

## **EFFECT OF DIETARY SUPPLEMENTAL AMINO ACIDS WITH OR WITHOUT PROBIOTIC ON PRODUCTIVE PERFORMANCE OF BROILER CHICKS**

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### **ABSTRACT**

Three hundred and sixty, 2 weeks old, unsexed Cobb chicks were used in this study to evaluate the effect of low protein diets fortification with amino acids and Probiotic on productive performance, carcass traits and some blood constituents.

Two control diets (19 % C.P.) and (17% C.P.) and eight experimental groups depending on two levels of Lysine and Methionine (0.1 or 0.2%) supplemented to the 17% protein diets with or without supplementation of probiotic (1.0×10<sup>9</sup> C.F.U. UP *Bacillus subtilis*; *Saccharomyces Cerevisiae*) were investigated.

Chicks fed 17% CP diet with adding 0.2% methionine plus probiotic (Treatment 10) showed significantly (P<0.05) highest body weight, body weight gain and consumed the lowest significantly (P<0.05) amount of feed. Furthermore, the same treatment showed highest value of carcass quality except for gizzard. However there was no significant effect of treatment on plasma total protein.

**Keywords:** Low protein diet, amino acids, Probiotic, broiler.

### **INTRODUCTION**

The feeding cost of poultry production are generally the most expensive item, particularly the protein units cost.

Protein is a critical component of poultry rations, and along with the other major nutrient classes of carbohydrates, fats, vitamins, minerals, and water it is essential for life (Cheeke, 2005; North and Bell; 1990, Pond *et al*, 1995).

Therefore, many workers aimed to reducing feed costs by decreasing dietary protein, levels, but the question is how they can achieve this goal without adverse impact on performance.

Amino acid requirements have been shown to fluctuate with the level of protein in the diet; specifically, the amino acid requirement, as a percentage of the diet, will increase with the concentration of dietary crude protein (Hurwitz *et al.*, 1998; Morris *et al.*, 1999; Sklan and Noy, 2003).

Addition of amino acids to diets permits a reduction in dietary protein content and at the same time provides the needs of all indispensable amino acids required by chicks with an optimal amino acid profile (Sklan and Noy, 2003).

It is known that broiler chicks fed diets marginal in protein but fortified with Methionine or Methionine plus lysine will perform as well as those fed a diet higher in its protein contents (Morris *et al.*, 1999).

The availability of commercial synthetic amino acids allow this to be done with low protein diets by avoiding an excess of each amino acid requirement.

Results obtained by many investigators indicate that protein utilization efficiency was improved as a consequence of minimizing excess levels of essential amino acids in the diet. Recently, it is observed that chicks fed low-protein diets supplemented with amino acids had similar performance as those fed a 23% crude protein diet (Hurwitz *et al.*, 1998).

Probiotic have been introduced as a feed additive. Some trials have shown that this component improves bird performance and causes a drop in mortality rates (El-Ghamry *et al.*, 2002).

*Saccharomyces cereviside* contains large amounts of yeast metabolites. These metabolites had the ability for inhibiting harmful bacteria, altering microbial metabolism and decrease intestinal pH and then used as probiotics (Makled, 1991 and Miles and Bootwella, 1991).

The present study aimed to investigate the effect of low protein diets with amino acids and probiotic supplementation on performance of broiler chickens.

## **MATERIALS AND METHODS**

The current study was carried out at the Experimental and Research Farm of Poultry, Poultry Production Department, Faculty of Agriculture, Mansoura University. The main objective was to investigate the effect of low protein diets fortification with amino acids and Probiotic on productive performance of broiler chicks, carcass traits, some blood constituents and economic efficiency.

### **Birds and management:**

A total of 360, one day old Cobb-500 broiler chicks were used in the present study. They were fed a commercial starter diet containing 21% crude protein and 3000 kcal ME/kg of diet from hatching to two weeks of age. At the beginning of the third week, chicks were randomly and equally distributed into ten groups of 36 chicks in three replicates, 12 chicks each. These groups were allotted to the following experimental treatments:

T<sub>1</sub>: birds were fed a basal diet containing 19% crude protein and served as a normal control group (Table1).

T<sub>2</sub>: birds were fed a basal diet containing 17% crude protein as a low protein diet group.

