Chemical Composition and Nutritional Evaluation of Variously Treated Defatted Rice Polishing for Broiler Feeding

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ABSTRACT : The study was conducted to improve the nutritive value of defatted rice polishing (DRP). DRP was treated with various concentrations of HCl, NaOH, H_2O_2 and Kemzyme-H F® and the effect on its chemical composition and nutritive value in broiler chicks was observed. The treatments levels of 0.4 N HCl, 0.2 N NaOH and 6% H_2O_2 were selected from many concentrations of HCl, NaOH and H_2O_2 tried earlier on DRP. The selection was made on the basis of release of nutrients from DRP. The Kemzyme-H F® was used at rate of 0.1% of DRP. The selected concentrations of HCl, NaOH, and H_2O_2 were then used for treatment of DRP that was used in biological experiments. Two hundred and forty, day-old Hubbard male broiler chicks (38-40 g) were randomly divided into 48 experimental units with five chicks each. Each chemically treated DRP was incorporated into broiler diets at 10, 20 or 30% levels replacing yellow corn from the control feed and thus sixteen experimental feeds were prepared. These feeds were randomly assigned to 48 experimental units such that there were three replicates of chicks on each diet. The results of the study suggest that DRP can be effectively used in broiler diets at 20% level. The best weight gain and feed conversion ratio were observed with diet containing 20% level of DRP treated with 6% H_2O_2. The diets containing 30% levels of treated DRP were uneconomical, as excess use of oil was required to compensate the energy needs of the birds. ***(Asian-Aust. J. Anim. Sci. 2003. Vol 16, No. 6 : 873-879)***

Key Words : Broilers, Defatted Rice Polishing, HCl, NaOH, H_2O_2 and Kemzyme-H F®

INTRODUCTION

Cereal grains, like maize, wheat, rice tips and sorghum constitute the bulk (about 50-60%) of poultry feed. Asian countries are not producing enough cereals for the human population or the feed industry. Thus a competition exists between the needs for human food and poultry feed, and therefore, it is necessary to search for alternate feed ingredients that are not being used as human food. These must have enough nutritional merits to compare with cereal grains and also have low cost to be economically used in poultry feed.

Rice polishing, a by-product of rice milling industry, is one such product abundantly and cheaply available during the rice milling season. It is about 10% of the paddy by weight. It is derived from the outer layers of the rice caryopsis during milling and consists of pericap, seed coat, nucleus, aleurone layer, germ and part of sub-aleurone layer of starchy endosperm (Juliano, 1988).

Nutritionally, rice polishing contains 13-15% protein, 11-12% oil and 40-45% nitrogen free extract. In addition, it contains a fair amount of vitamins and minerals. This chemical profile is comparable to other cereals like maize, wheat, sorghum and rice tips. It is also a rich source of phosphorus, potassium, iron, copper and zinc, and the amino acid profile of the rice bran protein is generally superior to that of cereal grains. The fiber contents range from 10-15% (Farrell, 1994). The oil present in rice polishing is known to be of good quality. Upon milling, the oil is exposed to lipase enzymes in the rice polishing, causing its rapid breakdown to free fatty acids. This process results in severe nutritional degradation if fed after prolonged storage and cause economic losses when fed to poultry. Because of this problem oil is extracted with solvents for human consumption and/or for industrial uses such as soap.

The defatted rice polishing (DRP) is not a preferred human food. A sizable portion of it is incorporated into poultry and cattle feed or it is exported as fertilizer. At present full potential of DRP as poultry feed is not being achieved due to the presence of anti-nutritive factors. These toxic factors are trypsin inhibitor, lectin (hemagglutinin), phytic acid as phytate and crude fiber. These anti-nutritive factors have been reported to reduce feed intake and depress performance of poultry (Kratzer et al., 1974).

So far, attempts to improve the nutritive value of rice polishing have had limited success and results obtained are equivocal. However, some reports indicated that the nutrients availability from DRP increases by treating it with HCl (Purushothaman et al., 1989) or enzyme preparations (Farrell and Martin, 1998); however, to date, no systematic attempt has so far been made in this direction.

