Potential Feeding Value of Deoiled Rice Bran by Japanese Quails. 1. The Metabolisable Energy Content

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ABSTRACT : The apparent metabolisable energy (AME) and N-corrected ME (AMEn) of deoiled rice bran (DORB) were determined with adult quails at 6 and 10- week of age. The DORB obtained from two types of extraction process, Batch (DORB-B) and the Continuous (DORB-C), was each included in a practical type of the reference diet at 20 or 40% level. The analysed crude protein, ether extract, total ash, calcium, phosphorus, glucose and starch content of DORB-B and DORB-C were found at 19.0, 0.79, 17.05, 0.11, 1.92, 2.3, 11.22, and 15.02, 1.56, 13.0, 0.40, 2.76, 2.16, 19.0, respectively. The level of inclusion of DORB in diet appeared to exert a significant effect on the AME and AMEn values. When bioassayed at 20% inclusion level the DORB was found to have a significantly ($p<0.01$) lower value than that obtained at 40% inclusion level. However, no significant effect of age of quails on the AME values of DORB was evident. The ME bioassays with quails gave significantly ($p<0.01$) higher AME values for DORB-C than DORB-B thereby indicating that the continuous system of solvent extraction of rice bran is superior to the batch system from this point of view. The AME value of DORB predicted from its chemical composition also revealed that the DORB-C contained approximately 15% more energy than that in DORB-B. *(Asian-Aust. J. Anim. Sci. 2001. Vol. 14, No. 5 : 680-683)*

Key Words : Metabolisable Energy, Japanese Quails, Deoiled Rice Bran

INTRODUCTION

In the production of white rice grain, rice bran (RB) is available as the chief byproduct which is rich in both the carbohydrates as also the oil. High demand for edible oil has encouraged solvent extraction of RB thus leaving behind an almost fat-free stuff referred to as the deoiled rice bran (DORB). Wide variability in the composition of DORB (Houston, 1972; Verma et al., 1990), the response of birds to dietary DORB (Ichhponani and Makkar, 1989) and also the metabolisable energy contents (Warren and Farrell, 1990; Verma et al., 1991) have been reported.

The commercial production of DORB is achieved in two ways, through a Batch system (DORB-B) and a Continuous system (DORB-C). Whether the extraction process has any significant bearing on the composition and the energy value of the extracted product remained to be examined. Since the DORB constitutes a sizable portion of most poultry rations in India, it is althemore important to understand the potential energy value of the two commercially available stuffs so as to help develop balanced rations for different avian stocks.

Keeping in view such objectives, the present study was undertaken, and this paper describes results of energy bioassays on DORB utilising adult male quails for experimental subject. Additionally, an exercise to predict the AME from the knowledge of the nutrient contents in DORB has also been made.

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MATERIALS AND METHODS

The two types of DORB evaluated in this study were obtained direct from the solvent extraction plants located in the Terai Region of Utter Pradesh. The apparent (AME) and N-corrected metabolizable energy (AMEn) of the two DORB samples were determined in two separate experiments employing male quails of two age groups (6- and 10-wk-old). Each of the two test materials was assayed at 20 or 40 per cent inclusion level in a practical-type diet (tables 1 and 2). The quails had been previously reared in standard farm conditions and then transferred to the individual metabolic cages with provisions for separate feeder, waterer and droppings trays. The feeding experiment lasted for 12 days including the balance period of last 5 days when records of feed intake by each bird were made and droppings voided over the same period collected quantitatively. The composite droppings from each bag were dried in forced draft hot-air oven at 70℃, weighed and pulverised.

Representative samples of the two test materials, the experimental diets and excreta were analysed for nutrient contents as per standard methods (AOAC, 1990). The two test materials were also examined for glucose and starch contents (Clegg, 1956). Gross energy was estimated with the help of ballistic bomb calorimeter.

The AME and AMEn of diets were worked out as per Hill and Anderson (1958) and, thereafter, the AME and AMEn, for the test materials were derived as per Potter and Matterson (1960). Additionally the AME of DORB were predicted with the help of the equations developed by Carpenter and Clegg (1956), Bolton (1964) and Sibbald et al. (1963).

Data pertaining to the ME bioassays were examined statistically (Snedecor and Cochran, 1980) for effect of the solvent extraction process, the level of inclusion in the diet and the age of the birds used in the ME bioassay.

