*J. Agric. Sci. Mansoura Univ., 28 (10): 7123 - 7138, 2003*

# EFFECTS OF DIETARY LEVEL OF RICE POLISHINGS ON THE PERFORMANCE, NUTRIENTS DIGESTIBILITY AND SOME BLOOD PARAMETERS OF BROILER CHICKS

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## ABSTRACT

The present study was carried out to investigate the effect of using rice polishings (RP) in broiler diets on the performance of chicks. Five levels of RP (0.0, 10, 20, 30 or 40%) were used in five starter and five grower diets. All experimental diets were used with or without phytase supplementation (0.0 or 0.4 kg/ton feed). The experimental diets were isoenergetic-isonitrogenous (the starter diets contained ME of about 3200 kcal/kg and CP of about 23%, whereas, the grower diets had ME of about 3100 kcal/kg and CP of about 20%). Three hundred and thirty, one-day-old, broiler-type Hubbard chicks were randomly divided into ten equal experimental groups of 3 replications each. The chicks were fed the starter diets *ad libitum* up to 21 day-old, then they were switched to the grower diets from 22 to 42 days of age.

The criteria of response were live body weight, weight gain, feed intake, feed conversion ratio, mortality rate, carcass traits, nutrients digestibility, some blood constituents (plasma glucose, total protein, total lipids, cholesterol and inorganic phosphorus) and economic efficiency. The obtained results can be summarized as follows: - Using RP in broiler diets up to 40% improved the economic efficiency and did not affect carcass traits, nutrients digestibility, mortality rate or blood parameters of chicks. However, when RP was added at inclusicn rate of 40% of the diet, both marketing live body weight and feed intake of broiler chicks were significantly depressed but the feed conversion ratio was not affected. Supplementation of the diets with phytase significantly increased the body weight of chicks, body weight gain, feed intake and improved the feed conversion ratio. However, enzyme supplementation had no effect on carcass traits, nutrients digestibility and blood constituents in chicks, or on the economic efficiency of the experimental diets. From the previous results, it can be concluded that rice polishings can be used up to 30% of the corn-soybean broiler diets by which good results of broiler performance, carcass traits and economic efficiency can be obtained. Supplementation of the diets with phytase significantly improved the performance of broiler chicks.
**Keywords:** rice polishings, phytase, broiler performance.

## INTRODUCTION

Several rice by-products are produced during the processing of rice seeds and include broken rice, rice polishings, rice bran and rice hulls, which are usually used in animal and poultry feeding. The term 'rice polishings' is used to describe the second by-product remaining after processing of brown rice to give white rice.

Rice polishings are commonly used in poultry diets in many countries mainly in the Far East and South-East Asia. Many authors used rice by-products in poultry diets. Some of them tested rice polishings in laying hen diets (El-Ghamry *et al.*, 1997; El-Mallah *et al.*, 2000). El-Mallah *et al.* (2000) used rice polishings in laying hen diets instead of yellow corn at replacement levels of 0, 25, 50 or 100%. They concluded that yellow corn of laying hen diets can be replaced by rice polishings at a replacement ratio of 25% (15% of the diet) without adverse effect on the performance for egg production or feed conversion. Other investigators used rice polishings in broiler diets (Ali and Leeson, 1995; Ali *et al.*, 1995; Thakur and Pradhan, 1995; Dafwang and Shwarmen, 1996; Azam and Howlider, 1998 and Khalique *et al.*, 2003). Azam and Howlider (1998) used autoclaved and non-autoclaved parboiled rice polish in broiler diets. They reported that inclusion of rice polishings in the diets decreased the feed intake and feed utilization and reduced the growth rate of broilers compared with their counterparts on control diet. Khalique *et al.* (2003) stated that defatted rice polishings can be effectively used in broiler diets at 20% level. The feeding cost in poultry production is considered to be the most expensive item. The price of yellow corn or soybean meal is higher than that of rice polishings. However, diets containing high levels of rice polishings are generally dusty and tended to stick to the beak of the chicks. In addition, most of the total phosphorus of rice polishings is existed in the phytate form.

Under normal dietary conditions, phytate phosphorus is either unavailable to, or poorly utilized by, poultry due to insufficient quantities of endogenous avian phytase. In general, the proportion of phytate phosphorus varies from 60 to 80% of the total phosphorus in plant feedstuffs (Ravindran *et al.*, 1995). Rice polishings have about 89% of its total phosphorus in phytate form (Nelson *et al.*, 1968). The high concentration of phytic acid in rice polishings has a negative influence on the solubility of proteins and the function of pepsine (Pallauf and Rimbach, 1995). Phytate complexes with various minerals, protein, lipids (Cosgrove, 1966) and starch (Thompson and Yoon, 1984). There is considerable interest in improving the phosphorus availability in plant diets, primarily as a means of reducing phosphorus pollution. Phytase enzyme is widely used in poultry diets to increase phosphorus availability.

This experiment aimed to study the effect of graded levels of rice polishings with or without phytase supplementation (RONOZYME) on broiler performance, carcass traits, digestibility of nutrients, and some blood constituents.

## MATERIALS AND METHODS

The present study was carried out (during April and May 2003) at the Agricultural Experiments and Researches Station, Poultry Production Farm, Faculty of Agriculture, Mansoura University, Egypt.

**Birds and diets:**

Three hundred and thirty, one-day-old unsexed Hubbard broiler chicks, were used in this study. The chicks were randomly divided into ten equal experimental groups, of 3 equal replications each, and each replicate served as an experimental unit. These experimental chicks were raised in an open-sided house, equipped with conventional wire-floored brooding and rearing batteries. The chicks were kept in the brooding batteries up to 21 days of age, then they were transferred to the rearing batteries until the conclusion of the experiment at 42 days of age. Ten-starter or grower diets containing rice polishings (RP) at levels of 0.0, 10, 20, 30 or 40%, supplemented with two levels (0.0 or 0.4kg/ton feed) of phytase enzyme were formulated and used. The enzyme used in this study (Phytase 2500 FYT/g; IUB No. 3.1.3.26.) having the trade name RONOZYME, is in the form of a dry stabilized powder, manufactured by Novo Nordisk, Denmark. The experimental diets were isoenergetic-isonitrogenous (the starter diets contain about 3200 kcal ME/kg and CP of about 23%, however, the grower diets Contain about 3100 kcal ME/kg and CP of about 20%). The chicks were fed the starter diets up to 21 day-old, then the birds were switched to grower diets from 22 to 42 days of age. Diet formulation was performed on the basis of the tabulated data of nutrient composition of feed ingredients published by NRC (1994). Composition and chemical analysis of the experimental diets are presented in Table 1. The chicks had a free excess feed and water throughout the experimental period.

**Performance of chicks:**

The following criteria were used to evaluate the performance of broiler chicks: live body weight, body weight gain, feed intake and feed conversion ratio as well as total mortality and net profit per kg gain, during the whole experimental period (0-42 days of age). The chicks were individually weighed weekly, whereas, weekly feed intake, body weight gain, and feed conversion were determined on a replicate group basis. Mortality was recorded daily. Net profit per kg gain was calculated as price of kg gain minus feed cost per kg gain. Cost per kg diet (Table 1) and values of feed conversion for the three replicates of each dietary treatment were used to calculate the feed cost per kg gain.

