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RESEARCH ARTICLE

Application of Different Chemical and Biochemical Treatments to Improve Nutritive Potential of Defatted Rice Polishing

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ABSTRACT

This Study was conducted to improve the nutritional value of defatted rice polishing for broiler rations by applying different chemical treatments under complete randomized design. For this purpose, day old broiler chicks (n=225) were randomly divided into five groups i.e. A, B, C, D and E. Each group was further divided in three subgroups R1, R2, R3 with 10%, 20% and 30% defatted rice polishing containing ration, each subgroup having 15 chicks. Groups A, B, C, D and E were fed ration containing defatted rice polishing as raw, hydrochloric acid (HCl) treated, Sodium hydroxide (NaOH) treated, hydrogen peroxide (H_2O_2) treated and Kemzyme (enzyme) added. Results showed that at 10 % inclusion (R1) of defatted rice polishing (DFRP) maximum ($P<0.05$) feed intake was observed in group A while minimum in groups C and B. weight gain was highly significant ($P<0.05$) in group D than groups C and B. In FCR, group D showed better performance while least in group A. At 20% DFRP inclusion (R2), no difference was found in feed intake between groups A, B, C and D. In weight gain, highest value obtained in groups D, B and C while lowest ($P<0.05$) in groups A and E. In FCR, group D was better and was statistically similar to groups B, C and E, however, group A showed significantly poor ($P<0.05$) FCR than all treated DFRP groups. At 30% DFRP inclusion (R3), difference in feed intake was non significant among all groups. Maximum ($P<0.05$) weight gain observed in group A while lowest in D. However, better FCR observed in groups A, B and C which was significantly different from groups D and E. It was concluded that up to 20% H_2O_2 treated DFRP can be effectively used in broilers diets.

INTRODUCTION

Broiler production is efficient, economical and quickest way of producing high quality animal protein for human consumption. In poultry production, the feed cost is 77% of the total production expenses (Perry, 1982). Although there is tremendous progress in poultry but still per capita protein availability is deficient in Pakistan. The reason is that most of the area under cultivation is used for growing cash crops for ever increasing human population. Due to this reason prices of feed stuffs used for poultry and livestock are increasing day by day. Moreover, quality of feed ingredients is too variable to be dependable due to poor processing techniques. So, it is imperative to properly process feed ingredients to enhance their nutritional quality. Among these ingredients, rice polishing is commonly used as an energy source. As rice is third high producing crop (6952000 tons/annum), rice polishing is available in abundant quantity in Pakistan (Anonymous, 2008). It is a finely ground powdered material obtained in polishing of rice kernels after the hulls have been removed as a by-product of rice milling. It is a good source of energy (3250 kcal/kg) and an assortment of amino acids.

Defatted rice polishing (DFRP) is a by-product of rice industry in Pakistan. It is comparatively economical feed ingredient than routinely used grains and rich in essential amino acids (Khalique et al., 2003, 2004). Its potential as energy source cannot be exploited due to presence of certain anti-nutritional factors like, trypsin inhibitors, crude fiber and haemeagglutinin (Deolankar and Singh, 1979). These anti-nutritional factors can be removed by different processes such as cooking or treating with weak acid or alkali (Majeed, 1997). Hence, this study focused on nutritional improvement of defatted rice polishing with chemical and biochemical treatments so that it can be safely used in broiler rations. It also contains a considerable amount of oil and its amino acid profile is reported to have better than cereal grain (Farrell, 1994). These qualities lead to a high demand for rice polishing as poultry feed (Piliang et al., 1982). The anti-nutritive factors such as haemagglutinin and trypsin inhibitors associated with rice polishing reduce the availability of amino acids and other nutrients to poultry (Khalique et al. 2004). Crude fiber is a limiting factor of defatted rice polishing, so in order to break its fibers, various chemicals such as HCl, NaOH, H_2O_2 and Kemzyme (Kemzyme H.F, an enzyme based supplement containing enzymes like α amylase, β glucansae, cellulase, and lipase) can be used to enhance availability of nutrients. So in order to utilize full nutritional benefits from this abundant available feedstuff, present project was planned with the objective to determine the influence of various chemical treatments on the nutritive value of defatted rice polishing in broilers.

