strain in regarding of NRC diet than Cobb300 broilers.

With respect to the effect of probiotics on the body weights of broilers in (Table 1) showed that broiler chick fed on the control diet supplemented by yeast and bacteria containing probiotic (BioGaurd) resulted in significantly heavier broiler chicks than Micro-BACLA from 2nd week of the experiment (499.55±3.63 g) than both fed on the basal diet supplemented by bacterial probiotic plus enzyme mixture (Micro-BACLA) (490.50±3.62 g) and both groups had significantly heavier weight than control one (475.34±3.58 g). This trend extended from 2nd week till the end of experiment and this result may be attributed maintenance good gut health and reduce pathogenic bacteria by probiotics, thereby reducing the incidence of disease in poultry themselves, which returns in good body weight (Kampf, 2012). This finding agreed with Ahmed (2007) who found highly significance body weight of broilers supplemented by Saccharomyces cerevesiae, Bacillus subtilis, and Bacillus liecheniformis.

The interaction between strain and treatment showed the same trend, where Arbor acres chicks were significantly heavier than Cobb300 chicks in all groups. Moreover, diet supplemented by yeast and bacteria containing probiotic (BioGaurd) increased body weights in both strains than basal diet supplemented by bacterial probiotic plus enzyme mixture (Micro-BACLA) and both improved body weight than control groups (Table, 1). The administration probiotics in feed of Arbor acres diet was recommended to stimulate productive performance including final weight, this results due to the action of microbial floras on alimentary tract have a considerable effect on health and performance of boiler chickens (Alkhalf et al., 2010 and Yanbo and Qing 2010).
Table (1) Effect of dietary probiotics supplementation on body weight development (g/bird) of Arbor acres and Cobb00 broiler chicks strains (Mean ± Standard error).

<table>
<thead>
<tr>
<th>Item</th>
<th>1st week</th>
<th>2nd week</th>
<th>3rd week</th>
<th>4th week</th>
<th>5th week</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strain</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arbor acres</td>
<td>190.93±1.35a</td>
<td>495.61±3.31a</td>
<td>979.23±6.21a</td>
<td>1466.34±9.80a</td>
<td>1970.00±14.24a</td>
</tr>
<tr>
<td>Cobb300</td>
<td>195.43±1.22a</td>
<td>482.45±3.00b</td>
<td>935.93±5.62b</td>
<td>1362.51±8.57b</td>
<td>1831.30±12.89b</td>
</tr>
</tbody>
</table>

Table (2): Effect of dietary probiotics supplementation on body weight gain (g/bird) of Arbor acres and Cobb00 broiler chicks strains (Mean ± Standard error).

<table>
<thead>
<tr>
<th>Item</th>
<th>1st week</th>
<th>2nd week</th>
<th>3rd week</th>
<th>4th week</th>
<th>5th week</th>
<th>Total gain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strain</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arbor acres</td>
<td>137.01±1.35a</td>
<td>304.68±2.42a</td>
<td>487.22±4.33a</td>
<td>487.10±5.37a</td>
<td>505.10±7.05a</td>
<td>1914.00±14.24a</td>
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<tr>
<td>Cobb300</td>
<td>131.86±1.22b</td>
<td>287.01±2.19b</td>
<td>453.48±4.79b</td>
<td>426.57±4.66b</td>
<td>468.78±6.39b</td>
<td>1769.35±12.89b</td>
</tr>
</tbody>
</table>

Table (3): Effect of dietary probiotics supplementation on feed conversion ratio (g/bird) of Arbor acres and Cobb00 broiler chicks strains (Mean ± Standard error).

<table>
<thead>
<tr>
<th>Item</th>
<th>1st week</th>
<th>2nd week</th>
<th>3rd week</th>
<th>4th week</th>
<th>5th week</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strain</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arbor acres</td>
<td>1.06±0.02a</td>
<td>1.31±0.01b</td>
<td>1.44±0.02c</td>
<td>1.89±0.02b</td>
<td>2.25±0.04b</td>
<td>1.72±0.01b</td>
</tr>
<tr>
<td>Cobb300</td>
<td>1.17±0.01a</td>
<td>1.39±0.01b</td>
<td>1.48±0.01b</td>
<td>2.00±0.02a</td>
<td>2.28±0.03a</td>
<td>1.78±0.01a</td>
</tr>
</tbody>
</table>

Means within the same column carry different superscripts are significantly different (P<0.05).

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b. Body Weight Gain:

The data presented in Table (2) showed that average body weight gains of Arbor acres broilers were significantly higher than Cobb300 from 1st week (137.01±1.35 vs. 131.86±1.22 g) till 5th week of rearing (505.10±7.05 vs. 468.78±6.39 g), consequently total gain were significantly higher in Arbor acres (1141.00±14.24 g) than Cobb300 (1179.35±12.89 g), these results agreed with Ciurescu and Grosu (2011) who found that total gain of Cobb300 broilers were slightly lower compared to Arbor Acres.

