

## Effects of Feeding Rancid Rice Bran on Growth Performance and Chicken Meat Quality in Broiler Chicks

B. J. Chae\*, K. H. Lee and S. K. Lee

College of Animal Resources Sci., Kangwon National University, Chunchon 200-701, Korea

**ABSTRACT :** A total of 225 day-old broiler chicks (43.08 g initial body weight) were allotted to three dietary treatments for a 6-week feeding trial. The treatments were 1) Control (defatted rice bran; DFRB), 2) fresh rice bran (FRB) and 3) rancid rice bran (RRB). Rice brans were intentionally spoiled by two degrees of rancidity by the values of free fatty acids (FFA): 7.6% (FRB) and 16.3% (RRB). Diets were prepared on an isonutrient basis, and defatted or rancid rice brans were included 5 and 10% for starter (0-3 week) and finisher (3-6 week), respectively. At the end of the feeding trial, six chicks per treatment were sacrificed, and thigh meats were ground and stored at 1°C for thiobarbituric acid reactive substances (TBARS) and peroxide value (POV) analyses. For a digestibility, 48 growing chicks (4 weeks old) were employed in cages (3 replicates/treatment, 2 birds/cage) according to the experimental design: FRB, RRB, pelleted and extruded rice bran. Some of the FRB were pelleted (70°C) or extruded (110°C). There was no significant difference in growth performance during the starter period, but chicks fed a diet containing DFRB grew faster ( $p < 0.05$ ) with increased feed intake ( $p < 0.05$ ) than those fed diets containing rice brans, FRB or RRB, during the finisher period. Feed conversion ratio in the RRB was inferior ( $p < 0.05$ ) to the DFRB. Between rice bran groups, weight gain was higher ( $p < 0.05$ ) in FRB than in RRB during finisher period. There was a similar trend in growth performance of chicks for the overall period (0-6 week) as the finisher period. Dry matter and energy digestibilities were higher ( $p < 0.05$ ) in extruded than in RRB group. Protein digestibility was improved ( $p < 0.05$ ) when rice bran was extruded, but not pelleted. The chicken meats from RRB showed higher ( $p < 0.05$ ) TBARS than those from FRB during storage for 4 weeks at 1°C. In conclusion, it would appear that feeding rancid rice bran gave negative effects on growth performance and lipid stability of meat in broiler chicks. (*Asian-Aust. J. Anim. Sci.* 2002, Vol 15, No. 2 : 266-273)

**Key Words :** Rice Bran, Rancidity, Growth, Digestibility, Chicken Meat Quality

### INTRODUCTION

Rice bran, a by-product of rice milling, is a source of feed ingredient in animal production. Large quantities of rice bran are available in many parts of the world, especially in Asia. Rice bran can be used in chicks diets, and dietary inclusion levels of up to 20% can be tolerated by chicks without depressing performances (Farrell, 1994).

However, due to high oil content and lipolytic enzymes, rice bran is easily oxidized during storage at room temperature (Linfield, 1985). It was also reported that feeding rancid rice bran reduced growth performance in chicks (Kratzer and Payne, 1977; Hussein and Kratzer, 1982) and in pigs (Chae and Lee, 2002).

To stabilize rice bran from oxidative rancidity, extrusion cooking is effective (Martin et al., 1993; Shin et al., 1997). In our previous study (Chae and Lee, 2002), the increase in free fatty acid level of extruded rice bran was significantly lower than that of raw or pelleted rice bran during storage. Feeding stabilized rice bran also made greater gains in chicks (Sayre et al., 1988) and better digestibility of nutrients in chicks and pigs (Freeman, 1976; Chae and Lee, 2002) than raw rice bran. However, Lewis and Wiseman (1977) reported that there was no significant fall in digestibility until the free fatty acid reached 50%.

Considerable quantities of full-fat rice bran (FFRB) is defatted to overcome the problems associated with storage of FFRB, and to use rice bran oil. However, defatted rice bran is dusty and it has lower energy due to higher fiber than FFRB (Warren and Farrell, 1990).