The present study was therefore initiated to develop a

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Table 1. Composition of experimental diets used in the biological evaluation

Ingredients	Control	Untreated			0.4 N HCl			0.2 N NaOH			6% H_2O_2			Kemzyme		
	T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8	T_9	T_{10}	T_{11}	T_{12}	T_{13}	T_{14}	T_{15}	T_{16}
Corn	66	64.5	51.5	39.5	64.5	51.5	39.5	64.5	51.5	39.5	64.5	51.5	39.5	64.5	51.5	39.5
Rice polishing (defatted)	-	10	20	30	10	20	30	10	20	30	10	20	30	10	20	30
Soybean meal	14	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Canola	12															
Corn gluten 60%	4.5	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
Fish meal	2	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
$CaCO_3$	1	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	0.5
Calculated values																
ME (kcal/kg)	2,900	2,900	2,900	2,900	2,900	2,900	2,900	2,900	2,900	2,900	2,900	2,900	2,900	2,900	2,900	2,900
Crude protein %	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
Crude fiber %	4	4.05	5.15	6.51	4.0	4.92	5.60	3.9	4.71	5.5	3.79	4.65	5.10	4.0	5.05	5.4
Ether extract %	3.65	4.94	5.1	5.0	4.96	5.1	5.0	4.97	5.0	5.0	4.98	5.01	5.1	4.97	5.0	5.1
Ash %	6.1	6.63	7.49	8.30	6.65	7.51	8.51	6.66	7.52	8.51	6.66	7.53	8.31	6.65	7.45	8.31

* Supplied per kilogram of diet: Vitamin A, 1,500 IU; Vit. D_3 200 ICU; Vit. E 10 IU; Vit. K 0.5 mg; Vit. B_1 1.8 mg; Vit B_2 3.6 mg; Vit. B_6 5.5 mg; Vit. B_{12} 0.01 mg; Biotin 0.15 mg; Choline 1,300 mg; Folic acid 0.55 mg; Pantothenic acid 10 mg; Niacin 35 mg; Iron 0.002%; Iodine 6.6×10^{-5}%; Zinc 9×10^{-4}%.

process to increase the availability of carbohydrates, proteins and minerals from DRP by treating it with acid (HCl), alkali (NaOH), hydrogen peroxide (H_2O_2) and an enzyme (Kemzyme-H F®) to hydrolyze or oxidize or break the bonds of toxins and complex carbohydrates and make it a suitable replacement for other normal cereal constituents of poultry feed.

MATERIALS AND METHODS

Preparation of chemical solutions

The various concentrations of HCl and NaOH (0.05, 0.1, 0.15, 0.20, 0.25, 0.30, 0.35 and 0.40 N) and of H_2O_2 (1, 2, 3, 4, 5 and 6%) were prepared by diluting 1N HCl, 1N NaOH and 35% w/w of H_2O_2 standard solutions.

Treatments and chemical analysis

The treated samples of DRP, after drying, were subjected to chemical analysis on a dry matter basis as detailed in Tables 2, 3 & 4. The CP, pH, NDF, NDS, ADF and ADS were analysed according to AOAC (1990). The absorption capacity of DRP was determined before its treatment with different chemicals to avoid the drainage of soluble nutrients due to excessive amounts of solutions. Five grams of DRP were soaked with 1, 2, 3, 4, and 5-ml of water to know its absorption capacity. It was observed that DRP could absorb water in the ratio of 1:1.5. After doing preliminary experiments on the effects of different concentrations of chemicals used followed by chemical composition of the resultant DRP, 0.4 N HCl, 0.2 N NaOH and 6% H_2O_2 were selected for further detailed studies (see tables 2, 3, and 4). These concentrations were selected on the basis of their ability to release certain nutrients from untreated DRP. These selected concentrations gave minimum values for NDF without bringing any change in the protein contents of the DRP. Kemzyme-H F ® is a commercial product that has the ability to enhance the digestibility of non-starch polysaccharides (NSP) present as feed ingredients. It was incorporated in DRP at rate of one g/kg. Portions of DRP were then treated by thorough mixing with each of the selected solutions of HCl (0.4 N), NaOH (0.2 N) and H_2O_2 (6%) by soaking the DRP at the rate of 1.5 l/kg DRP. There was no overflow of chemicals or nutritive material from the soaked DRP. After 5 hours of treatment, the samples of differently treated DRP were sun dried by spreading in 1-cm thick layer on a plastic sheet to less than 12% moisture.

