Potential Feeding Value of Deoiled Rice Bran by Japanese Quails. 2. Effect on Nutrient Utilization

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ABSTRACT : The implications of incorporating deoiled rice bran (DORB) in diet on the utilization of certain nutrients had been examined through balance studies made with 6- and 10- week-old Japanese quails. The stuffs evaluated in this study had their origin from two different types of processes- a batch extraction (DORB-B) and another continuous process (DORB-C), and each included at 10, 20 or 30% level in an iso-nitrogenous and iso-caloric diet. On chemical analyses, the DORB-B was found to contain crude protein, 19.0; ether extract, 0.79; total ash, 17.05; Ca, 0.11; P, 1.92; glucose, 2.35 and starch 11.22 g/100 g day matter. Corresponding values for DORB-C were 15.02, 1.56, 13.0, 0.40, 2.76, 2.16 and 19.0, respectively. The data on nutrient balances with quails fed diets containing the two-types of DORB suggested no significant ($p>0.05$) differences in per cent retention of diet dry matter (DM), organic matter (OM), ether extract (EE), gross energy (GE), nitrogen (N), crude fiber (CF), calcium (Ca) or phosphorus (P) content attributable to the extraction process. The age of the birds also appeared to have no significant ($p>0.05$) effect on nutrient utilization by them. However, the level of inclusion of DORB had a significant ($p<0.05$) effect on nutrient utilization by quails in that the retention of dietary N, EE, CF, Ca and P was better at lower than at higher levels. It is concluded that the DORB, irrespective of extraction process, can safely be employed upto 20% level in diet of adult Japanese quails without noticeable interference in utilizing the major dietary nutrients. *(Asian-Aust. J. Anim. Sci. 2001. Vol 14, No. 8 : 1144-1148)*

Key Words : Apparent Dgestibility, Deoiled Rice Bran, Quail

INTRODUCTION

Full-fat rice bran or rice polish when fresh or stabilized, has proved a good replacement for maize or other cereals in poultry feeds (Pal and Verma, 1969). An increasing demand and consequential high price for rice bran oil prompted millers to solvent extract rice bran leaving behind an almost fat-free stuff referred as the deoiled rice bran (DORB). Wide variability in the nutrient composition (Soaad et al. 1981; Zombade et al. 1982; Warren and Farrell, 1990) and response of birds to dietary DORB (Subramanyam et al. 1971) have been reported. During the process of oil extraction the stuff is charged with live steam for 30-40 minutes. It is, therefore, worth noting that the DORB besides practically free of oil also undergoes a great deal of thermal processing quite similar to that of autoclaving. Whether such a treatment will have any effect on the nutritional value of DORB remains to be examined. The present study has been undertaken to investigate the effect of using differently extracted DORB in diet on the utilization of certain dietary constituents by the adult Japanese quails.

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MATERIALS AND METHODS

The two types of DORB evaluated in this study were procured directly from the solvent extraction plants located in the Terai region of Uttar Pradesh. The effect of DORB on the balance of certain nutrients was examined with adult male quails of 6 and 10 weeks of age. Each of the two test materials were employed at 10, 20 or 30% level in an iso-nitrogenus and iso-caloric diet (table 1). Each of the seven test diets was offered *ad lib.* as mash to groups of male quails (3 quails to a cage) replicated six times. The birds were housed in metabolic cages for a period of 12 days including the balance trial of 4 days when net feed intake by the group of birds was recorded and the excreta voided over the same period collected quantitatively. The composite droppings from each lot were dried at 70°C, weighed and pulverised prior to chemical examination.

Representative samples of the two test materials, the experimental diets and excreta samples were analysed for major nutrient contents as per standard methods (AOAC, 1990). Additionally, the two test materials were examined for glucose and starch contents (Clegg,1956). Gross energy in all the materials was estimated directly with Ballistic bomb calorimeter. The apparent digestibility of the dietary nutrients was calculated by the following formula:

$$\text{Apparent Digestibility (\%)} = \frac{\text{Nutrient Intake} - \text{Nutrient Outgo}}{\text{Nutrient Intake}} \times 100$$

Table 1. Gross and analysed composition of experimental diets employed in the nutrient balance study with Japanese quails