T<sub>3</sub> and T<sub>4</sub>: birds were fed the low crude protein diet plus 0.1 or 0.2 % L-lysine.

T5 and T6: similar to T3 and T4 but with 1.5mg/kg diet of supplemental probiotic (*Bacillus subtilis*; *saccaromyces cerevisiae*).

T7 and T8: birds were fed the low crude protein diets (17%CP) plus 0.1 or 0.2% DL- Methionine, respectively.

T9 and T10: Similar to T7 and T8 but with the supplemental probiotic (1.5mg/kg diet).

- The composition and calculated analysis of the basal diets are shown in Table-1.

Feed and water were offered *ad libitum* during the experimental period which lasted for five weeks (3-7 wks of age). Chicks of all groups were kept under similar hygienic, environmental and managerial conditions.

**Table (1): Composition and calculated analysis of the experimental diets.**

| Treatment                    | Control diet | Low protein diet |
|------------------------------|--------------|------------------|
| <b>Ingredients</b>           |              |                  |
| Yellow corn                  | 72.54        | 76.33            |
| Soybean meal (44%)           | 9.00         | 10.00            |
| Corn gluten                  | 13.43        | 8.500            |
| Dicalcium phosphate          | 2.300        | 2.300            |
| Limestone                    | 1.300        | 1.300            |
| Vit. & min. premix*          | 0.400        | 0.400            |
| Common salt                  | 0.400        | 0.400            |
| DL-Methionine                | 0.060        | 0.120            |
| L-Lysine                     | 0.570        | 0.650            |
| <b>Total</b>                 | <b>100</b>   | <b>100</b>       |
| <b>Calculated analysis**</b> |              |                  |
| Crude protein (CP); %        | 19.16        | 17.00            |
| M.E., Kcal/kg                | 3135         | 3101             |
| Ether extract (EE); %        | 3.160        | 3.190            |
| Crude fiber (CF); %          | 2.400        | 2.480            |
| %Calcium,                    | 1.030        | 1.030            |
| A.ph. %                      | 0.500        | 0.500            |
| %Methionine,                 | 0.440        | 0.440            |
| Lysine, %                    | 1.130        | 1.200            |

\* Premix at 0.30 of the diet supplies, the following per Kg of the diets: Vit. A 1000 I.U., Vit D3 2000 I.U., Vit E 10 mg, Vit K 1 mg, Vit B<sub>1</sub> 5mg, Vit B<sub>2</sub> 5mg, vit B<sub>6</sub> 1.5 mg, Vit B<sub>12</sub> 0.01 mg, folic acid 0.35 mg, Biotin 0.05 mg, Pantothenic acid 10 mg, Niacin 30 mg, Choline 250 mg, Fe 30 mg, Zn 50 mg, Cu 4 mg and Se 0.1 mg.

\*\* according to N.R.C. 1994.

**Characteristics investigated:**

All birds were individually weighed at the beginning of the experimental period and then at weekly intervals to determine live body weight and body weight gain.

Feed consumption (g/bird/day) and feed conversion ratio (feed: gain, g) were recorded weekly for each treatment.

At the end of the experimental period (7 weeks of age) six chickens from each treatment were randomly selected, weighed and slaughtered to complete bleeding, followed by plucking the feather and then reweighed.

Dressing percentage was determined after removal of head, viscera, and shanks. Liver and gizzard were weighed, and expressed as a percentage of the live body weight. Blood samples from three birds per treatment were taken at slaughtering in heparinized tubes and centrifuged immediately for 10 min at 4000 r.p.m to separate blood plasma. The plasma samples were decanted in Ependorf tubes and plasma samples were kept frozen at -20° c until the time of analysis. Blood glucose was determined according Trinder (1969), total protein (Doumas, 1975), albumin (Doumas *et al.*, 1971), cholesterol (Allain *et al.*, 1974) Glutamic-Oxaloacetic Transaminase (GOT) and Glutamic-Pyruvic Transaminase (GPT) (Reitman and Frankel, 1957) were determined by using available commercial kits.

Data were statistically analyzed (SAS, 1990) by the application of the least square procedure. Differences among treatments means were done by using Duncan's multiple range test (Duncan, 1955).