MATERIALS AND METHODS

Day old Hubbard broiler chicks (n=225) of male sex were randomly divided into 5 equal groups (A, B, C, D and E; each containing 45 chicks). Each group was further divided in 3 subgroups having 15 birds in each subgroup (R1, R2, R3). Three subgroups of each group were fed basal rations containing different inclusion levels of defatted rice polishing (DFRP) i.e. 10, 20 and 30%, respectively. Composition of experimental ration and nutrient profile is depicted in Table 1. Each group was different from other groups with respect to treatment solutions applied while among each group subgroups were different with respect to different inclusion levels of DFRP. Fresh defatted rice polishing was purchased from a local rice market and was divided into five equal parts. One part of rice polishing remained untreated which was offered to group A which served as control group. The remaining four parts were subjected to treatments of 0.4 N HCl (treatment applies to all subgroups of group B), 0.2 N NaOH (applies to all subgroups of group C), 5% H_2O_2 (all subgroups of group D) and 0.1% Kemzyme (all subgroups of group E). For this purpose, chemical solutions of each treatments B, C and D were prepared for 31.5 kg batch of defatted rice polishing. For 0.4 N HCl treatment, 1972.8 ml of HCl (98% pure) was dissolved in 50 liters of distilled water. In case of 0.2 N NaOH treatments, 400 gm of NaOH was dissolved in 50 liters of distilled water. For 5% H_2O_2 treatment, 7 liters of H_2O_2 was dissolved in 50 liters of distilled water to treat 31.5 kg of defatted rice polishing. Kemzyme H.F. enzyme (15.75 gm) was added in feed for preparation of 1% Kemzyme H.F. mixed ration.

Total duration of experiment was 42 days. For first 28 days broiler starter diet (Table 1) was fed while for remaining period broiler finisher diet (Table 2) was offered to the respective groups. Chemical composition of the ingredients was determined according to the protocol described by AOAC (1990). Data on feed intake by each subgroup were recorded on weekly basis. Initial and final body weight gains were also recorded. The data on feed intake and weight gain were recorded on regular basis to calculate feed conversion ratios of all subgroups. The data thus obtained were analyzed using completely randomized design under factorial arrangement (Steel et al., 1997). Significance of means was tested using Duncan's multiple range test (Duncan, 1955). The differences were considered significant at $P<0.05$.

RESULTS AND DISCUSSION

Results of the experiment showed significant differences among different treated DFRP groups regarding feed intake (Table 3). At 10 % inclusion (R1) of defatted rice polishing (DFRP), maximum feed intake was observed in group A while minimum in groups C and B. At 20% DFRP inclusion (R2), a non significant difference was observed between groups A, B, C and D with regard to feed intake. However, feed intake was comparatively higher in group D whereas group E showed lowest ($P<0.05$) feed intake than all other groups. At 30% DFRP inclusion level (R3), a non-significant difference ($P>0.05$) in feed intake was observed among all groups. These results are in line with the previous findings (Majeed 1997; Ahmad, 1991) that reported higher feed intake in birds fed on treated DFRP.

Results of weight gain in birds showed significant differences ($P<0.05$) in experimental groups (Table 3). Weight gain at 10% DFRP inclusion (R1) was significantly higher ($P<0.05$) in group D as compared to groups C and B. At 20% inclusion (R2) of DFRP, maximum weight gain was also observed in group D, however it was statistically similar with groups B and C. Lowest ($P<0.05$) weight gain was observed in groups A and E. At 30% DFRP inclusion (R3), group A showed significantly maximum ($P<0.05$) weight gain than other experimental groups while lowest ($P<0.05$)