In addition, it was reported that oxidized oil diets induced rapid oxidation of the membrane-bound lipids and decreased their stability towards peroxide-mediated peroxidation in chicks (Lin et al., 1989). There is still limited information regarding the effects of feeding rancid rice bran on growth performance and meat stability in chicks. Therefore, as a series of experiments, we conducted an experiment to investigate growth performance, nutrient digestibility and chicken meat quality in broiler-type chicks fed diets containing fresh or rancid rice bran.

### MATERIALS AND METHODS

#### Design, sample preparation and animals

For a 6-week feeding trial, a total of 225 day-old broiler chicks (Avian, average 43.08 g body weight) were allotted to three dietary treatments. The treatments were 1) Control (defatted rice bran + animal fat), 2) fresh rice bran (FRB) and 3) rancid rice bran (RRB). A rice bran supplied by a rice milling plant was separately stored (for 10 days) in a cool warehouse (below 10°C) for FRB or stored outside with a cover (up to 30°C) for RRB until they were used for feeding or digestibility trials. The free fatty acid (FFA)

\* Address reprint request to B. J. Chae. Tel: +82-33-250-8616, Fax: +82-33-244-4946, E-mail: bjchae@cc.kangwon.ac.kr  
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values of FRB and RRB were 7.6% and 16.3%, respectively (table 1).

Diets (mash type) were prepared on an isonutrient basis containing 22% and 19% crude protein for starter (0-3 week) and finisher (4-6 week), respectively (table 2). Defatted, fresh or rancid rice brans were included 5 and 10% for starter and finisher, respectively. Chicks were housed in a room (floor with rice hull bedding) with controlled temperature and air ventilation. Room temperature was gradually decreased from 32-28°C during starter period, and controlled at 25±2°C during finisher period. Chicks had *ad libitum* access to water and diets. At the end of the feeding trial, six chicks per treatment were sacrificed, and thigh meats were ground and stored at 1°C for thiobarbituric acid reactive substances (TBARS) and peroxide value (POV) analyses.

For a digestibility trial, 48 growing chicks (4 weeks old) were used in cages (3 replicates/treatment, 4 birds/cage) according to the experimental design: FRB, RRB, pelleted and extruded rice bran. 12 chicks (3 replicates, 4 birds/cage) were additionally used to determine digestibility of basal diet (table 3). A part of the FRB was pelleted or extruded. A pellet mill (CPM®, Model 3020, USA) was used with 4.6 mm die in diameter. The operation temperature was 70°C. The extrusion was done at 110°C (last barrel) with a single screw extruder (Millbank®, Model 1001S, NZ).

Experimental diets were mixed with basal diet (70% basal and 30% experimental diet), and fed 2 times (09:00, 16:30) daily and whole feces were collected for 3 days from 4th day after feeding the diets. Feces were dried in an air-forced drying oven at 60°C for 24 h for chemical analyses. Digestibility of nutrients was calculated by the following formula, as described by Lee (2000).

Digestibility (%) =

$$\frac{\{\text{Digestibility of mixed diet} - (\text{Digestibility of basal diet} \times 0.7)\}}{0.3}$$

### Chemical and statistical analyses

Proximate and FFA compositions of the feeds or feces were analyzed according to the methods of AOAC (1990), and gross energy was measured with an adiabatic bomb

calorimeter (Model 1241, Parr Instrument Co., USA). Fatty acids were analyzed with a gas chromatography (Model 5890, Hewlett Packard Co., USA).

Chicken meat color was measured with a color difference meter (Yasuda Seiko Co., CR 310, Minolta, Japan), and thiobarbituric acid reactive substance (TBARS) as mg of malonaldehyde (MDA)/kg was determined by the method of Sinnhuber and Yu (1977) and peroxide values (POV) by Shantha and Decker (1994) in the chicken meat samples.

Data were analyzed using the General Linear Model (GLM) Procedure of SAS (1985). The statistical model was that appropriate for a randomized complete block design.