## RESULTS AND DISCUSSION

### **Live body weight:**

The effects of experimental treatments on body weight of broiler chicks are presented in Table (2). The initial body weight at the beginning of the third week of age, ranged from 413.33 to 416.67g without significant differences among treatments. At 5 weeks of age, the control (T<sub>1</sub>) and T<sub>8</sub>, T<sub>9</sub> and T<sub>10</sub> treatment groups showed the highest ( $p \geq 0.05$ ) mean of body weight. The lowest values were recorded for the other treatment groups that fed 17% either with or without supplementations.

At 7 weeks of age, broilers fed the experimental diet (17 % CP) with different additions (from T<sub>5</sub> up to T<sub>10</sub>) attained significantly higher body weight. However, broiler fed the control diet (19% CP) showed also similar body weight comparable to the highest values observed.

These results are in agreement with the findings by Tolba *et al.* (2004) who found significant increase in body weight at 35, 42 and 49 days of age compared with control group of those birds fed on a diet supplemented with probiotics.

However, El-Ghamry *et al.* (2002) indicated that there were no significant differences in live body weight and weight gain between the broiler chicks fed a basal diet with 0.1% or 0.2% yeast culture (*Saccharomyces cerevisiae*).

### **Body weight gain:**

At the period from 3 to 5 weeks of age, the T<sub>8</sub> and T<sub>10</sub> followed by T<sub>1</sub> and T<sub>9</sub>, respectively, showed the highest significantly body weight gain than other treatments. While, treatment (19% CP) had significantly lower body weight gain than the other groups through from 5 – 7 weeks of age.



Treatment 10 (17% CP + 0.2 Methionine + probiotic) and treatment 8 (17% CP + 0.2 Methionine) showed the highest of body weight gain at the period from 3 – 7 weeks of age, respectively (1683.33 and 1681.67), as shown in Table 2.

In the same trend, Salim (2004) studied the effect of using probiotics on growth performance of broiler chicks from 7 – 49 days of age. He found significant increase in body weight gain compared with the control during the most of the experimental periods

**Feed intake:**

During the first period of the experiment (3 – 5 weeks of age), broilers group received diet contained 17 % CP + 0.2 methionine with probiotic gave the highest value for feed intake (1395 g), while the lowest feed intake (1300 gm) was for broiler groups fed T<sub>2</sub> to T<sub>6</sub> as compared to those receiving other experimental diets. Treatment 3 (17% CP + 0.1 lysine) had significantly higher feed intake (2000.33 gm) than those fed other experimental diets during the second period of the experiment (5 – 7 weeks).

Overall the experimental period (3 – 7 weeks of age), birds fed on 17% CP + 0.1 % methionine or 17 % CP alone recorded the highest values for feed intake (3363.33 or 3362.33 gm) when compared to the other dietary treatments.

No significant effect due to experimental treatment at periods from 5 – 6 and 6 – 7 weeks of age.

These results are in agreement with Tolba *et al.* (2004) who found significant increases in feed intake at 35, 42, and 49 days of age compared with control. But, Abd-Elsamee (2001) showed that adding probiotic to broiler chick diets recorded significantly higher feed intake than those fed diets without supplementation during 1-4 and 5-7 weeks of age.

**Feed conversion ratio:**

The effects of experimental treatments on feed conversion ratio of broiler presented in Table (2).

The best FCR was obtained by birds fed T<sub>10</sub>, T<sub>8</sub> or T<sub>1</sub> while the worst FCR (1.90) was obtained by T<sub>2</sub> (17% CP alone) through the first period of the experimental (3 – 5 wks).

It is clear that, value FCR were significantly impaired with birds fed 19 or 17% CP diet when compared with the other experimental diets during the second period (5 – 7 weeks of age).

No significant effect due to experimental treatment at periods from 6 – 7 and 3 – 7 weeks of age.

**Blood parameters:**

The effects of experimental treatments on blood parameters of broiler chicks are presented in Table (3).

The results revealed that control treatment (19% protein) predeceased significant increased in the concentration of glucose, percentage of hemoglobin and activity of AST and ALT were negatively affected compared with their control counterparts.

3-4

There was significant effect due to experimental treatment on total protein and cholesterol.