**Digestibility trials:**

During the 6$^{th}$ week of age, digestibility trials were conducted for evaluating the digestibility coefficients of nutrients of the grower experimental diets. Five birds were selected from each treatment on the basis of average body weight, kept in a separate growing battery fitted with galvanized metal trays and fed their respective experimental diet for a period of two days to allow the birds to become adjusted to cages. The excreta were quantitatively collected for a 3-day period, during which feed consumption data were also recorded. Excreta samples were taken, immediately dried and kept for later analysis. The proximate analyses for the experimental diets and dried excreta were determined according to A.O.A.C. (1984). In order to estimate protein digestibility, fractions of fecal and urinary nitrogen in the excreta were chemically separated according to the method of Jakobsen *et al.* (1960). The percent of urinary organic matter was calculated by multiplying the percentage of urinary nitrogen by the factor 2.62 (Abou-Raya and Galal, 1971): Digestibility coefficients were calculated for dry matter (DM), organic matter (OM), crude protein (CP), Ether extract (EE), crude fiber (CF), and nitrogen free extract (NFE). Percentages of nitrogen and ash retention were also calculated.

**Table 1: Chemical composition of the experimental diets**

| Ingredients % | Starter diets* | | | | | Grower diets* | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Rice polishing levels | | | | | Rice polishing levels | | | | |
| | 0 | 10 | 20 | 30 | 40 | 0 | 10 | 20 | 30 | 40 |
| Yellow corn | 60.45 | 52.00 | 42.93 | 34.55 | 26.30 | 68.30 | 59.58 | 51.35 | 42.72 | 34.32 |
| Soybean meal, 44% | 12.00 | 9.50 | 7.00 | 5.73 | 4.70 | 10.35 | 7.50 | 7.30 | 5.20 | 3.90 |
| Fish meal, 72% | 1.80 | 1.40 | 1.40 | 1.00 | 1.00 | --- | --- | --- | --- | --- |
| Corn gluten meal, 60% | 16.90 | 18.10 | 19.10 | 19.80 | 19.80 | 14.00 | 15.00 | 14.70 | 15.40 | 15.60 |
| Wheat bran | 2.75 | 2.85 | 3.40 | 2.75 | 2.00 | 3.25 | 3.77 | 2.50 | 2.50 | 2.00 |
| Rice polishing | --- | 10.00 | 20.00 | 30.00 | 40.00 | --- | 10.00 | 20.00 | 30.00 | 40.00 |
| Sunflower oil | 1.70 | 1.70 | 1.70 | 1.70 | 1.70 | --- | --- | --- | --- | --- |
| Dicalcium P | 1.90 | 1.90 | 1.90 | 1.90 | 1.90 | 1.60 | 1.60 | 1.60 | 1.60 | 1.60 |
| Limestone | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 |
| Common salt | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 |
| Vit. & Min. premix ** | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 |
| DL-methionine | 0.05 | 0.05 | 0.07 | 0.07 | 0.10 | --- | 0.02 | 0.02 | 0.05 | 0.05 |
| L-lysine HCl | 0.35 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.43 | 0.43 | 0.43 | 0.43 |
| Total | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| **Calculated analysis (air dry basis)** | | | | | | | | | | |
| ME; kcal/kg | 3197 | 3202 | 3197 | 3202 | 3203 | 3100 | 3100 | 3101 | 3101 | 3101 |
| Crude protein; % | 23.07 | 23.01 | 23.07 | 23.07 | 23.03 | 20.03 | 20.00 | 20.05 | 20.06 | 20.04 |
| C/P ratio | 138.6 | 139.2 | 138.6 | 138.8 | 139.1 | 154.8 | 155.0 | 154.7 | 154.6 | 154.7 |
| Ether extract; % | 4.78 | 5.53 | 6.31 | 7.04 | 7.79 | 3.13 | 3.91 | 4.65 | 5.42 | 6.19 |
| Crude fiber; % | 2.70 | 2.78 | 2.89 | 2.96 | 3.03 | 2.77 | 2.86 | 2.93 | 3.01 | 3.09 |
| Calcium, % | 1.08 | 1.07 | 1.06 | 1.05 | 1.05 | 0.97 | 0.97 | 0.97 | 0.97 | 0.96 |
| Total P; % | 0.75 | 0.84 | 0.94 | 1.03 | 1.12 | 0.67 | 0.76 | 0.85 | 0.95 | 1.05 |
| Av. P; % | 0.46 | 0.45 | 0.45 | 0.45 | 0.46 | 0.38 | 0.38 | 0.38 | 0.39 | 0.39 |
| Lysine; % | 1.12 | 1.13 | 1.11 | 1.09 | 1.09 | 1.02 | 1.02 | 1.04 | 1.03 | 1.03 |
| Methionine; % | 0.53 | 0.53 | 0.56 | 0.56 | 0.59 | 0.40 | 0.43 | 0.43 | 0.46 | 0.46 |
| Meth.&Cyst.;% | 0.93 | 0.92 | 0.93 | 0.92 | 0.94 | 0.76 | 0.77 | 0.76 | 0.78 | 0.77 |
| **Determined analysis (on dry matter basis)** | | | | | | | | | | |
| Moisture; % | 9.23 | 9.42 | 9.29 | 9.38 | 9.44 | 9.70 | 9.56 | 9.48 | 9.63 | 9.72 |
| Dry matter; % | 90.77 | 90.58 | 90.71 | 90.62 | 90.56 | 90.30 | 90.44 | 90.52 | 90.37 | 90.28 |
| Crude protein; % | 25.47 | 25.52 | 25.39 | 25.35 | 25.30 | 22.27 | 22.09 | 22.22 | 22.15 | 22.25 |
| Ether extract; % | 5.31 | 5.96 | 6.92 | 7.71 | 8.30 | 3.42 | 4.23 | 4.98 | 5.98 | 6.77 |
| Crude fiber; % | 3.15 | 2.99 | 3.23 | 3.33 | 3.44 | 3.14 | 3.25 | 3.43 | 3.49 | 3.39 |
| Ash; % | 6.73 | 6.43 | 6.61 | 6.54 | 6.50 | 6.35 | 6.29 | 6.42 | 6.60 | 6.46 |
| NFE; % | 59.34 | 59.10 | 57.85 | 57.07 | 56.46 | 64.82 | 64.14 | 62.95 | 61.78 | 61.13 |
| Cost of 1kg feed; L.E. *** | 1.52 | 1.46 | 1.41 | 1.35 | 1.31 | 1.31 | 1.26 | 1.22 | 1.18 | 1.13 |

*: All starter and grower diets were used without or with phytase supplementation (0.4 kg/ton diet).

**: Each 3 Kg premix contain: Vit. A 12000000 I.U.; Vit. $D_3$ 2500000 I.U.; Vit. E 10g; Vit. K 2.5g; Vit. $B_2$ 5g; Vit. $B_6$ 1.5g; Vit. $B_{12}$ 10 mg; Biotin 50 mg; Folic acid 1g; Nicotinic acid 30 mg; Pantothenic acid 10 g; Antioxidant 10g; Mn 60g; Cu 10g; Zn 55g; Fe 35g; I 1g; Co 250 mg; Se 150 mg.