The DRPs so treated were included in broiler experimental diets at the levels of 10, 20 and 30% replacing corn, respectively.

Feeding trial

Sixteen, iso-caloric and iso-nitrogenous, broiler starter and finisher diets were formulated consisting of one commercial (T_1) and fifteen diets containing differently treated DRP (Table 1). The 15 experimental diets contained either 10, 20, or 30% untreated or treated (with HCl, NaOH, H_2O_2 or Kemzyme-HF®) DRP as detailed in Table 1. Two hundred forty, day-old, Hubbard male broiler chicks were randomly divided into 48 experimental units of five chicks each. Each experimental unit was placed in separate pen measuring 1.98×1.52×1.22 m. These experimental units were randomly allotted to the sixteen diets in such a way that there were three replicates on each diet. The experimental diets were offered to chicks in galvanized feeding troughs. The chicks were fed the allotted diet *ad*

Table 2. Comparisons of chemical composition of HCl treated defatted rice polishing according to the analysis of variance

Treatments of DRP	pH	C P	NDF	NDS	ADF	ADS
Untreated DRP	6.50±0.015	14.50±0.015	31.92±0.015	68.00	14.91±0.025	85.09
0.05N HCl	5.85±0.016 [a1]	14.72±0.023 [a]	35.86 ±0.027 [h]	64.14	16.86±0.021 [f]	83.14
0.1 N HCl	5.62±0.010 [b]	14.70±0.025 [a]	34.30±0.025 [g]	65.70	15.71±0.015 [e]	84.29
0.15N HCl	5.36±0.015 [c]	14.68±0.015 [a]	33.29±0.015 [f]	66.71	15.50±0.021 [d]	84.50
0.20N HCl	5.05 ±0.015 [d]	14.71±0.020 [a]	32.89±0.021 [e]	67.11	15.31±0.015 [c]	84.69
0.25N HCl	5.07±0.017 [d]	14.69±0.014 [a]	32.69±0.036 [d]	67.31	15.05±0.015 [b]	84.95
0.30N HCl	4.84±0.012 [e]	14.72±0.009 [a]	30.89±0.026 [c]	69.11	15.01±0.029 [b]	84.99
0.35N HCl	4.23±0.015 [f]	14.71±0.023 [a]	30.29±0.017 [b]	69.71	15.03±0.010 [b]	84.97
0.40N HCl	3.94±0.016 [g]	14.73±0.017 [a]	27.82±0.010 [a]	72.18	14.75±0.015 [a]	84.25
Mean of HCl treated DRP	4.99	14.71	32.25	67.75	15.402	84.598
SE of means	0.127	0.065	0.49	-	0.013	-

CP=crude protein. NDF=neutral detergent fiber. NDS=neutral detergent soluble (100-NDF). ADF=acid detergent fiber. ADS=acid detergent soluble (100-ADF)

[1] In this and succeeding tables, results with in a column with the same superscript are not significantly different ($p > 0.05$).

Table 3. Comparisons of chemical composition of NaOH treated defatted rice polishing according to the analysis of variance