The same trend found by El-Ghamry *et al.* (2002) showed that when broiler chicks fed on diets with 2 levels of yeast culture (0.1 and 0.2%), the concentration of plasma total protein, albumin and globulin were not affected markedly with the experimental diets

**Carcass quality:**

The effects of different treatment on carcass traits (as percent of live body weight) are shown in (Table 4)

Results indicated that no significant effect among treatments on live body weight, however, percentage of carcass traits including dressing carcass, heart, liver, abdominal fat were increased significantly by treatment 10 (17% CP + probiotic). Treatments (T<sub>3</sub>, T<sub>4</sub> and T<sub>5</sub>) showed highest significantly percentage of gizzard as compared to the other treatments.

These results agreement with found by Salim (2004) studied the effect of adding probiotics (Premalac, Lacture and Biobadus) of the diet to broiler chicks on carcass characteristics. They found that the average values of internal organs as a percentage of body weight (liver, gizzard, heart, spleen, thymus and bursa) increase in probiotic constituents compared to control group.

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### **تأثير إضافة الأحماض الأمينية مع أو بدون البروبيوتك علي الأداء الإنتاجي لدجاج التسمين**

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أجريت هذه الدراسة بهدف بحث تأثير استخدام مستويات منخفضة من بروتين العليقة مع إضافة الأحماض الأمينية على الأداء الإنتاجي لدجاج التسمين. تم تكوين عدد تسعة علائق تجريبية منخفضة في البروتين (17%) مع الاحتفاظ بنفس القدر من الطاقة المثلة بالإضافة لعليقة أخرى للمقارنة (19% بروتين خام).

تم استخدام عدد 360 كتكوت من سلالة الكب التجارية غير مجنسة قسمت إلى عشرة مجموعات تجريبية بالتساوي وغذيت الكتاكت علي العلائق التجريبية من بداية الأسبوع الثالث وحتى عمر 7 أسابيع تحت ظروف رعاية موحدة مع التغذية الحرة.

كانت المعاملات التجريبية كما يلي : المجموعة الأولى غذيت على عليقة تجارية تحتوى على 19% بروتين (للمقارنة) – المجموعة الثانية غذيت على عليقة تحتوى على 17% بروتين (منخفضة البروتين) بدون إضافات (للمقارنة أيضا) تم ثمانية علائق تجريبية منخفضة البروتين (17%) مع إضافة مستوي 0.1% من الحمض الأميني ليسين للمجموعة 3، 4، ومستوي 0.2% من الحمض الأميني ليسين للمجموعة 5، 6، ومستوي 0.1% من الحمض الأميني ميثونين للمجموعة 7، 8، ومستوي 0.2% من الحمض الأميني ميثونين للمجموعة 9، 10، وتم إضافة المحفز الحيوي بروبوتك بمعدل (1.5 ملليجرام لكل كيلوجرام للمجموعة) للمجموعات رقم 4، 6، 8، 10

تم اخذ القياسات المختلفة ومنها وزن الجسم الحي ، الزيادة في وزن الجسم ، معدل التحويل الغذائي، معدل استهلاك العلف ، مقاييس جودة الذبيحة، بعض مقاييس الدم ونشاط إنزيمات الكبد في الدم. أظهرت النتائج أن وزن الجسم وكذلك الزيادة الوزنيه يتحسن معنويا عند استخدام الحمض الأميني الميثونين بمستوياته وكذلك عند إضافة المحفز الحيوي لمستوي 0.2 من حمض الميثونين وكانت أفضل العلائق هي الأخيرة.

توضح النتائج أيضا أن معامل التحويل الغذائي كان أحسن ما يمكن في المجموعات التي غذيت على مستوي 17% بروتين

**ويمكن تلخيص النتائج المتحصل عليها خلال الفترة التجريبية فيما يلي :**

الدجاج الذي تغذي على العليقة التجريبية العاشرة ( 17% بروتين بإضافة البروبوتك) أظهرت تغيرات معنوية حيث زاد وزن الجسم و تحسن معامل التحويل و استهلكت كمية غذاء أقل وأظهرت تحسن في صفات الذبيحة عدا القنوصة و كذلك لم يظهر أي تأثير معنوي للعلائق المختبرة علي صفات الدم المدروسة.