Characteristics	Control	DORB-B			DORB-C		
	D1	D2	D3	D4	D5	D6	D7
Gross composition (%):							
Maize, Yellow	37.00	35.50	34.00	32.50	35.50	34.00	32.00
Soybean meal	20.00	20.00	20.00	20.00	20.00	20.00	20.00
Meat meal	10.00	10.00	10.00	10.00	10.00	10.00	10.00
Rice bran	30.00	20.00	10.00	0.00	20.00	10.00	0.00
DORB-B	0.00	10.00	20.00	30.00	0.00	0.00	0.00
DORB-C	0.00	0.00	0.00	0.00	10.00	20.00	30.00
Vegetable oil	0.00	1.50	3.00	4.50	1.50	3.00	4.50
Min. & Vitamin*	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Analysed composition (g/100 gDM)							
Dry matter	90.20	90.10	90.10	90.10	90.40	91.20	90.50
Organic matter	90.50	90.00	89.30	88.70	90.10	89.80	89.30
Crude protein	28.10	27.80	26.40	27.10	26.70	26.40	26.60
Ether extract	5.90	6.00	6.90	7.30	6.30	7.20	7.40
Crude fiber	7.90	7.10	6.40	5.70	7.30	6.60	5.20
Total ash	9.40	10.00	10.70	11.20	9.90	10.10	10.70
Calcium	2.00	2.00	1.80	1.70	1.80	1.80	1.90
Phosphorus	1.50	1.50	1.50	1.40	1.60	1.60	1.60
GE (Kcal/g)	4.79	4.65	4.62	4.52	4.62	4.53	4.46
ME (Kcal/Kg)#	3132	3057	3044	2980	3053	3009	2944

* Supplied (per Kg. diet): Vitamins A, 10000 IU ; D_3, 2000 IU ; E, 15 IU ; K , 2 mg ; Riboflavin,5mg ; Cyanocobalamin,20 µg ; Niacin, 20mg ; Choline chloride,1.5g ; Mn,80mg ; Zn,60mg ; Fe,25mg ; Cu,4mg ; I,2mg ; Co,0.9mg.
# Average of values derived at 6 and 10 wks of age.

Data pertaining to nutrient balance studies were examined statistically (Snedecor and Cochran, 1980) for treatment effects.

RESULTS AND DISCUSSION

The composition of the two test materials employed in this study has been given in table 2. It is apparent that the DORB Batch extracted (DORB-B) contained nearly 25% more crude protein (CP) and around 30% more of mineral matter than DORB Continuous extraction process (DORB-C) which in turn had more of the nitrogen free extract (NFE) including the high starch content. Variation in nutrient composition of DORB has also been reported by earlier workers (Houston, 1972; Mandal et al. 1974).

Data on the mean voluntary feed intake and body weight

Table 2. Daily voluntary feed intake (as fed) and body weight gain during the balance study

Attribute	Control diet	DORB-B (% in diet)				DORB-C (% in diet)			
		10	20	30	Overall mean	10	20	30	Overall mean
Feed intake (g/bird/day)									
6-wk	17.13	19.09	19.30	17.51	18.63	17.78	18.13	17.54	17.82
	±0.73	±1.25	±1.00	±1.40	±0.70	±1.29	±0.58	±0.29	±0.45
10-wk	18.03	21.55	21.18	21.15	21.3	20.49	19.86	19.85	20.74
	±1.19	±1.83	±1.46	±1.69	±0.90	±1.76	±1.63	±0.80	±0.79
Body weight gain (g/bird/day)									
6-wk	2.22	2.42	2.39	2.20	2.34	2.32	2.33	2.12	2.25
	±0.08	±0.15	±0.09	±0.10	±0.07	±0.16	±0.06	±0.04	±0.06
10-wk	2.29	2.80	2.64	2.60	2.68	2.57	2.45	2.37	2.46
	±0.15	±0.22	±0.18	±0.20	±0.11	±0.21	±0.20	±0.20	±0.20

Values are mean ± SE of six observations. Means carrying similar or no superscripts in a row do not differ significantly ($p>0.05$) from each other.

