EFFECT OF RICE HULL IN THE DRIED HOTEL FOOD WASTE BASED-DIET ON LIPID CHARACTERISTICS AND MEAT QUALITY OF BARROWS

I.M. Purnamartha, Setiyono and Panjono
Faculty of Animal Science, Gadjah Mada University,
Jl. Fauna No.3, Bulaksumur, Yogyakarta 55281- Indonesia
Corresponding E-mail: panjono@.ugm.ac.id

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ABSTRAK

Penelitian ini bertujuan untuk mengetahui pengaruh penggunaan sekam padi sebagai sumber serat dalam ransum berbasis limbah pangan hotel kering terhadap kadar lemak dan kolesterol daging babi. Dua puluh empat ekor babi persilangan Landrace x Yorkshire jantan kastrasi umur 2 bulan dibagi ke dalam empat kelompok perlakuan ransum, yaitu tanpa sekam padi (R0), 10% sekam padi (R1), 20% sekam padi (R2), dan 30% sekam padi (R3). Penelitian menggunakan kandang individu dengan lantai beton, berukuran panjang 1,9 m dan lebar 0,5 m. Air minum dan pakan diberikan secara ad libitum. Pengamatan dilaksanakan selama 10 minggu. Rancangan Acak Lengkap pola serah digunakan dalam penelitian. Data yang diperoleh dianalisis dengan analis ragam dan pembandingan rata-rata dengan Duncan's new Multiple Range Test. Kadar lemak daging R0, R1, R2, dan R3 masing-masing adalah 14,09±0,31, 13,30±0,44, 12,9±20,30, dan 11,95±0,56%. Kadar lemak daging kelompok R0 lebih tinggi (P<0,05) daripada ketiga kelompok lainnya. Kadar kolesterol daging R0, R1, R2, dan R3 masing-masing adalah 256,47±30,23, 252,34±26,56, 217,63±21,93, dan 199,21±25,94 mg/100 g. Kadar kolesterol daging kelompok R3 lebih rendah (P<0,05) daripada R0. Disimpulkan bahwa penggunaan sekam padi hingga konsentrasi 30% dalam ransum berbasis limbah pangan hotel kering dapat menurunkan kadar lemak dan kolesterol daging babi.

Kata kunci: sekam padi, limbah pangan hotel, lemak, kolesterol, daging babi

ABSTRACT

The study was constructed to observe the effect of rice hull as a fiber sources in the dried hotel food waste based-diet on fat and cholesterol level of pork. Twenty four heads of two months old of Landrace x Yorkshire cross barrows were randomly divided into four treatment groups, i.e. without rice hull (R0), 10% rice hull (R1), 20% rice hull (R2), and 30% rice hull (R3). They placed in individual concrete pen with 1.9 m in length and 0.5 m in width. Feed and water were given as ad libitum. Observation was done for 10 weeks prior to slaughter. Completely Randomized Design was used in this study. Data obtained was analyzev by anova and mean comparison of Duncan's new Multiple Range Test. Fat content of R0, R1, R2, dan R3 pork were 14.09±0.31, 13.30±0.44, 12.9±20.30 and 11.95±0.56%, respectively. Fat content of pork of R0 was higher (P<0.05) than that of others groups. Cholesterol content of pork of R0, R1, R2 and R3 were 256.47±30.23, 252.34±26.56, 217.63±21.93 and 199.21±25.94 mg/100 g, respectively. Cholesterol content of pork of R3 were lower (P<0.05) than those of R0. It is concluded that the use of rice hull up to 30% in the dried hotel food waste based-diet can decreases fat and cholesterol levels of pork.

Keywords: rice hull, hotel food waste, fat, cholesterol, pork

INTRODUCTION

Improvement economic and tourism sectors led to increasing the demand of pork. It is can be seen from the increased of pig's slaughter in Indonesia from 2008 to 2011 were from 691.837 to 859.546 head/year respectively (BPS, 2012). These numbers were in the second of top ranks after beef cattle.

Since the incidence of several diseases such

as atherosclerosis and coronary heart disease which is suspected to be related with high content of fat and cholesterol in foods, consumers had been tend to avoid them. As an example, pigs fed 50% hotel food waste will produced carcass containing 36.75% of fat (Parta, 1999). Jung *et al*. (2003) found that the giving of diet with high fat content for 28 days produced pork with 102.13 mg/dl of cholesterol.