Probiotics have been incorporated through diet in order to maintain the balance of the intestinal flora of animals, preventing digestive tract diseases, improving the digestibility of feed, leading to increased use of nutrients and causing better zootechnical performance of animal (Balcázar et al., 2006). These finding supported by other results which showed that broiler chick fed on the control diet supplemented by yeast and bacteria containing probiotic (BioGaurd) significantly increase weekly weight gain of broilers during 2nd week (309.92±2.65, 292.40±2.65 and 286.27±2.26 g/bird) and during all weeks of experiment till the last week (524.25±7.73, 481.12±7.73 and 452.32±7.62 g/bird) and consequently total weight gain were significantly higher in BioGaurd fed broilers (1938.99±15.60, 1801.18±15.59 and 1784.91±15.41 g/bird).

Although probiotics feeding within each strain did not significantly affect weight gain during 1st week however from 2nd week addition of yeast and bacteria containing probiotic (BioGaurd) to ration increased weight gain in Arbor acres (324.80±4.27 g/bird) than bacterial probiotic plus enzyme mixture (MicroBACLA) (298.42±3.77 g/bird) and control (301.00±3.88 g/bird) and in Cobb300 (295.03±3.47, 286.37±3.98 and 271.54±3.60 g/bird), Moreover this trend was clearly noticed during the next weeks of the experiment and total weight gain which was significantly higher in Arbor acres chicks fed yeast and bacteria containing probiotic (BioGaurd) (2016.04±25.45 g/bird) than bacterial probiotic plus enzyme mixture (Micro-BCLA) (1864.54±22.46 g/bird) and control group (1846.51±23.13 g/bird). The Cobb300 chicks showed the same weight gain trend of Arbor acres but with low gain compared to Arbor acres chicks (Table 2). This finding was in contact with those of Ahmed (2007) studied the effect of probiotics (Saccharomyces cerevisiae, Bacillus subtilis, and Bacillus liecheniformis) supplementation to broilers and found that highly significance body weight gain. Also Alkhalf et al (2010) found that probiotic treatment groups showed a significant increase in the daily weight gain due to improvement of digestibility and availability of many nutrients such as proteins, fats and carbohydrates, as well as, some mineral elements and vitamins.

The addition of bacterial probiotic plus enzyme mixture (Micro-BCLA) did not have any effect on body weight gain this was with an agreement with those of Seifi (2013) who found that the combination of (PrimaLac) contained the viable microorganisms (L. acidophilus, L. Casei, B. bifidum, E. faecium) and enzyme complex (Combo) containing β-glucanase, α-
amylose, cellulase, protease, and lipase not showed any significant effect on body weight gain.

c. Feed conversion ratio:
With feeding commercial broiler ration feed conversion ratio was better in Arbor acres broilers during 1st week (1.06±0.02 vs. 1.17±0.01), 2nd week (1.31±0.01), 3rd week (1.44±0.02), 4th week (1.89±0.02 vs. 2.00±0.02), 5th week (2.25±0.04 vs. 2.28±0.03) and total conversion ratio (1.72±1.78), variations between strains in their feed conversion ratio could be attributed to genetic makeup of each strain and so their requirements. This result agreed with Kalamah (2002) who found that as the cumulative feed conversion ratio was greater in Cobb strain than Ross and Arbor acres. Also with Ciurescu and Grosu (2011) who found that Cobb broilers had higher feed conversion ratio than Arbor acres broilers.

Regarding to the effect of probiotics, during 1st week control group not significantly different than two treated groups (Table 3), while, using yeast and bacteria containing probiotic (BioGaurd) improved total feed conversion ratio (1.69±0.03) compared to bacterial probiotic plus enzyme mixture (MicroBACLA) (1.78±0.01) and control groups (1.79±0.01). This trend was nearly during all weeks of the experiment from 2nd week (1.29±0.01, 1.38±0.02 and 1.39±0.01) and 5th week (2.15±0.09, 2.29±0.04 and 2.38±0.03) this could be attributed to the action of microbial floras on alimentary tract which have considerable effect on health and performance of broiler chickens (Yanbo and Qing 2010) and Alkhalf et al., 2010.

The interaction between strain and probiotic supplements showed that during 1st week Arbor acres had better conversion when fed bacterial probiotic plus enzyme mixture (Micro-BACLA) (1.01±0.01), while, during rest of experimental period feeding Arbor acres yeast and bacteria containing probiotic (BioGaurd) improve their feed conversion ration than bacterial probiotic plus enzyme mixture (MicroBACLA) and control during 2nd week, 3rd week, 4th week, 5th week and total feed conversion ratio (Table 3). Not only yeast and bacteria containing probiotic (BioGaurd) improve feed conversion ratio in Arbor acres broiler but also in Cobb300 broilers during all weeks of the experiment and in the total feed conversion ratio (Table 3). Moreover, during all weeks of experiment Arbor acres had better feed conversion than Cobb300 when feeding yeast and bacteria containing probiotic (BioGaurd), feeding bacterial probiotic plus enzyme mixture (MicroBACLA) or kept as control. This result agreed with Boostani et al., (2013) who found that Sacchromyces cerevisiae and Lactobacillus acidophilus significantly (p ≤ 0.01) improved feed conversion ratio. Also Abdel-Samee and Abdel-Hakim (2002) stated that Bacillus licheniformis bacteria and Bacillus subtilis significantly (P < 0.05) improved broiler performance.