## RESULTS

### Growth performance and nutrient digestibility

Growth performance of broiler chicks as affected by feeding rancid rice bran was presented in table 4. During the starter period (0-3 week), there were no significant differences in weight gain, feed intake and feed conversion ratio (FCR) among all treatments. However, chicks fed the control diet containing defatted rice bran grew faster ( $p < 0.05$ ) with increased feed intake ( $p < 0.05$ ) than those fed diets containing FRB or RRB during finisher period (4-6 week). In this period, chicks fed FRB diet also grew faster ( $p < 0.05$ ) than those fed RRB diet. During the overall period (0-6 week), chicks fed FRB or RRB showed reduced weight gain and feed intake compared to the control group ( $p < 0.05$ ). The FCR in the RRB was also inferior ( $p < 0.05$ ) to the control. Between rice bran groups, FRB group showed better ( $p < 0.05$ ) weight gain than RRB group, even though there was no difference in feed intake.

Nutrient digestibilities of chicks fed diets containing fresh, rancid, pelleted or extruded rice brans were presented in table 5. Dry matter and energy digestibilities were higher ( $p < 0.05$ ) in extruded than in RRB group. Protein digestibility was improved ( $p < 0.05$ ) when rice bran was extruded, but not pelleted. No difference was found in fat digestibility among treatments, but extruded rice bran showed the highest fat digestibility among all treatments.

### Changes in lipid stability and color of chicken meat during storage

The chicken meat from RRB showed higher ( $p < 0.05$ ) TBARS and POV than that from FRB when stored for 1 week at 1°C (table 6). This trend continued for 4 weeks after storage. However, there was no difference in POV when stored for 3 weeks among dietary treatments. In addition, TBARS and POV were higher ( $p < 0.05$ ) in chicken meats from the control group than in chicken meats from rice bran groups.

Fat and fatty acid compositions were also shown in table 7. The level of saturated fatty acids (SFA: C12:0,

**Table 1.** Chemical compositions of rice brans used in the

Contents (%)	Defatted rice bran	Rice bran <sup>1</sup>	
		FRB	RRB
Moisture	11.95	13.00	13.01
Crude protein	15.41	14.86	14.01
Crude fat	1.25	17.40	17.29
Crude ash	13.18	9.46	9.93
Calcium	0.36	0.37	0.41
Phosphorus	1.73	1.46	1.50
Free fatty acid	-	7.60	16.30

<sup>1</sup> FRB: Fresh rice bran; RRB: Rancid rice bran.

**Table 2.** Formula and chemical composition of experimental diets for broilers

	Starter <sup>1</sup>			Finisher		
	Control	FRB	RRB	Control	FRB	RRB
<b>Ingredients (%)</b>						
Yellow corn	56.05	57.05	57.05	57.75	59.75	59.75
Defatted rice bran	5.00	-	-	10.00	-	-
Rice bran	-	5.00	5.00	-	10.00	10.00
Soybean meal (44%)	19.00	18.00	18.00	14.00	12.00	12.00
Corn gluten meal (60%)	4.00	5.00	5.00	5.00	7.00	7.00
Fish meal (60%)	10.00	10.00	10.00	6.00	6.00	6.00
Animal fat	4.00	3.00	3.00	5.00	3.00	3.00
Limestone	0.38	0.38	0.38	0.40	0.40	0.40
Tricalcium phosphate	0.92	0.92	0.92	1.25	1.25	1.25
Salt	0.25	0.25	0.25	0.25	0.25	0.25
Vit-Min. mix <sup>2</sup>	0.10	0.10	0.10	0.10	0.10	0.10
Bacitracin (100 g/kg)	0.05	0.05	0.05	0.05	0.05	0.05
Choline chloride (25%)	0.15	0.15	0.15	0.15	0.15	0.15
DL-met. (50%)	0.10	0.10	0.10	-	-	-
L-lysine (78%)	-	-	-	0.05	0.05	0.05
Total	100.00	100.00	100.00	100.00	100.00	100.00
<b>Chemical Composition (%)<sup>3</sup></b>						
ME (kcal/kg)	3.054	3.052	3.052	3.059	3.054	3.054
Crude protein	22.13	22.18	22.18	19.15	19.25	19.25
Lysine	1.27	1.26	1.26	1.01	0.99	0.99
Methionine+Cystine	0.51	0.52	0.52	0.40	0.43	0.43
Calcium	1.00	1.00	1.00	0.90	0.90	0.90
Avail. phosphorus	0.45	0.45	0.45	0.40	0.40	0.40