**قام بتحكيم البحث**

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**Table (2): Effect of dietary protein levels and supplemental amino acids with or without probiotic on broiler performance (Means±SE).**

| Broiler performance | Treatment (T)                  |                              |                               |                               |                               |                              |                              |                               |                              |                              |
|---------------------|--------------------------------|------------------------------|-------------------------------|-------------------------------|-------------------------------|------------------------------|------------------------------|-------------------------------|------------------------------|------------------------------|
|                     | T1                             | T2                           | T3                            | T4                            | T5                            | T6                           | T7                           | T8                            | T9                           | T10                          |
| <b>Body weight</b>  |                                |                              |                               |                               |                               |                              |                              |                               |                              |                              |
| 3wk                 | 413.33 ± 6.01                  | 413.33 ± 8.82                | 416.67 ± 8.82                 | 415.00 ± 2.89                 | 413.33 ± 6.01                 | 411.67 ± 3.33                | 413.33 ± 4.44                | 413.33 ± 1.67                 | 416.67 ± 1.14                | 415.00 ± 2.89                |
| 5wk                 | 1225.00 ± 12.58 <sup>a</sup>   | 1140.00 ± 20.21 <sup>b</sup> | 1155.00 ± 22.19 <sup>b</sup>  | 1150.00 ± 5.77 <sup>b</sup>   | 1158.33 ± 15.90 <sup>b</sup>  | 1166.67 ± 7.26 <sup>b</sup>  | 1166.67 ± 12.02 <sup>b</sup> | 1241.67 ± 33.46 <sup>a</sup>  | 1223.33 ± 18.33 <sup>a</sup> | 1258.33 ± 8.66 <sup>a</sup>  |
| 7wk                 | 2048.33 ± 29.49 <sup>ab</sup>  | 1998.33 ± 6.01 <sup>c</sup>  | 2035.00 ± 21.79 <sup>bc</sup> | 2038.33 ± 6.01 <sup>bc</sup>  | 2060.00 ± 30.55 <sup>ab</sup> | 2056.67 ± 7.26 <sup>ab</sup> | 2058.33 ± 6.01 <sup>ab</sup> | 2095.00 ± 2.89 <sup>a</sup>   | 2095.00 ± 8.33 <sup>a</sup>  | 2098.33 ± 6.01 <sup>a</sup>  |
| <b>Weight gain</b>  |                                |                              |                               |                               |                               |                              |                              |                               |                              |                              |
| 3-5wk               | 811.67 ± 13.51 <sup>b</sup>    | 726.67 ± 9.28 <sup>c</sup>   | 738.33 ± 18.33 <sup>c</sup>   | 735.00 ± 4.24 <sup>c</sup>    | 745.00 ± 12.00 <sup>c</sup>   | 755.00 ± 8.88 <sup>c</sup>   | 753.33 ± 13.51 <sup>c</sup>  | 828.33 ± 16.46 <sup>a</sup>   | 806.66 ± 18.56 <sup>b</sup>  | 843.33 ± 14.89 <sup>a</sup>  |