Treatments of DRP	pH	C P	NDF	NDS	ADF	ADS
0.05N NaOH	6.93±0.015 [g]	14.50±0.015 [a]	40.78±0.003 [g]	59.22	16.94±0.021 [g]	83.06
0.1 N NaOH	7.41±0.006 [f]	14.52±0.010 [a]	40.78±0.021 [g]	59.22	16.80±0.000 [f]	83.20
0.15N NaOH	7.96±0.010 [e]	14.52±0.010 [a]	39.42±0.010 [f]	60.58	16.80±0.010 [f]	83.20
0.20N NaOH	8.20±0.025 [d]	14.52±0.005 [a]	37.44±0.021 [e]	62.56	16.55±0.015 [e]	83.45
0.25N NaOH	8.41±0.006 [c]	13.89±0.020 [b]	34.29±0.025 [d]	65.70	15.81±0.015 [d]	84.19
0.30N NaOH	8.73±0.016 [b]	13.86±0.012 [b]	32.00±0.016 [c]	68.00	14.86±0.006 [c]	85.14
0.35N NaOH	8.76±0.015 [b]	13.85±0.015 [b]	31.15±0.021 [b]	68.85	14.81±0.012 [b]	85.19
0.40N NaOH	9.18±0.015 [a]	13.76±0.021 [c]	30.42±0.017 [a]	69.58	14.71±0.012 [a]	85.29
Means of NaOH treated DRP	8.20	14.18	35.78	64.22	15.91	84.09
SE of means	0.146	0.071	0.849	-	0.193	-

CP=crude protein, NDF=neutral detergent fiber, NDS=neutral detergent soluble (100-NDF), ADF=acid detergent fiber, ADS=acid detergent soluble (100-ADF)

libitum. Fresh water was made available all the time. Record of experimental diets offered and refused was maintained daily. At the start of experiment the room temperature was maintained at 32±2°C. It was lowered by 3°C each week till 21°C which was maintained through out the rest of the experimental period. Continuous light was provided throughout 42 days of the experimental period. Daily feed consumption, weekly weight gain, feed efficiency, economics, dressing percentage, post mortem lesions and mortality, if any, were recorded regularly.

Statistical analysis

The data collected on various parameters were subjected to analysis of variance according to completely randomized design using orthogonal contrast (Steel and Torrie, 1996; Faqir, 2000). The comparisons of means were done according to Duncan (1955) using a software package (Minitab-11.12, 1996).

RESULTS

Effects of various concentrations of HCl on DRP are shown in table 2. The protein contents of DRP did not alter significantly with the increasing concentrations of HCl from 0.05 N to 0.40 N. Increasing the acid concentrations decreased the pH from 5.85 to 3.94 ($p<0.001$). The NDF decreased significantly ($p<0.001$) and NDS of DRP increased by 6.15% with 0.4 N HCl treatment. The ADF and ADS were also significantly ($p<0.001$) affected by various concentrations of HCl treatment.

The chemical composition and statistical analysis of DRP treated with various concentrations of NaOH are given in table 3. The pH, NDS and ADS values increased ($p<0.001$) with increased NaOH concentration from 0.05 N to 0.40 N. However the protein contents remained constant up till 0.2 N NaOH and then declined ($p<0.001$) with increasing dilutions (table 3).

The treatment of DRP with varying dilutions of H_2O_2 did not affect the pH and protein; however, it improved ($p<0.001$) the NDF and ADF content (table 4). The NDF and ADF gradually decreased with higher concentration of H_2O_2 whereas NDS and ADS increased. The statistical analysis revealed significant difference ($p<0.05$) between treatments. It appeared that 6% H_2O_2 treatment proved better in releasing the nutrients (table 4).

Table 4. Comparisons of chemical composition of H_2O_2 treated defatted rice polishing according to the analysis of variance.

Treatments of DRP	pH	CP	NDF	NDS	ADF	ADS
1% H_2O_2	6.55±0.000 [a]	14.50±0.015 [a]	32.69±0.006 [f]	67.31	15.88±0.015 [e]	84.12
2% H_2O_2	6.55±0.000 [a]	14.52±0.010 [a]	32.49±0.015 [e]	67.51	15.49±0.015 [d]	84.51
3% H_2O_2	6.55±0.000 [a]	14.54±0.009 [a]	28.14±0.015 [d]	71.86	15.42±0.012 [d]	84.58
4% H_2O_2	6.55±0.007 [a]	14.52±0.009 [a]	27.83±0.017 [c]	72.17	15.27±0.015 [c]	84.73
5% H_2O_2	6.55±0.010 [a]	14.53±0.016 [a]	27.68±0.015 [b]	72.32	15.25±0.021 [b]	84.75
6% H_2O_2	6.55±0.006 [a]	14.53±0.014 [a]	27.57±0.020 [a]	72.43	15.18±0.010 [a]	84.82
Mean of H_2O_2 treated DRP	6.549	15.07	29.40	70.60	15.415	84.585
SE of means	0.002	0.158	0.549	-	0.057	-