Pig production management besides directed to produce a good quality of meat, it is also conducted to reduce high production cost. Feed is major factor of the highest cost production, which is about 55 – 85%. Hotel food waste is one of the feedstuff with low price, but has high nutritional value. According to Rika *et al.* (1995), food waste production from 55 of five-star hotels in Bali that can be used as swine feed amount of 1.97 tons DM/day.

The weakness of hotel food waste is high level of water and fat, but the fiber is low. Bidura *et al.* (2008) suggested that it has crude fat content about 18.41 to 23.92%. Giving feed with containing high level of hotel food waste lead to increased carcass fat percentage and decreased in pork percentage (Westendorf, 1998). Harris (2002) suggested that standard of fats on pig carcass is about 19 – 20%, and the standard of pork cholesterol level is 93.00 mg/100 g (Chizzolini *et al.*, 1999).

To anticipate the problem above, then the use of hotel food waste needs to be balanced with the addition of fiber to reduce the impact of fat in the hotel food waste, which one of them can be done by using rice hull. Budaarsa (1997) was found that the use of 10% rice hull in the diet containing 10% tallow fats cannot reduces carcass fat significantly, but it can decrease cholesterol level of pork. The study was constructed to observe the effect of rice hull in the dried hotel food waste based-diet on the caecum fluid volatile fatty acid and ammonia levels, faecal fat content, chemical and physical qualities of pork, and lipid characteristics of pork and subcutaneous fat.

MATERIALS AND METHODS

Twenty four heads of Landrace x Yorkshire cross barrows with two months of age and 26.15±0.73 kg of initial body weight were randomly divided into four treatment groups, i.e. without rice hull (R0), 10% rice hull (R1), 20% rice hull (R2), and 30% rice hull (R3). Each group was consisted with six individual heads of animal. They were placed in individual concrete pen with 1.9 m in length and 0.5 m in width.

Hotel food waste was processed according to Westendorf *et al*. (1998), which was modified with method by Yanis *et al*. (2000). Rice hull was milled using Honda GX 160 machine with 1 mm diameter of sieve's hole. Before the experiment started, sample of the feedstuffs were taken for analysis of chemical composition. Nutrient content of diets were prepared according to NRC (1998) and Kyriazakis and Whittemore (2006). Composition and nutrient content of feed experiments were presented at Table 1.

Animals were allowed seven days period for adaptation with environmental condition and they were vaccinated against pasteurellosis and hog cholera before data collection was started. Observation was done for 10 weeks prior to slaughter. Daily temperature and humidity during experiment were 29.03±1.01^{0}C and 61.76±2.80% respectively. Feed and water were given *ad libitum*.

Before slaughter, animals were fasted for 12 hours. They were stunned using electrical method before killed. The sample of caecum fluid was taken after evisceration process. Sample of *Longissimus dorsi* muscle was taken to determine the chemical quality, physical quality, and lipid characteristics. Sample of subcutaneous fat was taken from 10th and 11th ribs to determine the lipid characteristics.

Meat and subcutaneous fat samples were analysed after 24 hours. Meat chemical quality analysis including water, fat, protein and ash content was done according AOAC (2005). The value of pH was measured using pH meter. The color score of meat was measured using photographic colour standard for muscle. Water-holding capacity of meat was measured with filter paper press method (Honikel and Hamm, 1994). Cooking loss measured according to modification method of Bouton *et al.* (1971) in Soeparno (2009). Analysis of cholesterol was done using Liebermann-Burchad method, triglycerides with colorimetry enzymatic test, HDL (High Density Lipoprotein) with CHOD-PAP method which was colorimetry enzymatic test and LDL (Low Density Lipoprotein) was calculated according to AOAC (1995).