weight gain observed in Group D. These results indicate that up to 20% inclusion of 5% H_2O_2 treated DFRP (D) can give better weight gain in broiler chicks. It is deduced that 5% H_2O_2 treated defatted rice polishing through hydrolysis of the hemicelluloses component to sugar has provided additional energy to the birds resulting in higher weight gain. Khalique et al. (2003) also reported that 6% H_2O_2 treatment of defatted rice polishing resulted in improved weight gain. Similar to our findings, improved performance of broiler chicks fed treated defatted rice polishing was also reported by Saleemi (2000). Some other studies, however did not find any significant difference in weight gain of broilers fed treated defatted rice polishing (Khan et al., 2002; Jeshwani et al., 1996; Masood et al., 1995).

Feed conversion ratio is good indicator of economic importance in broiler farming. The results obtained regarding feed conversion ratio (FCR) in broiler chicks among different groups are given in table 3. At 10% inclusion level (R1) of DFRP level, better FCR ($P<0.05$) was observed in group D birds while poor in group A. Likewise, at 20% inclusion (R2) of DFRP, comparatively better FCR was observed in group D which was statistically similar to groups B, C and E. However, group A showed significantly poor ($P<0.05$) FCR than all treated DFRP groups. At 30% level, better ($P<0.05$) FCR was observed in groups A, B and C which was significantly different from groups D and E. These results explain that group D was found better with 20% DFRP inclusion in rations. Conversely, the higher FCR value was observed in untreated rice polishing (A) which indicated the poor performance of birds on this particular diet. This low performance may be due to the presence of anti-nutritive factors i.e., phytic acid, lectin, trypsin inhibitor present in untreated rice polishing. Similarly, Tsuda (1979) concluded that

Table 1: Composition of broiler starter ration

Ingredients %	A			B			C			D			E		
	R1	R2	R3	R1	R2	R3	R1	R2	R3	R1	R2	R3	R1	R2	R3
Corn	59.5	46.5	34.5	59.5	46.0	34.5	59.0	46.5	34.5	59.5	46.5	34.5	59.5	46.5	34.5
D.F. Rice polishing 1	0.0	20.0	30.0	10.0	20.0	30.0	10.0	20.0	30.0	10.0	20.0	30	10.0	20.0	30.0
Soybean meal	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15	15.0	15.0	15.0
Cron gluten 60%	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8	8.0	8.0	8.0
Fish meal	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6	6.0	6.0	6.0
Vegetable oil	- -	3.0	5.0	- -	3.0	5.0	- -	3.0	5.0	- -	3.0	5	- -	3.0	5.0
CaCO3	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Pre-Mix	0.50	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Chemical composition															
ME (kcal/kg)	2900	2905	2908	2903	2905	2909	2910	2905	2906	2907	2908	2905	2904	2908	2910
CP%	21.02	21.04	21.06	21.0	21.04	21.05	21.03	21.05	21.06	21.07	21.08	21.06	21.04	21.08	21.09
CF%	5.05	6.15	7.71	5.0	6.05	7.60	5.01	6.00	7.5	5.05	6.10	7.5	5.0	6.05	7.4
EE%	4.95	7	4.99	4.96	7.1	5.0	4.97	7.0	5.0	4.97	7.0	5.0	4.96	7.0	5.0
Ash%	6.63	7.49	8.29	6.64	7.50	8.50	6.65	7.50	8.50	6.66	7.51	8.30	6.64	7.45	8.30
NFE%	54.35	50.34	49.95	54.4	50.31	49.85	54.34	50.45	49.94	54.25	50.31	50.14	54.36	50.42	50.21

DFRP= Defatted Rice Polishing; A= Control group fed on raw DFRP; B= Group fed on HCL treated DFRP; C= Group fed on NaOH treated DFRP; D= Group fed on H_2O_2 treated DFRP; E= Group fed on Kemzyme treated DFRP