Table 5. Means and standard errors of weight gain, feed consumed, feed conversion ratio (FCR), dressing percentage and economics of broiler birds fed on different experimental diets for 42 days

Experimental diets		Weight gain (g)	Feed consumed (g)	FCR (kg/kg)	Dressing (%)	Cost/kg live weight gain (PAK Rs[1].)
T_1	Commercial (control)	1715±11.86 [bc]	3201±7.36 [a]	1.86±.009 [bc]	62.50±0.603 [a]	22.04
T_2	10% DRP untreated	1674±12.49 [cd]	3164±29.91 [ab]	1.89±.010 [cd]	61.50±0.289 [a]	18.20
T_3	20% DRP untreated	1611±14.33 [e]	3168±44.20 [ab]	1.96±.012 [fg]	61.10±0.379 [a]	18.40
T_4	30% DRP untreated	1458±11.26 [g]	3167±23.39 [ab]	2.17±.006 [i]	61.60±0.265 [a]	19.10
T_5	10% DRP treated with 0.4N HCl	1638±11.84 [de]	3064±18.15 [de]	1.87±.009 [bc]	62.60±0.462 [a]	18.80
T_6	20% DRP treated with 0.4N HCl	1759±29.79 [ab]	3048±31.85 [de]	1.73±.012 [a]	61.80±0.306 [a]	18.80
T_7	30% DRP treated with 0.4N HCl	1534±3.84 [f]	3061±1.00 [de]	1.99±.003 [gh]	61.80±0.517 [a]	19.49
T_8	10% DRP treated with 0.2 N NaOH	1663±8.19 [de]	3117±14.34 [bcd]	1.88±.007 [bc]	62.30±0.281 [a]	18.30
T_9	20% DRP treated with 0.2 N NaOH	1558±22.23 [f]	3023±37.24 [e]	1.94±±.006 [ef]	60.60±0.306 [c]	18.40
T_{10}	30% DRP treated with 0.2 N NaOH	1511±2.73 [f]	3024±12.53 [e]	2.00±.009 [h]	61.90±0.627 [a]	19.03
T_{11}	10% DRP treated with 6% H_2O_2	1661±17.17 [de]	3161±20.84 [ab]	1.90±.009 [cd]	62.00±0.874 [a]	18.50
T_{12}	20% DRP treated with 6% H_2O_2	1788±5.78 [a]	3156±7.17 [ab]	1.76±±.003 [a]	63.00±0.635 [a]	19.60
T_{13}	30% DRP treated with 6% H_2O_2	1644±26.17 [de]	3150±10.41 [abc]	1.92±.31 [de]	60.50±0.446 [a]	20.10
T_{14}	10% DRP treated with Kemzyme®	1645±7.77 [de]	3121±12.72 [abcd]	1.90±.017 [cd]	62.00±0.323 [a]	18.50
T_{15}	20% DRP treated with Kemzyme®	1651±27.18 [de]	3072±38.41 [cde]	1.86±.015 [bc]	61.50±0.921 [a]	19.05
T_{16}	30% DRP treated with Kemzyme®	1454±14.57 [g]	2863±36.79 [f]	1.97±.006 [fg]	60.60±0.653 [a]	20.26