RESULTS AND DISCUSSION

The composition of the two test materials employed in this study has been given in table 3. The crude protein (CP) content in DORB obtained from Batch and Continuous extraction processes was found to be 19.0% and 15.0% respectively. Protein content in DORB is reported to vary from 10.4% (Houston, 1972) to 21.5% (Mandal et al., 1974) with most samples containing around 14.0% CP. The difference in CP content of DORB may be attributed to the variety of paddy rice and efficiency of the milling process. As for ether extract the amount of residual oil reflects on the efficiency of solvent extraction process, and the content of which vary from 0.5% (Houston, 1972) to 3.5% with average values around 1.0%. These observations are in line with the findings of present study. It is apparent that the Batch extraction system is more efficient than the Continuous system from the standpoint of deoiling the rice bran. Higher N-free extract values in DORB-C (58.7%) than those DORB-B (51.85%) truly reflected the higher starch content of DORB-C and is an indicative of its higher energy content. The AME and AMEn values of the two test materials derived from the energy balance data have been summarised in table 4. The mean values determined for the DORB-B with 6-wk-old birds varied from 1313 to 1875 kcal/kg DM. When examined with 10-wk-old birds, the AME value ranges from 1504 to 1561 kcal/kgDM. AME values determined at 20% inclusion level were found to be significantly ($p<0.01$) lower than those realized at 40% inclusion level. The AME values of DORB-C assayed at different inclusion levels in diet of 6-wk-old quails were found to vary between 1587 to 2176 kcal/kg DM. The DORB-B was found to have significantly ($p<0.01$) lower AME values than the DORB-C when assayed at two dietary inclusion levels irrespective of

Table 1. Composition of reference diet used in Metabolisable energy bioassay

Constituents	Part/100 parts	
Basal mix.		
Maize,yellow	50.0	
Groundnut meal	15.0	
Soybean meal	15.0	97.0
Meat meal	12.0	
Ricebran	8.0	
	100.0	
Supplement:		
Dicalcium phosphate	50.0	
Limestone powder	23.4	
Sodium chloride	10.0	3.0
Mineral & vitamin premix*	10.0	
DL-Methionine	3.3	
L-Lysine	3.3	
	100.0	100.0

* Supplied (per kg. diet): Vitamins, A, 6000 IU; D3, 1200 IU; E, 10 IU; Riboflavin, 5 mg; Nicotinamide, 12 mg; Calcium pantothinate, 3 mg; Cyanocobalamin, 10 μg; Choline chloride, 180 mg; Mn, 30 mg; Zn, 20 mg; Fe,10 mg; Cu,2.5 mg; I,1.5 mg; Co, 0.5 mg

Table 2. Gross and analysed composition of reference and test diets (g/100 g) for energy bioassay

Characteristics	Reference Diet	DORB-B		DORB-C	
		20%	40%	20%	40%
Gross composition					
Basal mix.	97.0	77.0	57.0	77.0	57.0
DORB-B	0.0	20.0	40.0	0.0	0.0
DORB-C	0.0	0.0	0.0	20.0	40.0
Supplement*	3.0	3.0	3.0	3.0	3.0
Analysed composition					
Moisture (%)	4.29	13.01	13.64	14.49	14.50
Nitrogen (%)	4.59	4.22	4.10	4.19	3.88
GE (kcal/g)	4.257	4.016	3.925	3.964	3.901
ME (kcal/g)	3.027	2.670	2.335	2.653	2.423

* Composition of supplement is given in table 1.

Table 3. Chemical composition of deoiled rice bran (g/100 g DM)

Characteristics	DORB-B	DORB-C
Dry matter	89.12	83.19
Crude protein	19.00	15.02
Ether extract	0.79	1.56
Crude fiber	11.31	11.72
Total ash	17.05	13.00
N-Free extract	51.85	58.70
Calcium	0.11	0.40
Phosphorus	1.92	2.76
Glucose	2.35	2.16
Starch	11.22	19.10
Gross energy (kcal/g)	3.80	4.08

Table 4. AME and AMEn values of DORB (kcal/kg DM) evaluated at two inclusion levels with two age groups of male Japanese quails

Attributes	DORB-B			DORB-C		
	20%	40%	Overall mean#	20%	40%	Overall mean#
AME*						
6 wk	1313±55[a]	1875±88[b]	1594± 98	1587±78[a]	2167±144[b]	1882±118
10 wk	1504±79	1561±67	1532± 50	1502±77[a]	1941± 55[b]	1722± 43
AMEn*						
6 wk	1337±42[a]	1844±66[b]	1590±85	1525±64[a]	2183±68[b]	1851±109
10 wk	1491±66	1575±43	1533±43	1505±56[a]	1941±49[b]	1723± 75

* Values are Mean±SE based on six observations in a group, and those bearing similar or no superscripts in a row do not differ significantly (p>0.01) from each other.

\# Values are Mean±SE based on twelve observations in a group.

the age of the birds (figure 1).

N-correction has been employed to the AME values for reducing variations attributable to bird-type, and the dietary N content. Differences between the N-corrected and uncorrected ME values on this account have been assessed from 1 to 5% (Sibbald and Price, 1975). In the present study the differences between the AME and AMEn of the two types of DORB were found to be within 2%.