***: Calculated according to the prevailing market prices of feed ingredients during the experimental period.

## Carcass traits:

At the end of the experiment (42 day-old), five birds were selected from each treatment on the basis of average weight, and immediately sacrificed by decapitation. Then, their carcasses were scalded, feather-plucked and eviscerated. Procedures of cleaning out and excising of the abdominal fat contents were performed on hot carcasses. The abdominal fat includes the adipose tissues surrounding the gizzard and the bursa of Fabricius and cloaca. Records on individual weights of eviscerated carcass and edible organs (heart, liver without gall bladder and skinned empty gizzard) were maintained. Total edible parts were calculated as eviscerated carcass plus giblets. All measurements of carcasses and components were expressed as relative weights.

**Blood constituents:**

Blood samples were collected in heparinized tubes, by puncturing the wing veins of five birds from each treatment at the end of the experiment (42 days of age). Then, plasma were separated by centrifugation and stored at – 20 °C for later analysis. Individual plasma samples were analyzed, using commercial kits, for determination of glucose, total proteins, total lipids, cholesterol, and inorganic phosphorus according to the methods of Trinder (1969), Henry (1964), Frings and Dunn (1970), Allain *et al.* (1974), and Daly and Ertingshausen (1972), respectively.

**Statistical analyses:**

Data were processed using Quattro Program software (Borland International, Inc., 1990). Statistical analysis of the results was performed using Statgraphics Program software, Version 5.0 STSC (Rockville, 1991). A completely randomized design with a factorial arrangement of treatments (5 × 2) was used. The significant differences among means of treatments for each criterion were identified at P≤0.05 by LSD-multiple range test.

## RESULTS AND DISCUSSION

**Growth performance of broiler chicks**

Data on the performance (live body weight, weight gain, feed consumption and feed conversion) of broiler chicks fed the experimental diets are presented in Tables 2, 3, 4 and 5, respectively. Statistical analysis showed significant differences in live body weight among the experimental treatments due to the effects of dietary RP level or enzyme supplementation, yet the interactions between these effects were not significant. Regarding the final live body weight at 42 day-old (Table 2), highly significant (P≤0.01) differences were detected, due to the effect of dietary RP level. The highest live body weight (1771.5 g) was recorded for the experimental group fed the diet containing 20% RP, followed by the group of chicks fed the 10% RP-diet and the control group (0.0% RP), without significant differences among them. The group of chicks fed diet containing 30% RP gave an average body weight of 1710.2 g, which did not differ significantly from that of chicks of the control group or that of the group fed the 10% RP-diet. The lowest (P≥0.01) average body weight (1585.8 g) was achieved with the group of chicks fed diet with the high level of RP (40% of the diet). Regarding the effect of enzyme supplementation, the addition of phytase (Ronozyme) to the diets increased the final live body weight of chicks (1789.7 g) significantly (P≤0.01) compared with that of chicks fed the unsupplemented diets (1633.9 g).

**Table 2: Means and standard errors of live body weight of the experimental broiler chicks.**

| Treatments | Live body weight (g) | | | | | | |
|---|---|---|---|---|---|---|---|
| | One-day-old | Chick's age in weeks | | | | | |
| | | 1 | 2 | 3 | 4 | 5 | 6 |
| Main factors | | | | | | | |
| Rice polishing levels A | | | | | | | |
| 1 0.0% | 40.73 | 126.7$^{a}$ | 300.8$^{b}$ | 563.4$^{ab}$ | 895.1$^{a}$ | 1305.5$^{a}$ | 1729.1$^{ab}$ |
| 2 10% | 40.75 | 129.1$^{a}$ | 313.5$^{a}$ | 573.9$^{a}$ | 906.0$^{a}$ | 1305.0$^{a}$ | 1762.5$^{ab}$ |
| 3 20% | 40.41 | 121.1$^{b}$ | 303.6$^{ab}$ | 559.1$^{ab}$ | 901.1$^{a}$ | 1311.7$^{a}$ | 1771.5$^{a}$ |
| 4 30% | 40.26 | 116.8$^{bc}$ | 284.8$^{c}$ | 546.9$^{b}$ | 855.6$^{b}$ | 1281.3$^{a}$ | 1710.2$^{b}$ |
| 5 40% | 40.51 | 114.6$^{c}$ | 278.0$^{c}$ | 485.2$^{c}$ | 782.1$^{c}$ | 1201.9$^{b}$ | 1585.8$^{c}$ |
| SE | 0.286 | 1.85 | 4.34 | 8.19 | 12.5 | 15.4 | 19.6 |
| Significance level | NS | ** | ** | ** | ** | ** | ** |
| Phytase levels B | | | | | | | |
| 1 0.0g/kg | 40.53 | 117.9$^{b}$ | 282.5$^{b}$ | 515.7$^{b}$ | 816.3$^{b}$ | 1219.4$^{b}$ | 1633.9$^{b}$ |
| 2 0.4g/kg | 40.54 | 125.4$^{a}$ | 309.8$^{a}$ | 575.7$^{a}$ | 919.6$^{a}$ | 1342.8$^{a}$ | 1789.7$^{a}$ |
| SE | 0.181 | 1.17 | 2.74 | 5.18 | 7.9 | 9.8 | 12.4 |
| Significance level | NS | ** | ** | ** | ** | ** | ** |
| Interaction A×B | | | | | | | |
| T No. | | | | | | | |
| T1 1×1 | 40.70 | 119.9 | 283.0 | 534.2 | 857.6 | 1249.1 | 1653.2 |
| T2 1×2 | 40.76 | 133.3 | 318.5 | 592.5 | 932.6 | 1361.9 | 1805.0 |
| T3 2×1 | 40.63 | 123.4 | 298.8 | 539.1 | 833.9 | 1234.2 | 1689.3 |
| T4 2×2 | 40.88 | 134.8 | 328.2 | 608.8 | 978.2 | 1375.8 | 1835.7 |
| T5 3×1 | 40.17 | 117.8 | 286.1 | 513.9 | 829.4 | 1243.4 | 1687.7 |
| T6 3×2 | 40.65 | 124.5 | 321.2 | 604.2 | 972.7 | 1380.0 | 1855.3 |
| T7 4×1 | 40.32 | 116.1 | 280.6 | 530.9 | 812.7 | 1226.1 | 1619.0 |
| T8 4×2 | 40.20 | 117.6 | 289.1 | 563.0 | 898.4 | 1336.6 | 1801.4 |
| T9 5×1 | 40.81 | 112.6 | 263.9 | 460.3 | 748.1 | 1144.1 | 1520.3 |
| T10 5×2 | 40.21 | 116.5 | 292.1 | 510.0 | 816.1 | 1259.7 | 1651.3 |
| SE | 0.404 | 2.61 | 6.14 | 11.7 | 18.0 | 21.8 | 27.7 |
| Significance level | NS | NS | NS | NS | NS | NS | NS |
| Overall mean | 40.53 | 121.7 | 296.2 | 545.7 | 867.9 | 1281.1 | 1711.8 |
| SE | 0.128 | 0.83 | 1.94 | 3.7 | 5.6 | 6.9 | 8.8 |

**Means having different superscripts in the same column are significantly different.**
**NS: not significant; **: Significant at P≤0.01.**

Table 3 shows the weekly average body weight gain of chicks during the different periods of the study. There were significant differences in body weight gain due to the effect of dietary RP level at all studied ages except during the fourth week of age. The effect of enzyme supplementation of the diets on body weight gain of chicks was significant during the first-four weeks of age and the whole period of study (0-6 weeks). However the effects of the dietary RP level and enzyme supplementation on body weight gain of chicks were not interrelated. Regarding the body weight gain values of chicks during the whole period of study (0-6 weeks of age); the differences among experimental treatments due to the effect of dietary RP level were significant (P≤0.01). The group of chicks fed the high RP-diets (40%) gave the lowest (P≤0.01) average body weight gain (1545.3 g), compared with those of the other experimental groups, which achieved significantly similar body weight gain values. The phytase-supplemented diets improved (P≤0.01) the chicks body weight gain (1749.6 g) compared with that of chicks fed the unsupplemented diets (1593.5 g).