The incorporation of Lactobacillus with enzymes in Micro-BACLA had no significant effect on feed conversion ratio compared to control groups in both strains of broilers during all weeks of the experiment this result is in close accordance with Seifi (2013) who found that combination of (PrimaLac) contained the viable microorganisms (L. acidophilus, L. Casei, B. bifidum, E. faecium) and enzyme complex (Combo) containing β-glucanase, α-amylase, cellulase, protease, and lipase had no significant effect on feed conversion ratio.

2. Economic efficiency:
The data presented in Table (4) showed that cost of production of Arbor acres chick was significantly higher than (24.91±0.01 L.E/bird) than Cobb300 bird (24.13±0.02 L.E/bird). Moreover, the benefit of rearing Arbor acres broilers was better than Cobb300 broilers as the total return per average weight of bird was significantly higher (27.88±0.21 vs. 25.93±0.19 L.E/bird), net return (2.97±0.20 vs. 1.80±0.18 L.E/bird) and net return/total cost ratio (11.92±0.81 vs. 7.45±0.74 %).This result attributed to the genetic structure of the two strain similarly, Omar (2003) Ahmed (2007) concluded that strains of broilers have a significant effect on the efficiency measures of production and percentage of net profit to total cost as Arbor acres significantly higher in Cobb broilers during summer season.

With respect to the effect of BioGaurd and MicroBACLA on the economic efficiency of broiler, the obtained results (table 4) showed that, although feed additives significantly increased total cost than control group, however, yeast and bacteria containing probiotic (BioGaurd) improved total return (28.14±0.26 L.E/bird) compared to Lactobacillus with enzymes in Micro-BACLA (26.32±0.23 L.E/bird) and both were better than control group (25.99±0.25 L.E/bird), net return (3.48±0.23 L.E/bird) than MicroBACLA and control groups (1.57±0.24 vs. 1.91±0.24 L.E/bird) and net return/total cost ratio (14.11±0.96 L.E/bird).
The increment of total cost when using Lactobacillus with enzymes than when use yeast and bacteria containing probiotic (BioGaurd) attributed to high price of Micro-BACLA than BioGaurd due to extra cost in producing enzyme in Micro-BACLA, similarly Obih et al., (2013) found that cost of finisher broiler birds fed enzyme/yeast supplemented broiler finisher rations, enzyme only, yeast only and enzyme+yeastand found that feed cost/kg differed significantly (p<0.05) between treatment means because of the extra cost in producing enzyme and yeast.

Feeding two types of feed additives within two different strains showed nearly the same results where BioGaurd and Micro-BACLA supplements increased significantly total cost compared to control group for each strain (Table 4), moreover, the increment in the total cost was compensated by highly significant increase in the total return (29.05±0.38 L.E./bird) when Arbor acres chicks supplemented by yeast and bacteria containing probiotic (BioGaurd) and (25.15±0.35 L.E./bird) when Cobb300 chicks fed yeast and bacteria containing probiotic (BioGaurd), however, with Lactobacillus with enzymes in Micro-BACLA the total return was nearly equal to control group.

Not only total return but also net return was significantly higher when Arbor acres broilers supplemented by yeast and bacteria containing probiotic (BioGaurd) (4.48±0.34 L.E./bird) and net return/total cost ratio (18.01±1.10 %), similarly, yeast and bacteria containing probiotic (BioGaurd) improved net return and net return/total cost ratio (2.69±0.29 L.E./bird) and (10.97±1.21%) respectively in Cobb300 broilers. This result in contact with those of Panda et al. (2006) and Bonsu et al. (2012) who found that probiotics on broiler chicken’s lead to increased economic profit margins this due to positive effect on performance. Micro-BACLA group supplemented groups not different than control group in total return and net return this could be attributed to the higher cost of Micro-BACLA which reduce the net return from Micro-BACLA, while, total return is high as bird's weight was high. This result was in agreement with Kefali et al (2007) who found that the effects of some commercial probiotic preparations on economics of broilers did not provide any profitable income under the market conditions when the study was conducted.

From the previous results of this study, it could be concluded that, Arbor acres strain had better body weight, body weight gain, feed conversion ratio, net return and net return/total cost ratio than Cobb300 strain. Also, yeast and bacteria containing probiotic (BioGaurd) feed additives improved broiler performance (body weight and weight gain and feed conversion ratio), also improved total return, net return and net return/total cost ratio in the both strains of broilers compared to Lactobacillus with enzymes in Micro-BACLA and those fed ration without feed additives.

G. REFERENCES