The obtained data were analyzed using one-way ANOVA based on Completely Randomized Design. When there were significant differences,

Table 1. Composition and Nutrient Content of Feed Experiment

Weight (kg)	Variables	R0	R1	R2	R3	Standard
20 – 50	Feedstuffs (%)					
	Hotel food waste	50.0	50.0	50.0	50.0	
	Rice hull	-	10.0	20.0	30.0	
	Pollard	7.0	7.0	3.0	1.0	
	Corn meal	28.0	20.0	5.0	1.0	
	Fish meal	8.0	10.0	10.0	12.0	
	Coconut meal	7.0	3.0	12.0	6.0	
	Total	100.0	100.0	100.0	100.0	
	Nutrient content					
	Dry matter (%)	90.8	91.1	91.9	92.1	
	Metabolizable energy (kcal/kg)	3274.8	3280.5	3263.2	3246.0	3265.0[a]
	Crude protein (%)	18.0	18.1	18.0	17.9	18.0[a]
	Crude fat (%)	10.4	9.6	10.4	9.2	7.0[b]
	Crude fiber (%)	1.7	4.1	6.8	9.0	4.0[b]
	Calcium (%)	1.4	1.4	1.6	1.6	0.6[a]
	Phosphorus (%)	0.8	0.8	0.9	0.8	0.5[a]
50 – 80	Feedstuffs (%)					
	Hotel food waste	50.0	50.0	50.0	50.0	
	Rice hull	-	10.0	20.0	30.0	
	Pollard	12.0	2.0	9.0	1.0	
	Corn meal	30.0	30.0	3.0	1.0	
	Fish meal	3.0	6.0	4.0	7.0	
	Coconut meal	5.0	2.0	14.0	11.0	
	Total	100.0	100.0	100.0	100.0	
	Nutrient content					
	Dry matter (%)	90.5	90.8	91.8	92.1	
	Metabolizable energy (kcal/kg)	3278.2	3270.4	3265.3	3249.6	3265.0[a]
	Crude protein (%)	15.5	15.5	15.4	15.6	15.5[a]
	Crude fat (%)	9.8	9.2	10.3	9.6	5.5[b]
	Crude fiber (%)	1.9	4.0	7.1	9.3	5.0[b]
	Calcium (%)	1.1	1.2	1.4	1.4	0.5[a]
	Phosphorus (%)	0.6	0.7	0.8	0.8	0.4[a]

R0: 0% rice hull; R1: 10% rice hull; R2: 20% rice hull; R3: 30% rice hull; [a]: based on standard of NRC (1998); [b]: based on standard of Kyriazakis dan Whittemore (2006)

analysis was continued using Duncan's Multiple Range Test (Steel dan Torrie, 1981). Data analysis was performed using SPSS version 16 for windows (SPSS Inc, 2007).

RESULTS AND DISCUSSION

Chemical Quality of Pork

Chemical quality of pork including water, fat, protein and ash content were presented in Table 2. Water content of pork of R2 was higher (P<0.05) than that of others groups, and that of R3 was higher (P<0.05) than that of R0 and R1. Water content has a positive correlation with pH and water-holding capacity, because ultimate pH can affect on density of actin and myosin filaments (Huff-Lonergan dan Lonergan, 2005). These results are in the normal range of meat water content which is about 65 – 80% (Lawrie and Ledward, 2006).

Protein content of pork of R2 and R3 was higher (P<0.05) than that of R1 and that of R1 was higher (P<0.05) than of R0 (Table 2). The use of rice hull as a fiber source can make lipolysis of fatty adipose tissue and increased accumulation of protein in the muscle tissue. However, these results are in the normal range of meat protein content which is about 12 – 20% (Soeparno, 2011; Lawrie dan Ledward, 2006).

Fat content of pork of R0 was higher (P<0.05) than that of others groups and that of R1 and R2 was higher (P<0.05) than that of R3 (Table 2). This is because fat content from hotel food waste can be absorbed and deposited maximally. Rice hull can reduce lipid emulsification in the diet and remove it together through the feces. Dietary fiber can increase fat excretion through the feces and effective in diluting bile acid, so that the absorption of fat will be reduced (Demigne *et al*., 2001). These results are similar to those of Martins *et al*. (2005), inclusion of fiber in the diet will be decreased fat content of the pork.

Ash content of pork of R2 was higher (P<0.05) than that of R0 (Table 2). Ash content in this study was followed to the pattern of protein content and inversely to the fat content. However, ash content in this study was in the normal range which is between 0.6% and 1.0% (Soeparno, 2011; Lawrie and Ledward, 2006).