[1] One US dollar = 60 Pak rupees

Weight gain

The results of weight gains and other parameters are presented in Table 5. The experiment was run for 42 days and the initial weight of the chicks was 38-40 g. The maximum weight gain was recorded in chicks fed on experimental diet T_{12} (containing 20% DRP treated with 6% H_2O_2). The next in order were T_6 (20% DRP treated with 0.4 N HCl) and T_1 (control). The chicks fed on diets T_2, T_3, T_5, T_8, T_{11}, T_{13}, T_{14} and T_{15} gained weights within the range of 1.600-1.700 g. In these groups T_2, T_5, T_8, T_{11}, and T_{14} diets contained only 10% DRP with or without treatments, whereas the diets T_3 and T_{15} contained 20% untreated and Kemzyme-H F® treated DRP respectively; however, T_{13} diet contained 30% DRP treated with 6% H_2O_2. The chicks fed on diets T_7, T_9 and T_{10} gained weights in the range of 1,500-1,600 g. The diet T_7 contained 30% DRP treated with 0.4N HCl. T_9 contained 20% DRP treated with 0.2 N NaOH and T_{10} contained 30% DRP treated with 0.2 N NaOH. The least weight gains 1,400-1,500 were observed in birds fed on diets T_4 (30% untreated DRP) and T_{16} containing 30% Kemzyme-H F® treated DRP.

Feed consumption

The maximum average feed consumed was recorded in the chicks fed on commercial diet (control, T_1). The next group was of those chicks that were fed diets T_2, T_3, T_4, T_8 and T_{14} and were non-significant ($p>0.05$) to each other. The diets T_2, T_3, and T_4 contained 10, 20 and 30% untreated DRP, respectively. However, diets T_8 and T_{14} contained 10% DRP treated with 0.2N NaOH or Kemzyme-H F®. The statistical analysis revealed non-significant ($p>0.05$) differences in feed consumption among the diets T_{11}, T_{12} and T_{13} containing 10, 20 and 30% of 6% H_2O_2 treated DRP, respectively. Similarly the chicks fed on rations T_5, T_6, T_7, T_9, T_{10} and T_{15} consumed feed within the range of 3,000-3,100 g/chick and were statistically non-significant ($p>0.05$) among themselves. Statistically minimum feed was consumed by chicks fed on 30% DRP treated with Kemzyme-H F®. It is evident from the results that DRP can be included in the rations up to 30% in broiler feed, however, treatment affected the the palatability of feed. It seems that treatment of DRP with 6% H_2O_2 improved its palatability and feed consumption and the values were comparable with the commercial diet group. However, the palatability and consumption of DRP treated with Kemzyme-H F® decreased at its highest (30%) inclusion level in broiler diet (table 5).

Feed conversion ratio

The best FCR (feed required per unit gain) 1.73 was observed in chicks fed the experimental diet containing 0.4 N HCl treated DRP (T_6). The next in order was the FCR (1.76) of birds fed on diet T_{12} (20% DRP treated with 6% H_2O_2), however, the difference between them was non-significant (p>0.058). The next groups with FCR (1.84-1.88) were T_1, T_2, T_5, T_8, T_{11} and T_{15}. Comparison of means revealed no difference among these groups. Similarly groups of chicks with FCR ranging from 1.90 to 2.00 and fed on diets T_{13} and T_{14}, T_9 and T_{13}, T_3, T_9 and T_{16}; T_7, T_{10} and T_{16} showed similarity with each other. The minimum FCR was noted for the diet containing 30% untreated DRP. It might be due to the higher levels of crude fiber in this diet (table 5).

Dressing percentage

Dressing percentages were determined by slaughtering the chicks, removing the skin, head, feathers, lungs, toes with feet, gastro-intestinal tract, heart, liver and gizzard. Statistical analysis revealed that the values obtained were not significantly different among the various groups tested (table 5).

Postmortem lesions

No mortality was observed in any group whether control or experimental throughout the duration of the experiment for 6 weeks. At the end of the experiment postmortem lesions were studied in the gastro-intestinal tract of broiler chicks of different groups. Other organs, such as breast muscles, bursa of Fabricius, lungs, liver, kidney and heart were also studied carefully. There were no diseases or pathological lesions observed in these organs. All the organs were of normal shape, color and texture.

Economics

The feed cost of diets containing differently treated DRP were lower than the cost of a commercial diet. However, the feed cost of the diet containing 30% level of DRP was slightly higher irrespective of the treatment involved. This was because of addition of extra amount of oil in these experimental diets to maintain their energy level (table 5).