Table 2: Composition of broiler finisher ration

Ingredients %	A			B			C			D			E		
	R1	R2	R3	R1	R2	R3	R1	R2	R3	R1	R2	R3	R1	R2	R3
Corn	64.5	51.5	39.5	64.5	51.5	39.5	64.5	51.5	395	64.5	51.5	39.5	64.5	51.5	39.5
DFRP	10	20	30	10	20	30	10	20	30	10	20	30	10	20	30
Soybean meal	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Cron gluten 60%	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
Fish meal	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
Vegetable oil	- -	3	5	- -	3	5	- -	3	5	- -	3	5	- -	3	5
CaCO3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Pre-Mix	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Chemical Composition															
ME (kcal/kg)	2950	2954	2958	2952	2954	2953	2952	2954	2957	2954	2959	2960	2952	2950	2955
CP%	19.02	19.04	19.06	19.0	19.04	19.05	19.03	19.05	19.06	19.07	19.08	19.06	19.04	19.08	19.09
CF%	5.05	6.15	7.71	5.0	6.05	7.60	5.01	6.00	7.5	5.05	6.10	7.5	5.0	6.05	7.4
EE%	4.95	7	4.99	4.96	7.1	5.0	4.97	7.0	5.0	4.97	7.0	5.0	4.96	7.0	5.0
Ash%	6.63	7.49	8.29	6.64	7.50	8.50	6.65	7.50	8.50	6.66	7.51	8.30	6.64	7.45	8.30

DFRP= Defatted Rice Polishing; A= Control group fed on raw DFRP; B= Group fed on HCL treated DFRP; C= Group fed on NaOH treated DFRP; D= Group fed on H_2O_2 treated DFRP; E= Group fed on Kemzyme treated DFRP.

Table 3: Mean (± S.D) feed intake, weight gain and feed conversion ratio of broilers fed diets containing different levels of treated rice polishing

Rations	Feed intake (gm)			Weight gain (gm)			Feed conversion ratio (%)		
	R1	R2	R3	R1	R2	R3	R1	R2	R3
A	2896±110.67[a]	2828±121.35[a]	2709±501.2[a]	1417±52.92[b]	1444±30.55[b]	1584±64.29[a]	2.11± 0.07[a]	1.97± 0.03[a]	1.93± 0.05[b]
B	2428±59.47[c]	2863±86.38[a]	2808±28.8[a]	1297±20.0[c]	1557±52.92[a]	1494±20.0[abc]	1.94±0.09[c]	1.85±0.03[b]	1.86± 0.0 1[b]
C	2414±233.58[c]	2786±84.46[a]	2856±43.6[a]	1310±20.55[c]	1537±72.11[a]	1557±43.59[ab]	2.06± 0.03[ab]	1.84± 0.09[b]	1.86±0.01[b]
D	2765±103.22[ab]	2906±41.79[a]	2841±166.7[a]	1500±15.28[a]	1577±20.0[a]	1464±50.33[c]	1.89±0.04[c]	1.89± 0.02[b]	2.04± 0.09[a]
E	2531±46.32[bc]	2554±118.2[b]	2913±90.18[a]	1377±20.0[b]	1377±20.0[b]	1490±61.10[bc]	1.98±0.08[bc]	1.87± 0.02[b]	2.03±0.01[a]

DFRP= Defatted Rice Polishing; A= Control group fed on raw DFRP; B= Group fed on HCL treated DFRP; C= Group fed on NaOH treated DFRP; D= Group fed on H_2O_2 treated DFRP; E= Group fed on Kemzyme treated DFRP; Values with different superscripts in a column differ significantly ($P<0.05$).

untreated rice polishing depressed growth due to presences of anti-nutritive factors present in rice polishing. However, our results are contrary to the earlier findings (Purushothaman et al., 1989; Tiemoko, 1992) that did not find any significant differences in FCR of birds fed treated defatted rice polishing.

Conclusion

Among the different treatments used, 5% H_2O_2 treatment yielded better results. Based upon findings of this study, it may be concluded that up to 20% inclusion level, 5% H_2O_2 treated defatted rice polishing containing ration can be used effectively in broiler rations for improved performance without any adverse effects.

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