◀Research Note▶

Chemical Composition, Digestibility of Crude Fiber and Gross Energy, and Metabolizable Energy of Whole Paddy Rice of Momiroman

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The experiment was carried out to determine the chemical composition, digestibility of crude fiber (CF), gross energy (GE), and metabolizable energy (ME) of Momiroman paddy rice (PR) (Momiroman is a kind of feed rice cultivar).

The chemical composition of PR was 5.11% crude protein (CP), 1.83% ether extract, 68.04% nitrogen-free extract and 10.54% CF on air dry basis. The GE of PR (3.77 kcal/g) is close to that of corn. Although the value of CP was low and that of CF was high, this GE value suggests that PR can probably be used as a feasible alternative grain source in poultry diets.

Eight 15-wk-old male Cochin layer chickens (weighing 2.5 kg) housed in individual cages were used to determine the true digestibility (TD) and ME. The TD of CF and GE were 38.65% and 80.35%, respectively. Apparent ME and true ME were 2.79 and 3.02 kcal/g on air dry basis, respectively. The apparent ME values of PR was slightly lower than that of corn in chickens. The present results would provide new information for poultry diet formulations and suggest that PR can probably be used as a good alternative cereal grain source in poultry diets, and can replace corn.

Key words: chemical composition, digestibility, metabolizable energy, Momiroman, paddy rice

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Introduction

Energy sources are the main component of poultry diets; corn predominates worldwide. Some developed countries, however, including Japan, are importers of these cereal grains as energy sources (Cino, 1997). Consequently, the feed cost will be correlative with the price of these cereal grains. This leads to a search for cereal grains that can be used as alternative energy sources. Simultaneously, Japanese government has been encouraging rice cultivation for animal rice (feed rice), which will then be available for use in poultry diets. Among feed rice, Momiroman, a kind of feed rice cultivar, seems to be the most suitable cultivar due to its large seed.

The Standard Tables of Feed Composition in Japan (2009) reported that paddy rice (PR) contained, on air dry basis, 6.5% crude protein (CP), 2.2% ether extract (EE), 63.6% nitrogen free extract (NFE), and 8.6% crude fiber (CF), while Karunajeewa and Tham (1984) reported CP, EE, and CF were 5.4, 2.0, and 7.7%, respectively. The amounts might vary depending on the variety or cultivar. The values for the gross energy (GE) content of PR and corn were close to the values reported by the Standard Tables of Feed Composition in Japan (2009).

This result suggests that paddy rice can probably be used as a beneficial grain source for poultry diets.

In feeding experiments using chickens, metabolizable energy (ME) is a necessity for the formulation of poultry diets and has been accepted as the preferred measure of the energy content of feedstuffs (McNab, 1990). However, the information available on the ME of Momiroman PR has not been established. To reduce the cost for threshing, whole PR was used. Consequently, in the current study, the intention was to evaluate the chemical composition, the nutrient digestibility, and the ME of PR for use in further formulations of poultry diets.

Materials and Methods

Chemical Analysis

Momiroman, one cultivar of feed rice, was harvested on a rice farm at Kagawa University. An amount of PR weighing about 2 kg was ground through a 1-mm screen and then a sample was evaluated for proximate analysis following the methods described by AOAC (1998).

Nutrient Digestibility and Metabolizable Energy Determination

Eight 15-week-old male Cochin layer chickens with an average weight of 2.5 kg were housed in individual cages with a daily lighting regimen of 16 hours of light and 8 hours of dark at a mean environmental temperature of 20°C. A metal tray was placed under the individual cages to collect the excreta. The birds were divided into two groups of four birds each and then fed *ad libitum* for a

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seven-day adaptation period. Each group was subjected to a 24 hour fast to clear feed residues from the birds' digestive tracts. The experiment was conducted as a two-period crossover design to determine the true digestibility (TD) and ME, according to the procedure described by Sibbald (1977 a, b), Cheva-Isarakul *et al.* (2003), and Buwjoom *et al.* (2004).

In the first period, 30 g of PR were fed through a plastic tube to the force-feeding group (in whole-grain form), with excreta collection per bird carried out for 24 hours ($n = 4$). Another four birds served as the fasting group and were fasted for 24 hours; the excreta from each cage was collected for 24 hours then pooled together ($n = 1$). In the second period, the birds were crossed over to the opposite experimental group. Consequently, eight sets of data from both the first period and the second were used to calculate TD and ME. All of the experiment and collection protocols in the present study were managed in accordance with the Animal Care and Use Committee for Kagawa University.