| 5-7wk               | 823.33 ± 10.14 <sup>c</sup>    | 858.33 ± 8.82 <sup>bc</sup>  | 880.00 ± 12.58 <sup>b</sup>   | 888.33 ± 7.26 <sup>ab</sup>   | 901.67 ± 14.53 <sup>a</sup>   | 890.00 ± 7.64 <sup>a</sup>   | 891.66 ± 8.82 <sup>a</sup>   | 853.33 ± 6.89                 | 871.67 ± 14.24 <sup>b</sup>  | 840.00 ± 13.02 <sup>bc</sup> |
| 3-7wk               | 1635.00 ± 27.54 <sup>abc</sup> | 1585.00 ± 2.89 <sup>c</sup>  | 1618.33 ± 13.64 <sup>bc</sup> | 1623.33 ± 7.26 <sup>bc</sup>  | 1646.67 ± 36.09 <sup>ab</sup> | 1645.00 ± 7.64 <sup>ab</sup> | 1645.00 ± 5.77 <sup>ab</sup> | 1681.67 ± 4.41 <sup>a</sup>   | 1678.33 ± 1.67 <sup>a</sup>  | 1683.33 ± 7.26 <sup>a</sup>  |
| <b>Feed intake</b>  |                                |                              |                               |                               |                               |                              |                              |                               |                              |                              |
| 3-5wk               | 1363.67 ± 8.37 <sup>ab</sup>   | 1380.00 ± 6.01 <sup>a</sup>  | 1358.33 ± 3.33 <sup>ab</sup>  | 1344.67 ± 8.8 <sup>b</sup>    | 1311.33 ± 12.02 <sup>c</sup>  | 1300.00 ± 12.03 <sup>c</sup> | 1393.33 ± 5.00 <sup>a</sup>  | 1380.00 ± 6.01 <sup>a</sup>   | 1386.67 ± 8.66 <sup>a</sup>  | 1395.00 ± 4.41 <sup>a</sup>  |
| 5-7wk               | 1982.34 ± 14.24 <sup>ab</sup>  | 2000.33 ± 10.14 <sup>a</sup> | 1958.33 ± 3.33 <sup>b</sup>   | 1960.00 ± 3.33 <sup>b</sup>   | 1971.67 ± 12.58 <sup>b</sup>  | 1961.67 ± 11.67 <sup>b</sup> | 1970.00 ± 7.26 <sup>b</sup>  | 1980.00 ± 10.14 <sup>ab</sup> | 1966.67 ± 13.02 <sup>b</sup> | 1958.34 ± 6.67 <sup>b</sup>  |
| 3-7wk               | 3346.00 ± 31.13 <sup>a</sup>   | 3362.33 ± 13.64 <sup>a</sup> | 3316.67 ± 6.67 <sup>ab</sup>  | 3305.00 ± 21.79 <sup>ab</sup> | 3283.33 ± 34.80 <sup>b</sup>  | 3261.67 ± 4.41 <sup>b</sup>  | 3363.33 ± 4.41 <sup>a</sup>  | 3360.00 ± 12.58 <sup>a</sup>  | 3353.33 ± 15.90 <sup>a</sup> | 3353.33 ± 6.01 <sup>a</sup>  |
| <b>Feed conv.</b>   |                                |                              |                               |                               |                               |                              |                              |                               |                              |                              |
| 3-5wk               | 1.68 ± 0.001 <sup>b</sup>      | 1.90 ± 0.011 <sup>a</sup>    | 1.84 ± 0.004 <sup>ab</sup>    | 1.83 ± 0.007 <sup>ab</sup>    | 1.76 ± 0.004 <sup>b</sup>     | 1.72 ± 0.003 <sup>b</sup>    | 1.85 ± 0.002 <sup>ab</sup>   | 1.66 ± 0.014 <sup>b</sup>     | 1.72 ± 0.009 <sup>b</sup>    | 1.65 ± 0.005 <sup>b</sup>    |
| 5-7wk               | 2.40 ± 0.006 <sup>a</sup>      | 2.33 ± 0.001 <sup>a</sup>    | 2.22 ± 0.009 <sup>b</sup>     | 2.21 ± 0.007 <sup>b</sup>     | 2.19 ± 0.002 <sup>b</sup>     | 2.20 ± 0.016 <sup>b</sup>    | 2.21 ± 0.019 <sup>b</sup>    | 2.32 ± 0.0015 <sup>a</sup>    | 2.26 ± 0.006 <sup>b</sup>    | 2.33 ± 0.017 <sup>a</sup>    |
| 3-7wk               | 2.04 ± 0.002 <sup>b</sup>      | 2.12 ± 0.005 <sup>a</sup>    | 2.05 ± 0.002 <sup>b</sup>     | 2.04 ± 0.002 <sup>b</sup>     | 1.99 ± 0.002 <sup>b</sup>     | 1.98 ± 0.001 <sup>b</sup>    | 2.04 ± 0.003 <sup>b</sup>    | 2.00 ± 0.006 <sup>b</sup>     | 2.00 ± 0.001 <sup>b</sup>    | 1.99 ± 0.003 <sup>b</sup>    |