**Table 3: Means and standard errors of body weight gain of the experimental broiler chicks.**

| Treatments | Body weight gain (g) | | | | | | |
|---|---|---|---|---|---|---|---|
| | Chick's age intervals in weeks | | | | | | |
| | 0-1 | 1-2 | 2-3 | 3-4 | 4-5 | 5-6 | 0-6 |
| Main factors | | | | | | | |
| Rice polishing levels A | | | | | | | |
| 1 0.0% | $85.9^{ab}$ | $174.1^{ab}$ | $262.4^{a}$ | $331.5^{ab}$ | 410.0 | $423.6^{ab}$ | $1688.6^{a}$ |
| 2 10% | $88.4^{a}$ | $184.4^{a}$ | $260.4^{a}$ | $332.3^{a}$ | 398.6 | $457.4^{a}$ | $1721.8^{a}$ |
| 3 20% | $80.7^{bc}$ | $182.5^{a}$ | $255.4^{a}$ | $341.9^{a}$ | 410.5 | $459.7^{a}$ | $1730.8^{a}$ |
| 4 30% | $76.6^{c}$ | $168.0^{b}$ | $262.1^{b}$ | $296.9^{bc}$ | 426.1 | $428.5^{ab}$ | $1670.0^{a}$ |
| 5 40% | $74.1^{c}$ | $163.5^{b}$ | $207.1^{b}$ | $308.7^{c}$ | 420.1 | $383.9^{b}$ | $1545.3^{b}$ |
| SE | 2.4 | 3.8 | 7.1 | 8.4 | 14.7 | 17.7 | 21.3 |
| Significance level | ** | ** | ** | ** | NS | * | ** |
| Phytase levels B | | | | | | | |
| 1 0.0g/kg | $77.4^{b}$ | $164.5^{b}$ | $233.2^{b}$ | $300.9^{b}$ | 403.4 | 414.1 | $1593.5^{b}$ |
| 2 0.4g/kg | $84.8^{a}$ | $184.5^{a}$ | $266.0^{a}$ | $343.5^{a}$ | 423.8 | 446.6 | $1749.6^{a}$ |
| SE | 1.5 | 2.4 | 4.5 | 5.3 | 9.3 | 11.2 | 13.5 |
| Significance level | ** | ** | ** | ** | NS | NS | ** |
| Interaction A×B | | | | | | | |
| T No. | | | | | | | |
| T1 1×1 | 79.3 | 163.1 | 251.2 | 323.3 | 391.4 | 404.1 | 1612.6 |
| T2 1×2 | 92.6 | 185.2 | 274.0 | 339.7 | 429.5 | 443.2 | 1764.3 |
| T3 2×1 | 82.8 | 175.4 | 240.3 | 294.8 | 400.3 | 455.2 | 1648.7 |
| T4 2×2 | 93.9 | 193.4 | 280.6 | 369.4 | 397.9 | 459.6 | 1794.8 |
| T5 3×1 | 77.6 | 168.3 | 227.8 | 315.5 | 413.9 | 444.3 | 1647.5 |
| T6 3×2 | 83.9 | 196.7 | 283.0 | 368.5 | 407.3 | 475.3 | 1814.7 |
| T7 4×1 | 75.7 | 164.6 | 250.3 | 281.8 | 413.7 | 392.9 | 1578.7 |
| T8 4×2 | 77.4 | 171.5 | 273.9 | 335.5 | 437.5 | 464.8 | 1761.2 |
| T9 5×1 | 71.8 | 151.3 | 196.4 | 287.9 | 396.0 | 376.2 | 1479.5 |
| T10 5×2 | 76.3 | 175.6 | 217.9 | 306.1 | 443.6 | 391.5 | 1611.1 |
| SE | 3.4 | 5.4 | 10.0 | 11.9 | 20.8 | 25.0 | 30.1 |
| Significance level | NS | NS | NS | NS | NS | NS | NS |
| Overall mean | 81.1 | 174.5 | 249.5 | 322.2 | 413.2 | 430.7 | 1671.3 |
| SE | 1.1 | 1.7 | 3.2 | 3.8 | 6.6 | 7.9 | 9.5 |

**Means having different superscripts in the same column are significantly different.**
**NS: not significant; *: Significant at P≤0.05; **: Significant at P≤0.01.**

Table 4 indicates the averages of feed intake of the experimental chicks during the period of the study at weekly intervals. The analysis of variance showed that the effects of dietary RP level and phytase supplementation on feed intake of chicks were significant at all studied ages; except during the fourth week of age. However, the effects of both the two factors on feed intake of chicks were not interrelated. As for the feed intake values during the whole period of study; highly significant differences (P≤0.01) were observed among the experimental treatments due to the effect of dietary RP level. Increasing the inclusion rate of RP in the diet (30 or 40%) significantly decreased the feed intake of chicks. Supplementation of the diets with phytase significantly (P≤0.01) increased the feed consumption of chicks (3817.4 g and 3540.1 for chicks fed the supplemented and unsupplemented diets, respectively).