Physical Quality of Pork

Physical quality of pork including pH value, color score, cooking loss and water-holding capacity were presented in Table 3. There was not significant differences pH value among groups. This results indicated that the use of rice hull up to 30% in the diet did not affect to muscle glycogen reserves, so that the value of decline in pH after slaughter is not much different relatively. Meat in this study has ultimate pH in the normal range which is about 5.5 to 5.75 (Lawrie and Ledward, 2006).

The color score of pork of R2 was higher (P<0.05) than that of R0 and R1 (pork in R2 was lower than R0 and R1, which is reflected in the fat content. According to Lawrie and Ledward (2006), marbling is one of the factors that affecting meat color becomes brighter. These results are similar to those of Myer *et al*. (1999).

Water-holding capacity of pork of R2 was higher (P<0.05) than that of R1 (Table 3). Ultimate pH value of pork in this study was higher than isoelectric pH, so there is an excess for negative charge, which is makes myosin and actin filamen away from each other, causing the available space is getting bigger and increases the water-holding capacity (Huff-Lonergan and

Table 2. Effect of Rice Hull in the Dried Hotel Food Waste Based-Diet on the Chemical Quality of Pork

Variables (%)	R0	R1	R2	R3
Water	65.85±0.34 ^{c}	65.83±0.48 ^{c}	67.74±0.06 ^{a}	67.09±0.35 ^{b}
Protein	18.33±0.32 ^{c}	19.14±0.12 ^{b}	19.97±0.31 ^{a}	19.93±0.09 ^{a}
Fat	14.09±0.31 ^{a}	13.30±0.44 ^{b}	12.92±0.30 ^{b}	11.95±0.56 ^{c}
Ash	0.92±0.03 ^{b}	0.97±0.05 ^{ab}	1.03±0.04 ^{a}	0.99±0.03 ^{ab}

R0: 0% rice hull; R1: 10% rice hull; R2: 20% rice hull; R3: 30% rice hull; ^{a,b,c} different superscripts at the same row indicate significant differences (P<0.05)

Table 3. Effect of Rice Hull in the Dried Hotel Food Waste Based-Diet on the Physical Quality of Pork

Variables	R0	R1	R2	R3
Value of pH	5.60±0.08	5.53±0.06	5.65±0.07	5.58±0.04
Meat color	2.50±0.50[b]	2.33±0.29[b]	3.33±0.29[a]	2.83±0.29[ab]
Water-holding capacity (%)	57.39±1.40[ab]	55.39±1.40[b]	58.29±0.20[a]	56.89±0.43[ab]
Cooking loss (%)	34.64±0.06[b]	34.63±0.08[b]	34.98±0.22[a]	34.93±0.10[a]

R0: 0% rice hull; R1: 10% rice hull; R2: 20% rice hull; R3: 30% rice hull; [a,b] different superscripts at the same row indicate significant differences (P<0.05)

Table 4. Effect of Rice Hull in the Dried Hotel Food Waste Based-Diet on the Lipid Characteristics of Pork

Variables (mg/100 g)	R0	R1	R2	R3
Cholesterol	256.47±30.23 [a]	252.34±26.56 [a]	217.63±21.93 [ab]	199.21±25.94 [b]
Triglyceride	193.39±30.71 [a]	162.16±41.90 [ab]	137.40±10.74 [b]	123.79±10.60 [b]
LDL [1)]	169.03±22.54 [a]	142.86±14.71 [ab]	146.15±18.26 [ab]	117.93±8.69 [b]
HDL [2)]	48.76±2.94 [b]	77.05±5.45 [a]	44.00±4.64 [b]	56.52±15.66 [b]

LDL: Low density lipoprotein; HDL: high density lipoprotein; R0: 0% rice hull; R1: 10% rice hull; R2: 20% rice hull; R3: 30% rice hull; [a,b] different superscripts at the same row indicate significant differences (P<0.05)

Lonergan, 2005). Water-holding capacity of meat is also influenced by protein content, which is proved from R2 group was has highest protein content.