<sup>1</sup> FRB: Fresh rice bran; RRB: Rancid rice bran.

<sup>2</sup> Supplied per kg diet: 8,000 IU vitamin A, 2,500 IU vitamin D<sub>3</sub>, 30 IU vitamin E, 3 mg vitamin K, 1.5 mg thiamin, 10 mg riboflavin, 2 mg vitamin B<sub>6</sub>, 40 µg vitamin B<sub>12</sub>, 30 mg pantothenic acid, 60 mg niacin, 0.1 mg biotin, 0.5 mg folic acid, 53 mg Mn, 40 mg Zn, 38 mg Fe, 0.6 mg I, 0.2 mg Co, 0.13 mg Se.

<sup>3</sup> Calculated values.

C14:0, C16:0, C18:0) in chicken meat was higher ( $p < 0.05$ ) in RRB than in FRB group, and the level of unsaturated fatty acids (USFA: C16:1, C18:1, C18:2, C18:3) in meat had opposite results.

Chicken meat colors as affected by feeding rancid rice bran were presented in table 8. L value (lightness) was higher ( $p < 0.05$ ) in FRB than RRB group when slaughtered. A similar trend continued up to the 4th week of storage. L value was higher ( $p < 0.05$ ) in control group than rice bran groups during storage up to 3 weeks. a value (redness) was higher ( $p < 0.05$ ) in control and FRB than RRB group up to 1 week period of storage. b value (yellowness) was also higher ( $p < 0.05$ ) in FRB than RRB before and after storage up to 4 weeks.

## DISCUSSION

In terms of growth performance, RRB was inferior to FRB. This result is in agreement with the results of the previous studies in chicks (Kratzer and Payne, 1977; Hussein and Kratzer, 1982). Kratzer and Payne (1977) suggested that the stability of fat influenced the growth of chicks. Hussein and Kratzer (1982) reported that rancid rice bran gave poorer growth than fresh rice bran. They also

reported that chicks fed diets containing fresh or rancid rice bran also grew slower than those fed a control diet (rice bran was excluded). In our previous study with finishing pigs (Chae and Lee, 2002), similar results were found in growth performance.

Rice bran is easily oxidized during storage, as stated by Linfield et al. (1985). It was reported that feeding RRB can be a cause of digestive disorders (Yokochi, 1972). Rancidity also reduces palatability of feeds (Godber et al., 1993). In the present study, feed intake was reduced ( $p < 0.05$ ) in the chicks fed rice bran compared to the control chicks fed defatted rice bran. There was no difference in feed intake between rice bran fed groups (fresh vs. rancid). The difference in degrees of rancidity was not great (7.6 vs. 16.3% FFA), showing no difference in smell between them. Sensory analysis of raw rice bran revealed that even experienced panalists could not distinguish rancid rice bran from nonrancid rice bran until the level of FFA exceeded 15%. The level of FFA that is considered acceptable for human is 4% (Godber et al., 1993).