**T1: Control group, 19% CP, T2: Control group, 17% CP, T3: 17% CP +0.1%Lysine, T4: 17% CP +0.2%Lysine, T5: T3 + probiotic (1.5mg/kg diet), T6: T4 + probiotic (1.5mg/kg diet), T7: 17% CP + 0.1 Methionene, T8: 17% CP + 0.1 Methionene, T9: T7 + probiotic (1.5mg/kg diet), T10: T8 + probiotic (1.5mg/kg diet)**

**a,b,c,....means within rows with different superscripts differ significantly (p≤0.05).**

**Table (3): Effect of dietary protein levels and supplemental amino acids with or without probiotic on blood analyses (Means±SE).**

| Blood analyses | Treatment (T)             |                            |                            |                            |                           |                           |                           |                            |                           |                           |
|----------------|---------------------------|----------------------------|----------------------------|----------------------------|---------------------------|---------------------------|---------------------------|----------------------------|---------------------------|---------------------------|
|                | T1                        | T2                         | T3                         | T4                         | T5                        | T6                        | T7                        | T8                         | T9                        | T10                       |
| Globulin       | 235.33±21.57 <sup>a</sup> | 201.33±10.93 <sup>ab</sup> | 205.17±1.42 <sup>ab</sup>  | 199.00±9.93 <sup>ab</sup>  | 210.83±6.41 <sup>ab</sup> | 191.67±8.96 <sup>b</sup>  | 224.00±6.61 <sup>ab</sup> | 209.83±16.62 <sup>ab</sup> | 195.50±9.29 <sup>b</sup>  | 208.07±4.13 <sup>ab</sup> |
| Total protein  | 3.88±0.51                 | 3.48±0.008                 | 3.90±0.009                 | 3.59±0.007                 | 3.58±0.12                 | 3.60±0.32                 | 3.56±0.009                | 3.48±0.007                 | 3.81±0.14                 | 3.65±0.006                |
| HG             | 10.18±0.48 <sup>a</sup>   | 9.88±0.57 <sup>ab</sup>    | 9.36±0.34 <sup>bc</sup>    | 9.38±0.66 <sup>bc</sup>    | 8.68±0.33 <sup>bcd</sup>  | 7.76±0.27 <sup>d</sup>    | 8.30±0.32 <sup>cd</sup>   | 9.73±0.53 <sup>ab</sup>    | 9.20±0.005 <sup>bc</sup>  | 9.05±0.18 <sup>abc</sup>  |
| Glucose        | 274.72±13.95              | 294.82±11.45               | 283.32±8.87                | 321.81±7.65                | 316.28±1.66               | 315.76±5.34               | 289.63±13.23              | 317.99±33.38               | 303.75±34.54              | 302.01±5.95               |
| GPT            | 33.67±2.17 <sup>a</sup>   | 26.17±1.96 <sup>c</sup>    | 24.33±3.28 <sup>bc</sup>   | 20.33±1.96 <sup>bc</sup>   | 26.67±3.09 <sup>c</sup>   | 17.50±0.87 <sup>c</sup>   | 22.67±1.74 <sup>bc</sup>  | 22.67±1.74 <sup>bc</sup>   | 18.33±2.62 <sup>c</sup>   | 23.59±1.11 <sup>bc</sup>  |
| GOT            | 247.83±15.24 <sup>a</sup> | 204.33±7.84 <sup>bc</sup>  | 193.33±15.83 <sup>bc</sup> | 187.50±15.16 <sup>bc</sup> | 189.67±1.96 <sup>bc</sup> | 190.83±1.48 <sup>bc</sup> | 166.67±13.75 <sup>c</sup> | 213.00±8.54 <sup>b</sup>   | 166.33±12.37 <sup>c</sup> | 195.50±5.60 <sup>bc</sup> |

T1: Control group, 19% CP, T2: Control group, 17% CP, T3: 17% CP +0.1%Lysine, T4: 17% CP +0.2%Lysine, T5: T3 + probiotic (1.5mg/kg diet), T6: T4 + probiotic (1.5mg/kg diet), T7: 17% CP + 0.1 Methionene, T8: 17% CP + 0.1 Methionene, T9: T7 + probiotic (1.5mg/kg diet), T10: T8 + probiotic (1.5mg/kg diet)

a,b,c,.....means within rows with different superscripts differ significantly (p≤0.05).