**Table 4: Means and standard errors of feed intake of the experimental broiler chicks.**

| Treatments | Feed intake (g) | | | | | | |
|---|---|---|---|---|---|---|---|
| | Chick's age intervals in weeks | | | | | | |
| | 0-1 | 1-2 | 2-3 | 3-4 | 4-5 | 5-6 | 0-6 |
| Main factors | | | | | | | |
| Rice polishing levels A | | | | | | | |
| 1 0.0% | $140.0^{b}$ | $331.5^{a}$ | $565.4^{a}$ | $753.6^{ab}$ | 913.7 | $1013.8^{b}$ | $3718.0^{ab}$ |
| 2 10% | $154.1^{a}$ | $337.7^{a}$ | $576.8^{a}$ | $732.4^{abc}$ | 895.6 | $1113.3^{a}$ | $3809.9^{a}$ |
| 3 20% | $139.1^{bc}$ | $332.1^{a}$ | $542.3^{a}$ | $760.8^{a}$ | 915.3 | $1111.1^{a}$ | $3800.6^{a}$ |
| 4 30% | $137.4^{bc}$ | $314.7^{ab}$ | $551.2^{a}$ | $703.9^{bc}$ | 940.9 | $1003.7^{b}$ | $3651.9^{b}$ |
| 5 40% | $130.8^{c}$ | $301.1^{b}$ | $438.6^{b}$ | $678.6^{c}$ | 931.9 | $932.1^{b}$ | $3413.2^{c}$ |
| SE | 3.1 | 8.1 | 12.4 | 18.4 | 31.9 | 32.8 | 35.1 |
| Significance level | ** | * | ** | * | NS | ** | ** |
| Phytase levels B | | | | | | | |
| 1 0.0g/kg | $136.4^{b}$ | $313.4^{b}$ | $507.6^{b}$ | $694.9^{b}$ | 892.8 | $994.9^{b}$ | $3540.1^{b}$ |
| 2 0.4g/kg | $144.1^{a}$ | $333.5^{a}$ | $562.1^{a}$ | $756.9^{a}$ | 946.1 | $1074.8^{a}$ | $3817.4^{a}$ |
| SE | 2.0 | 5.1 | 7.9 | 11.6 | 20.2 | 20.8 | 22.2 |
| Significance level | * | * | ** | ** | NS | * | ** |
| Interaction A×B | | | | | | | |
| T No. | | | | | | | |
| T1 1×1 | 136.9 | 329.1 | 535.2 | 745.5 | 864.1 | 963.4 | 3574.1 |
| T2 1×2 | 143.0 | 333.9 | 595.6 | 761.8 | 963.2 | 1064.3 | 3861.9 |
| T3 2×1 | 145.5 | 332.7 | 540.0 | 689.1 | 885.5 | 1101.0 | 3693.8 |
| T4 2×2 | 162.7 | 342.7 | 613.6 | 775.8 | 905.6 | 1125.7 | 3926.2 |
| T5 3×1 | 134.8 | 319.7 | 508.5 | 710.6 | 902.5 | 1076.0 | 3652.2 |
| T6 3×2 | 143.3 | 344.5 | 576.1 | 810.9 | 928.1 | 1146.2 | 3949.1 |
| T7 4×1 | 140.9 | 306.4 | 538.2 | 662.4 | 917.9 | 917.7 | 3483.4 |
| T8 4×2 | 133.9 | 323.0 | 564.2 | 745.5 | 963.8 | 1089.8 | 3820.4 |
| T9 5×1 | 123.9 | 279.1 | 416.3 | 666.9 | 894.2 | 916.3 | 3296.8 |
| T10 5×2 | 137.6 | 323.0 | 460.9 | 690.3 | 969.8 | 947.9 | 3529.5 |
| SE | 4.4 | 11.4 | 17.6 | 25.9 | 45.2 | 46.4 | 49.6 |
| Significance level | NS | NS | NS | NS | NS | NS | NS |
| Overall mean | 140.3 | 323.4 | 534.9 | 725.9 | 919.5 | 1034.8 | 3678.7 |
| SE | 1.4 | 3.6 | 5.6 | 8.2 | 14.3 | 14.7 | 15.7 |

**Means having different superscripts in the same column are significantly different.**
**NS: not significant; *: Significant at $P \leq 0.05$; **: Significant at $P \leq 0.01$.**

The averages of feed conversion ratio of broiler chicks, fed the experimental diets are presented in Table 5. The analysis of variance revealed that the differences in feed conversion ratio which may be attributed to the dietary RP level were not significant at all age intervals. On the other hand, differences in feed conversion due to the effect of dietary supplementation with phytase enzyme were significant only during the second ($P \leq 0.05$), fourth ($P \leq 0.01$) weeks and the whole period of study. However, the interactions between the effects of dietary RP level and phytase supplementation on feed conversion ratio were insignificant throughout the experimental intervals. Regarding the whole period of study, the values of feed conversion ratio as affected by the dietary RP level, ranged between 2.188 and 2.215 without significant differences. Supplementation of the diet with phytase improved ($P \leq 0.05$) the feed conversion ratio of chicks' (2.183) compared with those fed the unsupplemented diets (2.222). The previous results; concerning the performance of the experimental chicks (Tables 2, 3, 4 and 5), showed that RP could be used successfully in broiler diets up to inclusion level of 30%. However, the high RP-diets (40% RP) resulted in reduction of feed intake and final body weight of chicks. The reduced feed intake of chicks fed such high RP-diets (40% RP) may be due to that the diet became dusty because of the highly fine texture of RP. It is well known that diets containing high levels of RP are generally dusty and tended to stick to the beak of the chicks. Pallauf and Rambach (1995) reported that the phytic acid in rice polishings has a negative effect on feed utilization. The analysis of variance showed that supplementation of the experimental diets with phytase increased the feed intake of chicks throughout the different age intervals of the experimental period, except during the fifth week of age. Due to this increase of feed intake, the chicks concomitantly put on more weight gain and achieved a heavier final live body weight. Consequently, the feed conversion was also improved in these chicks, since it is a growth-correlated trait.

**Table 5: Means and standard errors of feed conversion ratio of the experimental broiler chicks.**

| Treatments | Feed conversion ratio | | | | | | |
|---|---|---|---|---|---|---|---|
| | Chick's age intervals in weeks | | | | | | |
| | 0-1 | 1-2 | 2-3 | 3-4 | 4-5 | 5-6 | 0-6 |
| Main factors | | | | | | | |
| Rice polishing levels A | | | | | | | |
| 1 0.0% | 1.639 | 1.911 | 2.155 | 2.274 | 2.230 | 2.392 | 2.204 |
| 2 10% | 1.752 | 1.835 | 2.218 | 2.216 | 2.248 | 2.445 | 2.215 |
| 3 20% | 1.729 | 1.828 | 2.134 | 2.227 | 2.225 | 2.429 | 2.197 |
| 4 30% | 1.804 | 1.875 | 2.098 | 2.297 | 2.212 | 2.339 | 2.188 |
| 5 40% | 1.764 | 1.843 | 2.130 | 2.288 | 2.212 | 2.445 | 2.209 |
| SE | 0.057 | 0.043 | 0.054 | 0.038 | 0.036 | 0.054 | 0.019 |
| Significance level | NS | NS | NS | NS | NS | NS | NS |
| Phytase levels B | | | | | | | |
| 1 0.0g/kg | 1.769 | 1.904[b] | 2.177 | 2.313[b] | 2.216 | 2.407 | 2.222[b] |
| 2 0.4g/kg | 1.708 | 1.813[a] | 2.118 | 2.208[a] | 2.235 | 2.413 | 2.183[a] |
| SE | 0.036 | 0.027 | 0.034 | 0.024 | 0.023 | 0.034 | 0.012 |
| Significance level | NS | * | NS | ** | NS | NS | * |
| Interaction A×B | | | | | | | |
| T No. | | | | | | | |
| T1 1×1 | 1.732 | 2.019 | 2.133 | 2.307 | 2.216 | 2.379 | 2.218 |
| T2 1×2 | 1.548 | 1.80.2 | 2.177 | 2.242 | 2.245 | 2.405 | 2.190 |
| T3 2×1 | 1.767 | 1.898 | 2.245 | 2.334 | 2.221 | 2.425 | 2.241 |
| T4 2×2 | 1.738 | 1.773 | 2.192 | 2.099 | 2.275 | 2.465 | 2.189 |
| T5 3×1 | 1.751 | 1.896 | 2.230 | 2.253 | 2.180 | 2.423 | 2.217 |
| T6 3×2 | 1.709 | 1.761 | 2.037 | 2.200 | 2.270 | 2.435 | 2.177 |
| T7 4×1 | 1.868 | 1.861 | 2.155 | 2.351 | 2.219 | 2.339 | 2.208 |
| T8 4×2 | 1.740 | 1.889 | 2.042 | 2.244 | 2.204 | 2.340 | 2.168 |
| T9 5×1 | 1.725 | 1.847 | 2.121 | 2.319 | 2.244 | 2.469 | 2.228 |
| T10 5×2 | 1.803 | 1.839 | 2.139 | 2.255 | 2.179 | 2.421 | 2.189 |
| SE | 0.080 | 0.061 | 0.076 | 0.054 | 0.051 | 0.077 | 0.027 |
| Significance level | NS | NS | NS | NS | NS | NS | NS |
| Overall mean | 1.738 | 1.859 | 2.147 | 2.260 | 2.226 | 2.410 | 2.202 |
| SE | 0.025 | 0.019 | 0.024 | 0.017 | 0.016 | 0.024 | 0.009 |