In addition, between rice bran groups, there was a significant difference in growth of chicks during finisher, but not during the starter period. The difference may have been caused by the increased level of inclusion in the diet

**Table 3.** Formula of experimental diets used in broiler digestibility trial

Ingredient (%)	Basal diet	Rice bran <sup>1</sup>			
		FRB	RRB	PRB	ERB
Yellow corn	64.20	44.94	44.94	44.94	44.94
Rice bran	-	30.00	30.00	30.00	30.00
Soybean meal	15.60	10.92	10.92	10.92	10.92
Corn gluten meal	5.50	3.85	3.85	3.85	3.85
Fish meal	6.70	4.69	4.69	4.69	4.69
Animal fat	5.50	3.85	3.85	3.85	3.85
Limestone	0.44	0.30	0.30	0.30	0.30
Tricalcium phosphate	1.39	0.97	0.97	0.97	0.97
Salt	0.28	0.20	0.20	0.20	0.20
Vit-Min.mix <sup>2</sup>	0.11	0.08	0.08	0.08	0.08
Bacitracin (100 g/kg)	0.05	0.04	0.04	0.04	0.04
Choline chloride (25%)	0.17	0.12	0.12	0.12	0.12
L-lysine (78%)	0.06	0.04	0.04	0.04	0.04
Total	100.00	100.00	100.00	100.00	100.00
Chemical composition (%) <sup>3</sup>					
ME (kcal/kg)	3.251	2.743	2.719	2.719	2.736
Crude protein	19.38	17.22	17.31	17.31	17.19
Calcium	0.30	0.25	0.25	0.25	0.24
Avail. phosphorus	0.99	0.78	0.80	0.80	0.80

<sup>1</sup> FRB: Fresh rice bran; RRB: Rancid rice bran; PRB: Pelleted rice bran; ERB: Extruded rice bran.<sup>2</sup> Supplied per kg diet: 7,000 IU vitamin A, 1,000 IU vitamin D<sub>3</sub>, 10 IU vitamin E, 2 mg vitamin K, 3 mg vitamin B<sub>6</sub>, 20 µg vitamin B<sub>12</sub>, 10 mg pantothenic acid, 22 mg niacin, 0.15 mg biotin, 1 mg folic acid, 53 mg Mn, 40 mg Zn, 38 mg Fe, 0.6 mg I, 0.2 mg Co, 0.13 mg Se.<sup>3</sup> Calculated value.**Table 4.** Effects of feeding rancid bran on growth performance in broiler chicks

Item	Control	Rice bran <sup>1</sup>		SE
		FRB	RRB	
Starter (0-3 wk)				
Weight gain (g/bird)	517	477	489	27.97
Feed intake (g/bird)	887	841	865	44.82
FCR (F/G)	1.70	1.76	1.77	0.07
Finisher (4-6 wk)				
Weight gain (g/bird)	1,143 <sup>a</sup>	1,029 <sup>b</sup>	954 <sup>c</sup>	95.87
Feed intake (g/bird)	2,445 <sup>a</sup>	2,280 <sup>b</sup>	2,234 <sup>b</sup>	109.25
FCR (F/G)	2.14 <sup>a</sup>	2.22 <sup>ab</sup>	2.34 <sup>b</sup>	0.12
Overall (0-6 wk)				
Weight gain (g/bird)	1,660 <sup>a</sup>	1,507 <sup>b</sup>	1,443 <sup>c</sup>	12.86
Feed intake (g/bird)	3,323 <sup>a</sup>	3,121 <sup>b</sup>	3,100 <sup>b</sup>	129.68
FCR (F/G)	2.00 <sup>a</sup>	2.07 <sup>ab</sup>	2.15 <sup>b</sup>	0.09

<sup>1</sup> FRB: Fresh rice bran; RRB: Rancid rice bran.<sup>a,b,c</sup> Values with different superscripts in the same row differ ( $p < 0.05$ ).**Table 5.** The effect of rancid and processed rice brans<sup>1</sup> on the nutrient digestibility in broilers

	Raw		Processed		SE
	FRB	RRB	PRB	ERB	
Dry matter	48.35 <sup>ab</sup>	44.62 <sup>b</sup>	51.23 <sup>ab</sup>	61.79 <sup>a</sup>	9.79
Gross energy	48.35 <sup>ab</sup>	47.45 <sup>b</sup>	53.44 <sup>ab</sup>	65.72 <sup>a</sup>	10.85
Crude protein	38.20 <sup>ab</sup>	25.64 <sup>b</sup>	21.00 <sup>b</sup>	57.00 <sup>a</sup>	17.85
Crude fat	67.12	76.41	69.36	98.47	24.30

<sup>1</sup> FRB: Fresh rice bran; RRB: Rancid rice bran; PRB: Pelleted rice bran; ERB: Extruded rice bran.<sup>a,b,c</sup> Values with different superscripts in the same row differ ( $p < 0.05$ ).