Each sample of excreta was weighed, oven-dried at 60 °C, and ground through a 0.5 mm sieve for gross energy determination using an adiabatic bomb calorimeter (Model IKA-C5000) and proximate analysis (CF) following the methods described by the Association of Official Agricultural Chemists (AOAC) (1998). The endogenous loss from the fasting group was used to calculate TD and true metabolizable energy (TME), while apparent metabolizable energy (AME) was calculated without the endogenous loss (Sibbald, 1977a, b).

Results and Discussion

The chemical composition (air dry basis) of PR is presented in Table 1. The DM content was 90.52%, and the CP and CF contents were 5.11 and 10.54%, respectively. The CP and EE contents were slightly lower than those reported from Karunajeewa and Tham (1984) and the Standard Tables of Feed Composition in Japan (2009), but the CF content was higher than previously reported, which restricts the potential use of PR for monogastric food animals (Cheva-Isarakul *et al.*, 2003; Buwjoom *et al.*, 2004). This result might be due to the different rice variety or cultivar. When PR is compared to corn, recent studies indicate that the chemical composition of PR had values that were close to those of corn as listed by the Standard Tables of Feed Composition in Japan (2009). Consequently, although the value of CP was low and that of CF was high, PR has a probability for use as an alternative cereal grain to replace corn. Further studies have been carried out in this direction.

King *et al.* (1997) reported that the AME and TME estimates are important for birds, which is in agreement with Nadeem *et al.* (2005) who indicated that there is a necessity for TME contents to be used for accurate formulation of poultry diets. The ME method in this experiment is inexpensive and has a short collection period. In addition, the same birds were used for both the force-feeding

Table 1. Chemical composition (% air dry basis) of Momiroman paddy rice and corn

	Paddy rice	Corn ^{1/}
Dry matter		
-From air dry sample	90.52	85.5
Crude protein	5.11	7.6
Ether extract	1.83	3.8
Crude fiber	10.54	1.7
Ash	5.00	1.2
Nitrogen free extract	68.04	71.3
Organic matter	85.52	n.a.
Gross energy (kcal/g)	3.77	3.85
Calcium	0.30	0.03
Phosphorus	0.21	0.3

^{1/} Standard Tables of Feed Composition in Japan (2009).

n.a. = No data available.

group and the fasting group to reduce the stress in the birds, as well as errors in the fecal analysis (Cheva-Isarakul *et al.*, 2003; Buwjoom *et al.*, 2004).

The TD, AME, and TME of the nutrients in PR are presented in Table 2. When compared to corn as described by the Standard Tables of Feed Composition in Japan (2009), the PR in this experiment had lower values for the TD of GE content. The TD of CF content was 38.65%. The AME values of PR are lower than those of corn, in birds. The possible reason for the lower AME values of PR could be its lower EE content but higher CF content. Similarly, Sikka (2007) reported that there is a negative relationship between the energy and the crude fiber content.

In the present experiment, the GE content of PR (3.77 kcal/g air-dried) was close to that of corn (3.85 kcal/g air-dried) as listed by the Standard Tables of Feed Composition in Japan (2009). The AME and TME of PR were 2.79 and 3.02 kcal/g air-dried, respectively. This result suggests that PR can probably be used as a good alternative grain source in poultry diets. However, it is necessary to consider an appropriate ME compound ratio of PR depending on poultry species such as broilers (ME, 3.1 kcal/g). The data from this study also provide new information for poultry diet formulations.

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Table 2. True digestibility (% air dry basis) of crude fiber (CF) and gross energy (GE), apparent metabolizable energy (AME) and true metabolizable energy (TME) of Momiroman paddy rice and corn (means $\pm$ SE, $n=8$)

	True digestibility (%)		AME (kcal/g air dry)	TME (kcal/g air dry)
	CF	GE		
Paddy rice	38.65 $\pm$ 3.70	80.35 $\pm$ 1.95	2.79 $\pm$ 0.06	3.02 $\pm$ 0.07
Corn ^{1/}	n.a.	85.0	3.28	n.a.

^{1/} Standard Tables of Feed Composition in Japan (2009).

n.a. = No data available.

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