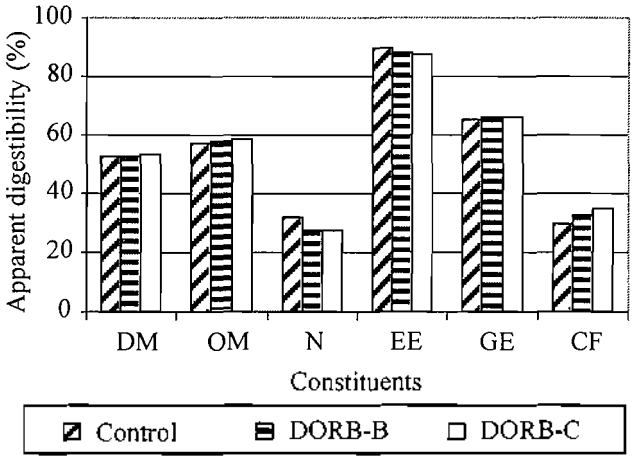

Figure 1. Effect of processing of DORB on the apparent digestibility of dietary nutrients

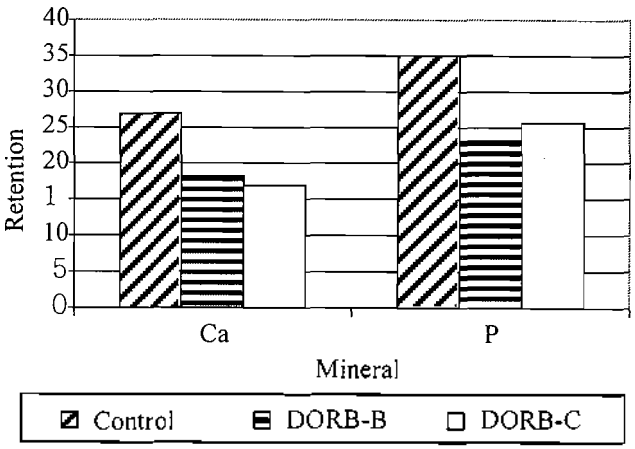

Figure 2. Effect of processing of DORB on the retention dietary minerals

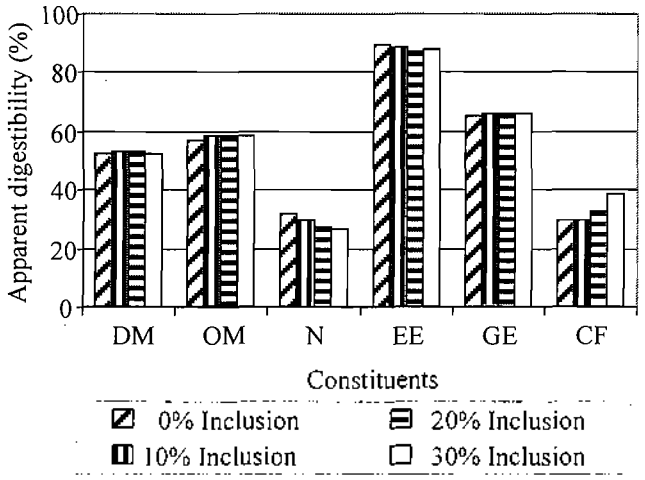

Figure 3. Effect of inclusion level of DORB on apparent digestibility of dietary nutrients