**Table 6.** TBARS (thiobarbituric acid reactive substance, mg/kg) and POV(peroxide value, meq/kg) in ground chicken meat as affected by rancid rice bran during storage

Storage (week) <sup>1</sup>	TBARS <sup>2</sup>			SE	POV <sup>2</sup>			SE
	Control	FRB	RRB		Control	FRB	RRB	
0	2.31 <sup>a</sup>	1.14 <sup>b</sup>	1.25 <sup>b</sup>	0.33	0.09 <sup>a</sup>	0.05 <sup>b</sup>	0.06 <sup>b</sup>	0.01
1	4.53 <sup>a</sup>	1.88 <sup>c</sup>	2.10 <sup>b</sup>	0.37	0.14 <sup>a</sup>	0.08 <sup>c</sup>	0.11 <sup>b</sup>	0.02
2	5.52 <sup>a</sup>	3.28 <sup>c</sup>	3.74 <sup>b</sup>	0.46	0.18 <sup>a</sup>	0.11 <sup>c</sup>	0.13 <sup>b</sup>	0.03
3	8.58 <sup>a</sup>	4.20 <sup>c</sup>	5.40 <sup>b</sup>	0.46	0.15	0.15	0.16	0.01
4	8.76 <sup>a</sup>	4.82 <sup>c</sup>	6.09 <sup>b</sup>	0.43	0.14	0.14	0.15	0.01

<sup>1</sup> Ground chicken meat was stored in loose packaging at 1°C for 3 weeks.<sup>2</sup> Control: defatted rice bran, FRB: Fresh rice bran, RRB: Rancid rice bran.<sup>a,b,c</sup> Means within row with different superscripts are significantly different ( $p < 0.05$ ).**Table 7.** Fatty acid compositions of broiler meat as affected by feeding rice bran

	Rice bran <sup>1</sup>			SE
	Control	FRB	RRB	
	----- % -----			
C12:0	1.89 <sup>ab</sup>	1.93 <sup>a</sup>	1.69 <sup>b</sup>	0.14
C14:0	1.41 <sup>c</sup>	1.94 <sup>a</sup>	1.62 <sup>b</sup>	0.24
C16:0	26.36 <sup>b</sup>	34.35 <sup>a</sup>	35.04 <sup>a</sup>	4.23
C16:1	4.34 <sup>c</sup>	5.06 <sup>b</sup>	6.09 <sup>a</sup>	0.78
C18:0	11.21 <sup>b</sup>	8.91 <sup>c</sup>	13.44 <sup>a</sup>	2.08
C18:1	24.20 <sup>b</sup>	24.65 <sup>a</sup>	17.44 <sup>c</sup>	3.50
C18:2	12.26 <sup>a</sup>	11.05 <sup>b</sup>	11.87 <sup>a</sup>	0.58
C18:3	18.33 <sup>a</sup>	12.10 <sup>b</sup>	12.82 <sup>b</sup>	2.96
SFA <sup>2</sup>	40.86 <sup>c</sup>	47.13 <sup>b</sup>	51.79 <sup>a</sup>	4.76
USFA	59.14 <sup>a</sup>	52.87 <sup>b</sup>	48.21 <sup>c</sup>	4.75

<sup>1</sup> FRB: Fresh rice bran; RRB: Rancid rice bran.<sup>2</sup> SFA: Saturated fatty acids (C12:0, C14:0, C16:0, C18:0), USFA: Unsaturated fatty acids (C16:1, C18:1, C18:2, C18:3).<sup>a,b,c</sup> Values with different superscripts in the same row differ ( $p < 0.05$ ).