Cooking loss of pork of R2 and R3 was higher (P<0.05) than that of R0 and R1 (Table 3). It is because of their fat content was so that their rate of meat water losses during cooking process were higher. Previous studies have confirmed that the improvement of peanut hull and restaurant food waste in swine diet decreases marbling score (Myer *et al*., 1999).

Lipid Characteristics of Pork and Subcutaneous Fat

Lipid characteristics of pork and subcutaneous fat including cholesterol, triglyceride, LDL and HDL were presented in Table 4 and 5, respectively. Cholesterol level of pork of R0 and R1 was higher (P<0.05) than that of R3. Similarly, cholesterol level of subcutaneous fat of R0 was higher (P<0.05) than that of R2 and R3. It is because rice hull is able to binding fats and cholesterol in the diet to removed together through the feces, and the improvement of volatile fatty acids in the caecum can decreases cholesterol biosynthesis in the body with inhibiting the activity of HMG-CoA reductase (Jurkonski *et al*., 2008). Reduction of cholesterol also can be caused by an increased activity of cholesterol 7á-hydroxylase (Martins *et al*., 2005).

There was not significant differences triglyceride level of subcutaneous fat among groups (Table 5), however the triglyceride level of pork of R0 was higher (P<0.05) than that of R2 and R3 (Table 4). The decreases of it was begins with reduction of fat and triglycerides absorption because it was bound by fiber to removed together through the feces (Jurkonski *et al*., 2008). Triglyceride level of pork is always lower than those found in subcutaneous fat, because it is storage in adipose tissue as an energy reserve. These results are similar to those of Budaarsa (1997), who found that an increasing of fiber in

Table 5. Effect of Rice Hull in the Dried Hotel Food Waste Based-Diet on the Lipid Characteristics of Subcutaneous Fat

Variables	R0	R1	R2	R3
	---------- mg/100 g ----------			
Cholesterol	263.10±12.13[a]	242.31±7.80[ab]	229.25±14.70[bc]	209.60±18.34[c]
Triglyceride	196.77±8.60[a]	186.57±38.76[a]	158.94±33.90[a]	153.28±6.10[a]
LDL	163.43±0.59[a]	149.36±11.13[a]	148.99±10.83[a]	128.67±9.34[b]
HDL	60.32±9.99[a]	55.64±11.15[a]	48.47±2.00[a]	50.27±10.04[a]

LDL: Low density lipoprotein; HDL: high density lipoprotein; R0: 0% rice hull; R1: 10% rice hull; R2: 20% rice hull; R3: 30% rice hull; [a,b,c] different superscripts at the same row indicate significant differences (P<0.05)

the diet can decreases triglyceride and LDL of pork.

LDL of pork of R0 was higher (P<0.05) than that of R3 (Table 4), however the LDL of subcutaneous fat of R0, R1, and R2 was higher (P<0.05) than that of R3 (Table 5). It is because supply of cholesterol and triglycerides are less to the liver, which making synthesis of LDL to be down, because it is formed from free fatty acids containing 60% of triglycerides and 15% of cholesterol (Martins *et al.*, 2005). These results are similar to those of Martins *et al.* (2005), where inclusion of blue lupin in the diet can decreases LDL level of pork.

There was not significant differences HDL of subcutaneous fat among the four different groups (Table 5), however the HDL of pork of R1 was higher (P<0.05) than others groups (Table 4). Animal in R1 group was consuming of most highly diet, thus it allowing to increases the polyunsaturated fatty acids absorption in the intestine. It is makes an increases of apoprotein A-1 as a major component of HDL biogenesis. According to Lewis and Rader (2005), the process of HDL biogenesis is started from apoprotein A-1 with excess of cholesterol and phospholipids from peripheral tissues to formed prebeta-1 HDL, then esterified to HDL by lecithin cholesterol acyl transferase (LCAT).

CONCLUSION

It is concluded that the use of rice hull up to 10% in the dried hotel food waste based-diet can increases HDL level of pork. The use of rice hull up to 20% decreases caecum fluid ammonia, but increases meat's protein content, color score and cooking loss. The use of rice hull up to 30% increases faecal fat and caecum fluid volatile fatty acids, but can decreases fat content of pork, and lipid characteristics including cholesterol and LDL of the pork and subcutaneous fat.

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