**Table (4): Effect of dietary protein levels and supplemental amino acids with or without probiotic on carcass traits(Means±SE).**

| Carcass traits | Treatment (T)             |                            |                            |                            |                            |                            |                            |                           |                            |                           |
|----------------|---------------------------|----------------------------|----------------------------|----------------------------|----------------------------|----------------------------|----------------------------|---------------------------|----------------------------|---------------------------|
|                | T1                        | T2                         | T3                         | T4                         | T5                         | T6                         | T7                         | T8                        | T9                         | T10                       |
| Body weight    | 2.047 ± 0.008             | 1.998 ± 0.008              | 2.033 ± 0.030              | 2.036 ± 0.063              | 2.056 ± 0.055              | 2.056 ± 0.023              | 2.096 ± 0.047              | 2.096 ± 0.039             | 2.069 ± 0.023              | 2.057 ± 0.057             |
| D. weight %    | 75.57 ± 0.18 <sup>a</sup> | 75.06 ± 0.24 <sup>c</sup>  | 75.08 ± 0.08 <sup>c</sup>  | 76.42 ± 0.25 <sup>ab</sup> | 75.23 ± 0.36 <sup>bc</sup> | 74.31 ± 0.96 <sup>c</sup>  | 75.20 ± 0.10 <sup>bc</sup> | 75.04 ± 0.25 <sup>c</sup> | 75.51 ± 0.23 <sup>bc</sup> | 76.80 ± 0.35 <sup>a</sup> |
| Heart %        | 0.53 ± 0.003 <sup>c</sup> | 0.54 ± 0.005 <sup>bc</sup> | 0.55 ± 0.005 <sup>bc</sup> | 0.55 ± 0.005 <sup>bc</sup> | 0.54 ± 0.008 <sup>bc</sup> | 0.55 ± 0.005 <sup>bc</sup> | 0.54 ± 0.010 <sup>bc</sup> | 0.53 ± 0.003 <sup>c</sup> | 0.56 ± 0.008 <sup>ab</sup> | 0.57 ± 0.010 <sup>a</sup> |
| Gizzard %      | 1.58 ± 0.024 <sup>c</sup> | 1.63 ± 0.021 <sup>b</sup>  | 1.75 ± 0.005 <sup>a</sup>  | 1.76 ± 0.017 <sup>a</sup>  | 1.75 ± 0.023 <sup>a</sup>  | 1.62 ± 0.005 <sup>bc</sup> | 1.65 ± 0.014 <sup>bc</sup> | 1.66 ± 0.008 <sup>b</sup> | 1.65 ± 0.031 <sup>b</sup>  | 1.57 ± 0.014 <sup>c</sup> |
| Liver %        | 2.57 ± 0.01 <sup>c</sup>  | 2.98 ± 0.02 <sup>ab</sup>  | 3.05 ± 0.02 <sup>a</sup>   | 3.01 ± 0.02 <sup>a</sup>   | 2.84 ± 0.14 <sup>b</sup>   | 3.00 ± 0.02 <sup>a</sup>   | 3.03 ± 0.01 <sup>a</sup>   | 3.01 ± 0.01 <sup>a</sup>  | 3.02 ± 0.02 <sup>a</sup>   | 3.06 ± 0.03 <sup>a</sup>  |
| A. fat %       | 2.58 ± 0.15 <sup>c</sup>  | 2.86 ± 0.03 <sup>ab</sup>  | 2.88 ± 0.03 <sup>ab</sup>  | 2.93 ± 0.01 <sup>b</sup>   | 2.99 ± 0.04 <sup>ab</sup>  | 3.00 ± 0.05 <sup>a</sup>   | 3.01 ± 0.06 <sup>a</sup>   | 3.01 ± 0.03 <sup>a</sup>  | 3.01 ± 0.08 <sup>a</sup>   | 3.02 ± 0.06 <sup>a</sup>  |

T1: Control group, 19% CP, T2: Control group, 17% CP, T3: 17% CP +0.1%Lysine, T4: 17% CP +0.2%Lysine, T5: T3 + probiotic (1.5mg/kg diet), T6: T4 + probiotic (1.5mg/kg diet), T7: 17% CP + 0.1 Methionene, T8: 17% CP + 0.1 Methionene, T9: T7 + probiotic (1.5mg/kg diet), T10: T8 + probiotic (1.5mg/kg diet)

a,b,c,.....means within rows with different superscripts differ significantly (p≤0.05).