(5% for starter and 10% for finisher) and increased FFA % during the extended storage period. We stored the rice bran in a cool area (less than 10°C) until it was used, but rancidity might have continued at a lesser speed.

In the present study, even though it was not significant, there was a tendency to decrease several nutrient digestibilities such as dry matter, protein, etc. when rancid rice bran was fed. Scott et al. (1976) stated that hydrolytic rancidity did not interfere with the nutritional value of rice bran. Hussein and Kratzer (1982) also reported that rancidity had no effect on the energy content of the rice bran.

It is not easy to explain why the weight gain was retarded by feeding rice bran in chicks. Reduced weight gain in chicks fed rice bran compared to the chicks fed defatted rice bran might be attributable to antinutritional factors in the raw rice bran. It is generally accepted that rice bran contains some antinutritional factors, i.e., trypsin inhibitor, which reduce feed intake and depress poultry performance (Saunders et al., 1986). Sayre et al. (1988) also reported that the pancreas weight was significantly

increased in chicks fed diets containing raw rice bran.

The possible inclusion level of FRB in broiler chicks is 20% (Warren and Farrell, 1990; Farrell, 1994). In our study, the inclusion level of rice bran was 10% during finisher period, but feed intake was reduced as compared to the control diet containing defatted rice bran. It is therefore concluded that rice bran should be included at the level less than 10% in the broiler diets.

Contrary to the report of Warren and Farrell (1990), Kratzer et al. (1974) showed a decline in broiler performance over the range of 0-60% rice bran in the diet. In the present study, there was a tendency to improve energy and protein digestibilities of rice bran by extrusion cooking. This result supports the suggestion of Hancock (1992), who reported that antinutritional factors such as trypsin inhibitors can be destroyed by extrusion cooking. Extrusion cooking has become the most widely used method to stabilize rice bran for human foods (Martin et al., 1993). Pelleting was not effective to improve nutrient digestibility in this experiment. This is in agreement with the findings of Kratzer and Earl (1978) who showed that

**Table 8.** Chicken thigh meat color as affected by feeding fresh or rancid rice bran during storage

Color	Storage (week) <sup>1</sup>	Treatment <sup>2</sup>			SE
		Control	FRB	RRB	
L	0	60.5 <sup>a</sup>	59.6 <sup>b</sup>	57.2 <sup>c</sup>	0.57
	1	61.8 <sup>a</sup>	59.8 <sup>b</sup>	58.2 <sup>c</sup>	0.57
	2	62.1 <sup>a</sup>	60.7 <sup>b</sup>	58.0 <sup>c</sup>	1.00
	3	61.8 <sup>a</sup>	60.9 <sup>b</sup>	58.1 <sup>c</sup>	0.43
	4	61.3 <sup>a</sup>	61.6 <sup>a</sup>	57.8 <sup>b</sup>	0.37
a	0	12.7 <sup>b</sup>	12.6 <sup>b</sup>	14.6 <sup>a</sup>	0.47
	1	13.5 <sup>b</sup>	13.6 <sup>b</sup>	15.3 <sup>a</sup>	0.53
	2	15.1	15.2	15.6	0.73
	3	14.3 <sup>b</sup>	15.1 <sup>b</sup>	16.8 <sup>a</sup>	0.80
	4	13.9	14.4	14.5	0.43
b	0	13.2 <sup>b</sup>	13.9 <sup>a</sup>	10.4 <sup>c</sup>	0.17
	1	14.4 <sup>a</sup>	14.6 <sup>a</sup>	12.1 <sup>b</sup>	0.53
	2	15.6 <sup>a</sup>	15.5 <sup>a</sup>	12.1 <sup>b</sup>	0.37
	3	14.3 <sup>b</sup>	15.5 <sup>a</sup>	12.8 <sup>c</sup>	0.33
	4	14.5 <sup>b</sup>	15.1 <sup>a</sup>	12.2 <sup>c</sup>	0.30

<sup>1</sup> Chicken meat was stored in loose packaging at 1°C for 4 weeks, and 0 is the 1<sup>st</sup> after slaughter.