**Means having different superscripts in the same column are significantly different.**
**NS: not significant; *: Significant at P≤0.05; **: Significant at P≤0.01.**

The results of broiler performance in this study are generally in agreement with those of other investigators (Azam and Howlider, 1998; Khalique *et al.*, 2003) who reported that rice polishings could be used in broiler diets up to 20% without adverse effects. They also stated that the high levels of rice polishings in broiler diets decreased both feed intake of chicks and feed utilization. On the other hand, Ali and Leeson (1995) reported that male broilers fed on diets containing 20% rice polishings had lower body weight and body weight gain than that of those fed corn-soybean diets.

**Carcass traits**

The results of slaughter test are presented in Table 6. Differences in carcass traits due to the effects of either dietary RP level or enzyme supplementation were not significant.

**Table 6: Means and standard errors for the relative weights (% of live weight) of carcass traits of 6-week-old experimental broiler chicks.**

| Treatments | Live weight; g | Liver wt. % | Gizzard wt. % | Heart wt. % | Giblets wt. % | Dressed wt. % | Total edible parts % | Abdo-minal fat % |
|---|---|---|---|---|---|---|---|---|
| Man factors: | | | | | | | | |
| Rice polishing levels A | | | | | | | | |
| 1 0.0% | 1727$^{a}$ | 2.59 | 1.42 | 0.56 | 4.57 | 70.27 | 74.84 | 1.90 |
| 2 10% | 1763$^{a}$ | 2.54 | 1.40 | 0.53 | 4.47 | 70.44 | 74.90 | 2.14 |
| 3 20% | 1769$^{a}$ | 2.53 | 1.44 | 0.55 | 4.52 | 70.54 | 75.06 | 2.17 |
| 4 30% | 1717$^{a}$ | 2.57 | 1.47 | 0.57 | 4.61 | 70.42 | 75.03 | 2.08 |
| 5 40% | 1593$^{b}$ | 2.64 | 1.46 | 0.56 | 4.66 | 70.03 | 74.69 | 2.19 |
| SE | 24 | 0.09 | 0.03 | 0.02 | 0.10 | 0.21 | 0.21 | 0.20 |
| Significance level | ** | NS | NS | NS | NS | NS | NS | NS |
| Phytase levels B | | | | | | | | |
| 1 0.0g/kg | 1635$^{b}$ | 2.59 | 1.45 | 0.57 | 4.60 | 70.19 | 74.79 | 2.09 |
| 2 0.4g/kg | 1792$^{a}$ | 2.56 | 1.43 | 0.54 | 4.53 | 70.48 | 75.01 | 2.10 |
| SE | 15 | 0.06 | 0.02 | 0.01 | 0.06 | 0.13 | 0.13 | 0.13 |
| Significance level | ** | NS | NS | NS | NS | NS | NS | NS |
| Interaction A×B | | | | | | | | |
| T No. | | | | | | | | |
| T1 1×1 | 1652 | 2.83 | 1.47 | 0.61 | 4.91 | 69.67 | 74.58 | 1.83 |
| T2 1×2 | 1802 | 2.35 | 1.38 | 0.50 | 4.23 | 70.87 | 75.09 | 1.96 |
| T3 2×1 | 1690 | 2.51 | 1.48 | 0.54 | 4.54 | 70.36 | 74.89 | 2.20 |
| T4 2×2 | 1835 | 2.56 | 1.32 | 0.51 | 4.40 | 70.51 | 74.91 | 2.09 |
| T5 3×1 | 1686 | 2.46 | 1.42 | 0.55 | 4.42 | 70.67 | 75.09 | 2.02 |
| T6 3×2 | 1852 | 2.61 | 1.46 | 0.54 | 4.61 | 70.41 | 75.02 | 2.31 |
| T7 4×1 | 1626 | 2.56 | 1.40 | 0.59 | 4.55 | 70.35 | 74.89 | 1.98 |
| T8 4×2 | 1807 | 2.59 | 1.54 | 0.56 | 4.68 | 70.48 | 75.16 | 2.19 |
| T9 5×1 | 1522 | 2.58 | 1.48 | 0.54 | 4.60 | 69.91 | 74.51 | 2.42 |
| T10 5×2 | 1664 | 2.69 | 1.44 | 0.58 | 4.71 | 70.15 | 74.86 | 1.96 |
| SE | 34 | 0.13 | 0.04 | 0.03 | 0.14 | 0.30 | 0.30 | 0.29 |
| Significance level | NS | NS | ** | NS | * | NS | NS | NS |
| Overall mean | 1714 | 2.57 | 1.44 | 0.55 | 4.57 | 70.34 | 74.90 | 2.10 |
| SE | 11 | 0.04 | 0.01 | 0.01 | 0.05 | 0.09 | 0.09 | 0.09 |

**Means having different superscripts in the same column are significantly different.**
**NS: not significant; *: Significant at P≤0.05; **: Significant at P≤0.01.**

The averages of total edible parts of broiler carcasses ranged from 74.69% to 75.06% with erratic trend. The inclusion of RP in the experimental diets slightly increased the abdominal fat content in chicks without significant differences. The effects of dietary RP level and enzyme supplementation were not significantly interrelated, except on gizzard and giblets percentages.

The experimental treatments did not affect dressing percentages of broilers as shown in Table 6. The values of dressing percentages in this experiment are in accordance with those obtained by many investigators (Raya, 1989b;Rabie *et al.*, 2002; Raya *et al.*, 2003a), regardless of their different dietary treatments. On the other hand, Azam and Howlider (1998) reported that the dressing yield % and abdominal fat % were lower, but gizzard weight % and visceral weight % were higher in broiler chicks fed rice polishings than that of the control group.

**Nutrients digestibility**

Table 7 shows the effects of the dietary RP level and enzyme supplementation, and, their interactions on the digestibility coefficients of nutrients of the experimental grower diets.