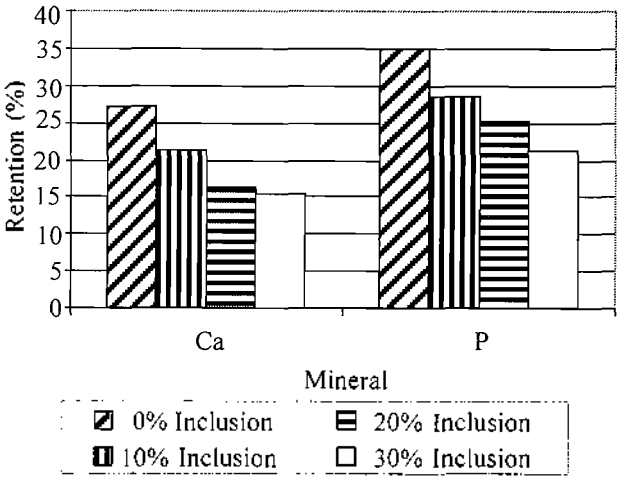

Figure 4. Effect of inclusion level of DORB on retention of dietary minerals

gain by male quails fed different experimental diets during the nutrient balance trials conducted with 6- and 10-wk-old birds have been set out in table 2. It is apparent that birds in all the dietary groups and in both the trials were in positive growth and which was in commensuration with their feed intake, irrespective of the level and type of DORB evaluated in this study. Although numerical differences in feed intake and body weight gains by the quails in different dietary groups existed but such differences did not reach significant level, a consideration, which minimizes experimental error in such nutrient balance studies. It is further to note that, in general, birds in all the test groups ate numerically higher amount of feed than their counterparts fed the control diet. Such differences in feed intake of birds are explainable in view of the differences in the metabolisable energy (ME) content of the control and the test diets (table 1) as the birds consume primarily to satisfy their energy requirements.

Nutrient balance studies with quails fed diets with or without DORB have, however, suggested little effect on the apparent digestibility of dietary DM, OM, and the retention of EE and GE. The apparent digestibility of DM and OM were higher for both the DORB supplemented diets as compared to the control diet. At the same time quails retained higher amounts of such nutrients from diets containing DORB-C than those containing DORB-B (figure 1). Relatively higher amounts of N and EE were retained from the control than the DORB-supplemented diets. Shingari and Negi (1968) have reported similar findings with White Leghorn chicks, where a decrease in protein and fat absorbability was attributed to the deoiling process of the rice polish. Moreover, the birds fed diets containing DORB utilized significantly ($p<0.05$) less CF, Ca and P than those fed the control diet (table 3 and figure 2). No significant

Table 3. Effect of inclusion level of differently processed DORB on the apparent digestibility/ absorbability of dietary constituents by quails

Attribute	Control diet	DORB-B (% in diet)				DORB-C (% in diet)			
		10	20	30	Overall mean	10	20	30	Overall mean
Dry matter (%)									
6-wk	52.32	53.92	53.79	52.78	53.38	54.15	53.66	53.03	53.61
	±0.78	±0.78	±0.95	±0.51	±0.49	±0.37	±0.24	±1.04	±0.23
10wk	51.95	51.83	51.88	50.99	51.56	52.82	52.54	53.25	52.87
	±1.51	±0.35	±0.61	±0.80	±0.34	±0.24	±0.42	±0.41	±0.21
Organic matter(%)									
6-wk	57.43	58.57	58.87	58.48	58.64	58.98	59.07	58.87	58.97
	±0.76	±0.91	±0.84	±0.37	±0.41	±0.26	±0.16	±0.94	±0.31
10-wk	56.78	57.00	57.22	56.13	56.78	57.71	57.97	58.91	58.20
	±1.31	±0.31	±0.67	±0.69	±0.24	±0.21	±0.42	±0.38	±0.16
Nitrogen (%)									
6-wk	31.12	30.80	29.00	27.70	29.17	32.00	28.13	27.20	29.15
	±2.16	±1.45	±2.25	±0.99	±0.94	±1.83	±1.96	±1.14	±1.03
10-wk	32.21^{a}	28.14^{b}	24.93^{c}	25.43^{bc}	26.17	27.31^{bc}	24.35^{c}	25.23^{bc}	25.53
	±1.87	±1.44	±0.70	±1.01	±0.68	±1.30	±0.60	±0.46	±0.40
Ether extract (%)									
6-wk	89.46	87.77	88.50	87.50	87.72	91.20	87.10	86.30	88.21
	±1.18	±1.17	±1.03	±1.87	±0.67	±0.67	±1.36	±0.81	±0.75
10-wk	89.62	89.92	88.00	88.67	88.52	86.90	85.42	88.54	86.72
	±1.68	±0.44	±0.24	±0.54	±0.25	±0.67	±0.67	±0.31	±0.47
Gross energy metabolised (%)									
6-wk	66.15	66.68	66.79	66.58	66.68	67.17	66.85	65.01	66.34
	±0.68	±0.76	±0.43	±0.60	±0.33	±0.10	±0.73	±0.55	±0.37
10-wk	64.61	64.77	64.94	65.29	64.99	65.00	65.99	67.00	66.00
	±0.69	±0.65	±0.68	±0.60	±0.35	±0.75	±0.37	±0.34	±0.34
Crude fiber (%)									
6-wk	32.38^{ab}	27.44^{b}	35.15^{a}	34.68^{ab}	32.53	35.40^{a}	27.00^{b}	38.44^{a}	35.10
	±2.38	±0.97	±2.39	±3.99	±1.73	±2.76	±2.11	±2.67	±1.68
10-wk	26.45^{d}	28.12^{d}	30.82^{cd}	38.61^{ab}	31.95	28.01^{d}	34.55^{bc}	43.18^{a}	35.24
	±1.74	±1.02	±1.88	±1.73	±1.41	±1.76	±3.90	±4.37	±1.77
Calcium retention (%)									
6-wk	26.28^{a}	24.60^{a}	17.34^{b}	15.40^{b}	19.10	19.10^{b}	17.02^{b}	15.37^{b}	17.04
	±0.62	±1.33	±2.11	±0.60	±1.25	±1.16	±0.76	±1.45	±0.69
10-wk	27.72^{a}	23.64^{a}	13.28^{b}	13.83^{b}	17.25	16.39^{b}	16.88^{b}	16.53^{b}	16.60
	±3.07	±1.20	±0.50	±1.95	±1.52	±7.06	±4.16	±4.9	±1.22
Phosphorus retention (%)									
6-wk	33.20^{a}	28.20^{b}	29.17^{b}	20.98^{c}	26.14	29.29^{b}	27.48^{b}	22.91^{c}	26.55
	±1.29	±2.10	±1.10	±0.64	±1.17	±0.82	±1.02	±1.63	±0.92
10-wk	36.92^{a}	24.53^{c}	18.08^{d}	17.30^{d}	19.96	31.88^{b}	25.74^{c}	23.40^{c}	26.50
	±2.79	±0.76	±0.56	±0.91	±0.88	±2.64	±1.13	±1.16	±1.33