The level of inclusion of DORB in diet appeared to bring about a significant effect on its AME value, an observation in agreement to the previous workers (Bhatia, 1969; Mandal et al., 1974). In our study, the average AME value of DORB were found to be 1477 and 1888 Kcal/kg DM at 20 and 40% inclusion levels, respectively (figure 2). Which is very much close to that obtained in bioassays previously made in this laboratory with chicks (Verma et al., 1991). In view of these observations the values of 1875 and 2176 kcal/kg DM obtained for DORB-B and DORB-C, respectively at 40% inclusion level in a practical type of diet using quails appeared to be the most realistic estimates of the ME value of DORB. The ME bioassays with quails gave significantly ($p<0.01$) higher AME values for DORB-C than the DORB-B thus

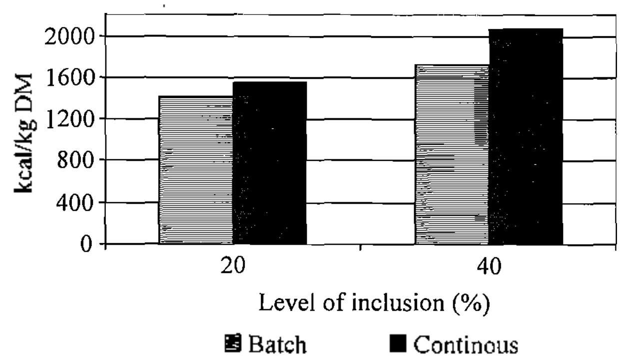

Figure 2. Effect of inclusion level of DORB in diet on its AME value

indicating that the continuous system of solvent extraction is better than the Batch system.

The data on ME bioassays revealed no effect of age of the birds employed during this study, an observation largely contrary to that reported by earlier workers with chickens (Sibbald and Slinger, 1962, 1963; Guirguis, 1976; Pym and Farrell, 1977; Warren and Farrel, 1990). In the present study the DORB was assayed for its energy content employing 6-and 10-wk-old quails, and the two groups of birds being

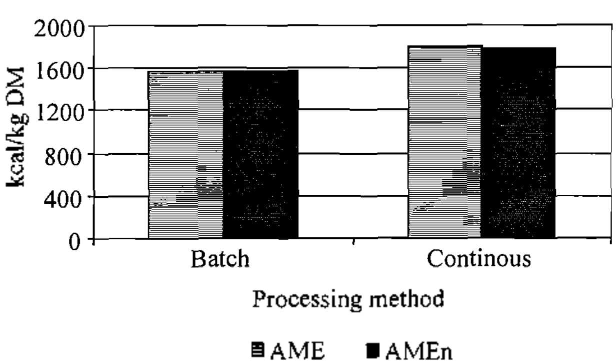

Figure 1. Effect of processing method on the AME and AMEn value of DORB

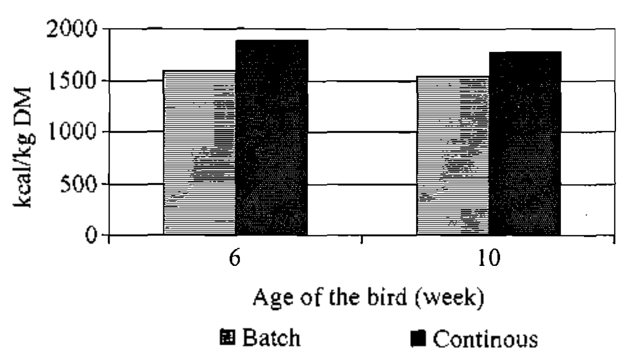

Figure 3. Effect of age of the quails on the AME value of DORB

Table 5. AME of DORB as predicted from the chemical composition

Prediction equation developed by	AME (kcal/kg DM)		Difference over DORB-B (%)
	DORB-B	DORB-C	
Carpenter and Clegg (1956)	1400	1637	(+) 16.9
Bolton (1962), Young birds	1438	1705	(+) 18.6
Bolton (1962), Adult birds	1536	1803	(+) 17.4
Sibbald et al. (1963)	1431	1825	(+) 27.5
Through Bioassay in present study	1563	1802	(+) 15.3

adult may have similar biological activity in their digestive tract, hence deriving almost like amount of energy from the DORB (figure 3). However, the fact that the same group of birds in simultaneous assays exhibited their ability to realize significantly more ME from the DORB-C than DORB-B is a significant observation and which corroborates the earlier results of chemical composition wherein a sample of DORB-C had consistently being found superior to DORB-B.

The AME values for the two types of DORB employed in this study had been found out utilising the knowledge of the various energy yielding components determined on chemical examination (table 5). It would appear that there exists a close agreement amongst the AME values obtained for the two types of DORB even though by applying different equations. However, there is a highly significant ($p<0.01$) difference between the AME values derived for the two types of materials. On the whole, the DORB-C was found to contain 15% higher AME than that in DORB-B. A similar trend was also evident from the values obtained in ME bioassay.

The results of the study demonstrated that DORB obtained from the Continuous Extraction system supplied 15-17% more ME than that from the stuff obtained in the Batch Extraction system. The observations are of great significance to both the poultry feed compounding industry and the solvent extraction industry.

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