**Table 7: Means and standard errors of digestibility coefficients of nutrients for experimental grower diets fed to broiler chicks during the 6th week of age.**

| Treatments | Digestibility coefficients | | | | | | N Retention | Ash Retention |
|---|---|---|---|---|---|---|---|---|
| | DM | OM | CP | EE | CF | NFE | | |
| Main factors: | | | | | | | | |
| Rice polishing levels A | | | | | | | | |
| 1 0.0% | 76.39 | 79.13 | 94.26 | 84.63 | 17.01 | 85.71 | 64.52 | 47.96 |
| 2 10% | 75.79 | 78.65 | 94.02 | 84.16 | 17.60 | 84.95 | 65.65 | 42.54 |
| 3 20% | 77.01 | 79.83 | 94.18 | 83.55 | 20.08 | 86.71 | 65.16 | 48.17 |
| 4 30% | 77.11 | 79.65 | 94.18 | 83.36 | 21.47 | 86.21 | 66.98 | 49.60 |
| 5 40% | 77.15 | 79.79 | 94.10 | 83.26 | 21.37 | 86.30 | 67.38 | 47.12 |
| SE | 0.77 | 0.69 | 0.27 | 0.52 | 2.62 | 0.55 | 1.08 | 1.82 |
| Significance level | NS | NS | NS | NS | NS | NS | NS | NS |
| Phytase levels B | | | | | | | | |
| 1 0.0g/kg | 76.76 | 79.53 | 94.25 | 83.94 | 19.25 | 86.21 | 65.53 | 47.34 |
| 2 0.4g/kg | 76.62 | 79.29 | 94.04 | 83.65 | 19.75 | 85.74 | 66.35 | 46.82 |
| SE | 0.49 | 0.44 | 0.17 | 0.33 | 1.66 | 0.34 | 0.68 | 1.15 |
| Significance level | NS | NS | NS | NS | NS | NS | NS | NS |
| Interaction A×B | | | | | | | | |
| T No. | | | | | | | | |
| T1 1×1 | 76.14 | 79.03 | 94.18 | 84.78 | 17.12 | 85.89 | 62.99 | 47.24 |
| T2 1×2 | 76.65 | 79.22 | 94.35 | 84.48 | 16.90 | 85.52 | 66.05 | 48.67 |
| T3 2×1 | 75.97 | 78.87 | 93.99 | 83.55 | 18.04 | 85.45 | 64.72 | 43.70 |
| T4 2×2 | 75.62 | 78.43 | 94.05 | 84.79 | 17.15 | 84.45 | 66.58 | 41.38 |
| T5 3×1 | 77.72 | 80.39 | 94.34 | 84.97 | 20.51 | 87.05 | 66.38 | 50.37 |
| T6 3×2 | 76.29 | 79.27 | 94.01 | 82.14 | 19.64 | 86.37 | 63.95 | 45.97 |
| T7 4×1 | 77.11 | 79.76 | 94.36 | 83.20 | 20.61 | 86.41 | 66.90 | 48.64 |
| T8 4×2 | 77.10 | 79.55 | 94.00 | 83.53 | 22.33 | 86.01 | 67.07 | 50.55 |
| T9 5×1 | 76.88 | 79.61 | 94.37 | 83.23 | 19.98 | 86.24 | 66.64 | 46.74 |
| T10 5×2 | 77.43 | 79.98 | 93.82 | 83.29 | 22.76 | 86.36 | 68.11 | 47.51 |
| SE | 1.09 | 0.98 | 0.38 | 0.75 | 3.71 | 0.77 | 1.53 | 2.58 |
| Significance level | NS | NS | NS | NS | NS | NS | NS | NS |
| Overall mean | 76.69 | 79.41 | 94.15 | 83.80 | 19.50 | 85.98 | 65.94 | 47.08 |
| SE | 0.35 | 0.31 | 0.12 | 0.24 | 1.17 | 0.24 | 0.48 | 0.82 |

**NS: Not significant.**

There were no significant differences in nutrients digestibility among the experimental treatments due to the effects of dietary RP level and enzyme supplementation or their interaction. In spite of the absence of significant differences, the digestion coefficients of dry matter (DM), crude fiber (CF), nitrogen free extract (NFE) and nitrogen retention tended to increase by elevating the inclusion rate of RP into the diets. The overall means of digestion coefficients of DM, organic matter (OM), crude protein (CP), ether extract (EE), CF, NFE, nitrogen and ash retention were 76.69, 79.41, 94.15, 83.80, 19.50, 85.98, 65.94 and 47.08, respectively. These values are partially in agreement with those of other workers (Raya, 1989b;Rabie *et al.,* 2002: Raya *et al.,* 2003b) who reported similar figures for nutrients digestibility in broiler chicks, irrespective of their different dietary treatments.

**Blood constituents**

Concentrations of some blood constituents (glucose, cholesterol, total protein, albumin, total lipids and inorganic phosphorus) in chicks fed the experimental diets are presented in Table 8. Analysis of variance showed no significant differences in the levels of these blood constituents among experimental groups, due to the effects of dietary RP level and enzyme supplementation or their interactions.

**Table 8: Means and standard errors of some blood constituents and mortality rate of chicks and economic efficiency values of the dietary treatments**

| Treatments | Blood constituents | | | | | | Mortality rate (%) | Economic efficiency (L.E.) |
|---|---|---|---|---|---|---|---|---|
| | Glucose (mg/dl) | Cholesterol (mg/dl) | Total protein (g/dl) | Albumin (g/dl) | Total lipids (g/dl) | Inorganic phosphorus (mg/dl) | | |
| Main factors: | | | | | | | | |
| Rice polishing levels A | | | | | | | | |
| 1 0.0% | 249.9 | 86.4 | 3.55 | 1.65 | 0.66 | 4.22 | 7.58 | 2.72$^{e}$ |
| 2 10% | 252.1 | 92.3 | 3.68 | 1.68 | 0.71 | 5.04 | 9.10 | 2.82$^{d}$ |
| 3 20% | 244.5 | 87.4 | 3.63 | 1.59 | 0.72 | 4.63 | 9.10 | 2.95$^{c}$ |
| 4 30% | 250.7 | 84.2 | 3.61 | 1.61 | 0.69 | 4.55 | 10.61 | 3.15$^{a}$ |
| 5 40% | 246.7 | 89.7 | 3.71 | 1.73 | 0.70 | 4.73 | 9.10 | 3.05$^{b}$ |
| SE | 2.6 | 2.7 | 0.06 | 0.07 | 0.02 | 0.24 | 2.14 | 0.03 |
| Significance level | NS | NS | NS | NS | NS | NS | NS | ** |
| Phytase levels B | | | | | | | | |
| 1 0.0g/kg | 249.7 | 88.2 | 3.61 | 1.62 | 0.68 | 4.54 | 9.10 | 2.92 |
| 2 0.4g/kg | 247.8 | 87.8 | 3.67 | 1.68 | 0.70 | 4.73 | 9.10 | 2.96 |
| SE | 1.6 | 1.7 | 0.04 | 0.04 | 0.01 | 0.15 | 1.36 | 0.02 |
| Significance level | NS | NS | NS | NS | NS | NS | NS | NS |
| Interaction A×B | | | | | | | | |
| T No. | | | | | | | | |
| T1 1×1 | 253.2 | 91.1 | 3.44 | 1.58 | 0.63 | 4.02 | 6.07 | 2.70 |
| T2 1×2 | 246.6 | 81.7 | 3.65 | 1.72 | 0.69 | 4.41 | 9.10 | 2.74 |
| T3 2×1 | 252.8 | 93.2 | 3.63 | 1.71 | 0.72 | 4.95 | 9.10 | 2.79 |
| T4 2×2 | 251.4 | 91.3 | 3.73 | 1.64 | 0.70 | 5.14 | 9.10 | 2.84 |
| T5 3×1 | 245.0 | 84.8 | 3.59 | 1.51 | 0.71 | 4.51 | 9.10 | 2.92 |
| T6 3×2 | 244.0 | 89.9 | 3.68 | 1.66 | 0.73 | 4.75 | 9.09 | 2.99 |
| T7 4×1 | 251.0 | 85.2 | 3.62 | 1.50 | 0.68 | 4.54 | 9.10 | 3.14 |
| T8 4×2 | 250.4 | 83.3 | 3.61 | 1.72 | 0.70 | 4.57 | 12.12 | 3.18 |
| T9 5×1 | 246.6 | 86.8 | 3.77 | 1.79 | 0.70 | 4.65 | 12.13 | 3.05 |
| T10 5×2 | 246.8 | 92.6 | 3.65 | 1.67 | 0.69 | 4.80 | 6.07 | 3.06 |
| SE | 3.6 | 3.9 | 0.09 | 0.09 | 0.03 | 0.34 | 3.03 | 0.04 |
| Significance level | NS | NS | NS | NS | NS | NS | NS | NS |
| Overall mean | 248.8 | 88.0 | 3.64 | 1.65 | 0.70 | 4.64 | 9.09 | 3.05 |
| SE | 1.1 | 1.2 | 0.03 | 0.03 | 0.01 | 0.11 | 0.96 | 0.01 |