Values are mean ± SE of six observations. Means carrying similar or no superscripts in a row do not differ significantly ($p>0.05$) from each other.

($p>0.05$) effect of the age of the birds on the utilization of these nutrients was observed although the 6- wk-old birds appeared to have retained more nutrients than their counterparts at 10 weeks age.

With respect to the effect of dietary level of DORB, no significant ($p>0.05$) effect on the utilization of dietary DM, OM and GE, irrespective of the age of quails, was evident (figure. 3). However, at 10% inclusion level of DORB the utilization of such constituents was relatively better than at higher level of inclusion and also the control diet. The per cent CF utilization increased significantly ($p<0.05$) with an increase in the level of DORB in diet. The result suggested that probably the CF in the DORB was better digestible, which corroborate the earlier report (Purushothaman et al., 1990) where the broiler chicks fed diet containing DORB upto 10% level had better CF digestibility than control. However, increasing the level of DORB the digestibility of the same declined. On the other

hand, Ca and P utilization decreased significantly ($p<0.05$) as the level of DORB inclusion in diet increased.

Data on the nutrient balances have clearly demonstrated little or no adverse effect of dietary DORB on the apparent digestibility or retention of major nutrients that have been examined in the present study, and thereby corroborate earlier reports (Pal and Verma, 1969; Subramanyam, 1971) wherein the chicks fed diets containing high amount of upto 30% DORB generally performed well. Verma and Shrivastava (1989) in an experiment with laying hens also observed that dietary inclusion of DORB upto 20% level exerted no adverse effect on their performance. At the same time it has also been noted that the 6-wk-old quails better utilized the dietary nutrients than the 10-wk-old birds. Examination of data on the utilization of dietary GE by quails revealed practically no difference attributed to the supplemented DORB. It may be pointed out that in view of low ME content in DORB reported with chicks (Verma et al., 1991) care had been taken in the present study to equalize dietary ME through addition of vegetable oil.

It was evident that the retention of Ca and P from diets containing DORB was adversely affected and quails retained less amount of such elements as the dietary DORB level increased from 10 to 30% (figure 4). These observations derive support from other reports (Nwokolo and Bragg, 1977; Deolanker and Singh, 1979; Purushothaman et al., 1990; Warren and Farrell, 1991) in that the retention of such minerals decreased when DORB formed part of chicken diet. Such an effect can be expected in view of high phytin phosphorus content in DORB (Tyagi et al., 1998) which besides not being available by itself also partly renders the dietary Ca and other elements unavailable to the birds.

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