DISCUSSION

In the present study the solvent hexane was used to extracted rice polishing. The removal of oil from regular polishing by solvent extraction not only brought about proportional increases in the concentrations of all major constituents except water but also decreased the toxic effects of rancid rice polishing in broiler feed. Kratzer et al., (1974) also reported that solvent extraction removed the oil and the activity of lipases became zero because the substrate for the lipases was removed.

The analysis of DRP used in the present study revealed that values of CP were higher than reported by Malik and Chughtai (1979). Our processing did not affect the protein content of rice polishing. The values of NDF and ADF were higher than the values reported by Warren and Farrell (1990). It might be due to the differences of varieties of rice polishing used for analysis. However, the results are in line with Rao and Reddy (1986), who reported that the chemical composition varies due to the varieties or processing conditions of rice polishing. The chemicals HCl, NaOH, H_2O_2 used in treating DRP altered its chemical composition. The HCl, NaOH or H_2O_2 treatments affected DRP and reduced its NDF and increased soluble contents (NDS and ADS), which indicates that the bonds between lignin, hemicellulose and other solubles were broken and the ratio of cell insoluble to cell soluble material increased. The results are in agreement with Rasper (1979) and Hashmi et al., (1989), who reported that chemical treatments can modify the nutrient composition and upgrade the nutritive value by breaking the lignocellulose bonds. Chaudhry and Miller (1998) also observed that chemical treatments modified cell wall structure with a subsequent increase in digestibility and could also improve the energy value.

The biological study revealed significantly higher weight gain of chicks fed on diets containing 20% DRP treated with 6% H_2O_2 (T_6) and with 0.4N HCl (T_{12}). The reason might be that H_2O_2 did not affect the gastrointestinal physiology much as compared with other chemical treatments. The DRP crude fiber is composed predominantly of arabinose and xylose. The proteins are bonded as side chain with them (Neukom, 1976). The H_2O_2 treatment might have detached proteins from complex carbohydrates and made them available to chicks or it might have eliminated the growth depressing factors through chemical break down of phytate, lectin or other such compounds as reported by Tsai (1976). The decrease in weights of broiler chicks fed on diets containing 30% untreated DRP might be due to higher fiber contents in the feed. Higher fiber concentration reduced the digestibility of fat, protein and carbohydrate and increased the transit time of feed from the gastro-intestinal tract (Siri et al., 1992; Smits, 1996). The feed containing 30% untreated DRP also became uneconomical due to the addition of extra oil to compensate the energy deficiency. The broiler chicks fed on 30% treated DRP (all treatments) also did not promote any better growth. It might be due to the unacceptability of high proportions of treated defatted rice polishing in poultry feed.

The feed consumption and its efficiency of conversion into body weight were significantly better with diets T_6 and T_{12} both containing 20% DRP. The results are comparable with the findings of Dar (1990) and Majid (1997). These authors reported improvement in nutritive value of rice polishing for broilers after acetic acid or calcium hydroxide treatments. The present results are not in line with reports of Bersch et al., (1989), Purushothaman et al., (1989), and Jeswani et al., (1996). They revealed that although treatment of DRP with diluted HCl (7 ml/100 g) reduced the crude fiber, NDF, ADF and increased protein content, the results of biological trial revealed that acid treated DRP did not improve the growth performance of the broilers. The Kemzyme-H F® was used to cleave the large molecules of complex carbohydrates and release of nutrients from DRP. The enzyme gave no response at 10% treated DRP inclusion in poultry feed. However, growth rate, feed intake and feed conversion declined at 20 and 30% levels. It can be concluded from the results obtained in the present study that complex carbohydrates present in DRP are not a single significant factor in altering the nutritive value of defatted rice polishing and the enzyme used was therefore unlikely to be of any benefit. The results of the present study are in line with the observations of Classen (1996), who reported that enzyme hydrolysis activity is most effective in improving starch utilization; however the presence of other anti-nutritive factors may compromise the digestive capacity of chick for utilization of complex carbohydrates.

CONCLUSION

It can be tentatively concluded that chemical treatment can improve the nutritive value of DRP for broiler growth, however, further investigations on details of nutrient utilization and detail analyses of DRP are needed.

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