**NS: Not significant.** ****: significant at $P \leq 0.01$.**

It is worth noting that similar concentrations of blood constituents in broiler chicks were reported by other workers (Ross *et al.*, 1978; Raya, 1989a; Raya and El-Shinnawy, 1989; Rabie *et al.*, 2002; and Raya *et al.*, 2003b), in spite of differences in their dietary treatments.

**Mortality rate**

Mortality rate of chicks in Table 8 showed no significant differences among the experimental groups, thus the differences can not be related to the effects of dietary RP level and phytase supplementation or their interactions. Regardless of the absence of significant differences in mortality rate of chicks due to the effect of dietary RP level, it was obvious that the inclusion of RP into the diets caused a slight increase in chicks' mortality compared with the control group.

**Economic efficiency**

Values of the economic efficiency of the dietary treatments are presented in Table 8. There were significant differences in economic efficiency due to the effects of dietary RP level compared with the control. However, the supplementation of diets with phytase and the interaction of dietary RP level by this supplemental enzyme had no significant effect on the economic efficiency. Elevating the level of RP in the diets increased the economic efficiency, but the best economic efficiency was obtained with the 30% RP-containing diet. This could be manly attributed to differences in the feeding cost, since RP is cheaper than yellow corn or soybean meal.

From the previous results it can be concluded that RP can be used up to 30% of the corn-soybean broiler diets, by which good results of broiler performance, carcass traits and economic efficiency can be obtained. However, the high inclusion rate of RP (40% of the diet) decreased the marketing live body weight and feed intake of broiler chicks. Supplementation of the diets with phytase significantly improved the performance of broiler chicks.

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# تأثير محتوى العليقة من ناتج تبييض الأرز علي أداء كتاكيت اللحم، هضم العناصر الغذائية وبعض مركبات الدم

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أجريت هذه الدراسة لمعرفة تأثير استخدام ناتج تبييض الأرز في علائق كتاكيت اللحم علي المواصفات الإنتاجية. تم استخدام خمسة مستويات من ناتج تبييض الأرز وهي صفر، ١٠، ٢٠، ٣٠ أو ٤٠% في عمل خمسة علائق بادئ وخمسة علائق نامي لكتاكيت اللحم. كل العلائق استخدمت بدون إضافة أو بإضافة إنزيم الفيتيز بنسبة ٠,٤كجم/طن عليقة فأصبحت العلائق عددها ١٠ بادئ و ١٠نامي. تم حساب العلائق لتكون متماثلة في الطاقة والبروتين (العلائق البادئ بها طاقة ممثلة حوالي ٣٢٠٠ كيلوكالوري/كجم والبروتين الخام حوالي ٢٣% أما علائق النامي بها طاقة ممثلة حوالي ٣١٠٠ كيلوكالوري/كجم وبروتين خام حوالي ٢٠%). استخدم في هذه الدراسة عدد ٣٣٠ كتكوت تسمين هبرد عمر يوم والتي قسمت عشوائياً إلي عشرة مجاميع تجريبية متساوية بكل مجموعة ثلاثة مكررات متساوية العدد. تم تربية الكتاكيت في بطاريات حضانة لمدة ٣ أسابيع ثم في بطاريات رعاية حتى نهاية التجربة عند ٤٢ يوم من العمر.
القياسات التي تم تسجيلها كانت وزن الجسم والزيادة الوزنية والعلف المستهلك ومعدل التحويل الغذائي وتم تسجيل النفوق وكذلك تم عمل اختبار ذبح لمعرفة خصائص الذبائح وتجارب هضم لمعرفة معاملات هضم العناصر الغذائية. كذلك تم أخذ عينات دم لمعرفة تركيز بعض مكونات الدم(تركيز البلازما من الجلوكوز، البروتينات، الدهون، الكولسترول، والفوسفور الغير عضوي) وتم حساب الكفاءة الغذائية للتغذية. ويمكن تلخيص أهم النتائج المتحصل عليها فيما يلي:
لم يؤثر استخدام ناتج تبييض الأرز في علائق كتاكيت اللحم حتى مستوي ٤٠% معنويا في خصائص الذبائح، هضم العناصر الغذائية، نسبة النفوق، أو تركيز مكونات الدم. زيادة مستوي ناتج تبييض الأرز في العلائق أدي إلي زيادة العائد المادي (الكفاءة الغذائية). استخدام المستوي العالي (٤٠% من العليقة) من ناتج تبييض الأرز أدي إلي تقليل وزن الطيور عند التسويق وكذلك خفض العلف المستهلك لكتاكيت اللحم لكن كفاءة تحويل الغذاء لم تتأثر. إضافة إنزيم الفيتيز بمستوي ٠,٤ كجم/طن علف أدي لزيادة معنوية في وزن الطيور التسويقي وكذلك الزيادة الوزنية وزيادة العلف المستهلك للطيور وحسن الكفاءة التحويلية للغذاء. إضافة الإنزيم لم يؤثر معنويا في صفات الذبيحة، هضم العناصر الغذائية، الكفاءة الغذائية أو تركيز مركبات الدم المدروسة.
من النتائج السابقة يمكن استنتاج أنه يمكن استخدام ناتج تبييض الأرز حتى نسبة ٣٠% في علائق كتاكيت اللحم المكونة أساسا من الذرة وكسب فول الصويا للحصول علي نتائج جيدة بالنسبة لأداء الطيور، مواصفات الذبيحة، الكفاءة الغذائية. كذلك فإن استخدام إنزيم الفيتيز مع ناتج تبييض الأرز حسن معنويا أداء كتاكيت اللحم.