<sup>2</sup> Control: Defatted rice bran, FRB: Fresh rice bran, RRB: Rancid rice bran.

<sup>a,b,c</sup> Means within row with different superscripts are significantly different ( $p < 0.05$ ).

pelletting failed to improve the feeding value of diets containing full-fat rice bran.

In our previous study with finishing pigs (Chae and Lee, 2002), pigs fed a diet containing FRB grew faster than those fed a diet containing defatted rice bran. This result is different from the result obtained from the present study which means that defatted rice bran is better than full fat rice bran for feed use in broiler chicks.

On the other hand, lipid stability such as TBARS was decreased when chicks were fed RRB during storage of chicken at 1°C. A similar trend was found in our previous study with finishing pigs (Chae and Lee, 2002). Poor stability might be influenced by the decreased antioxidant agents such as  $\alpha$ -tocopherol, oryzanol, etc. in rice bran during storage as demonstrated by Godber et al. (1993) and Xu (1994).

It was reported that  $\alpha$ -tocopherol content in the diet is very important to improve meat stability (Monahan et al., 1992; Jensen et al., 1997; Rey et al., 2001). Our results support the previous reports of Asghar et al. (1989), Lin et al. (1989), and Buckley et al. (1989), who found that rates of lipid peroxidation in pig and broiler muscles were much higher when these animals were fed oxidized oil. This might be due to the fact that intake of oxidized feed could lead to decreased  $\alpha$ -tocopherol retention in the live animal (Engberg et al., 1996). The level of SFA (C12:0, C14:0, C16:0, C18:0) in meat was higher ( $p < 0.05$ ) in RRB than in FRB groups. This result implies lipid oxidation occurs in rice bran during storage. It was reported that the changes in the type and amount of dietary fat in monogastric animals will be reflected in the composition of adipose tissue fatty acids (Enser, 1984). Rhee et al. (1990) reported differences

in oxidative stability in meats with different degrees of fatty acid unsaturation.

In the present study, the level of SFA (C12:0, C14:0, C16:0, C18:0) was lower in chicken meat from FRB group than in chicken meat from RRB group, while the level of USFA (C16:1, C18:1, C18:2, C18:3) was higher in chicken fed FRB (table 7). Even though chicken meat from FRB had higher level of USFA than that from RRB group, the lipid was more stable during storage. Generally, USFAs in meat are more susceptible to oxidation than SFAs (Enser, 1984). The present result could be explained by the reports of Xu (1994) who reported higher antioxidant levels in meats from pigs fed FRB than those fed RRB.

Also, lightness (L), redness (a) and yellowness (b) in the chicken meats were higher ( $p < 0.05$ ) in FRB than RRB groups during storage. This means that the color of chicken meats from RRB group was more unstable than chicken meats from FRB group. It is difficult to explain the changes in chicken meat color as affected by feeding RRB. This might be due to the fact that lipid oxidation of chicken meat from RRB affects the formation of oxidized pigment such as metmyoglobin. According to Lee et al. (2001), the increase in light intensity to beef promoted not only discoloration but also lipid oxidation. Consequently, lipid oxidation was related to color stability of chicken meat.

The vitamin E level in the red meat is involved in color stability (Buckley et al., 1989), while Resurreccion and Reynolds (1990) reported that there was no difference in pork color values when dietary vitamin E level was different. There is little information about meat colors as affected by fat rancidity in the diet. Further experiments are necessary to ensure the changes in chicken meat colors

when oxidized oil, rather than rancid rice bran, is included in broiler diets.

### IMPLICATION

Chicks showed poor growth performance when dietary rice bran was rancid. Extrusion cooking would be an effective way to improve digestibility of nutrients in rice bran in chicks. The chicken meats RRB group showed higher ( $p < 0.05$ ) TBARS and POV than those from FRB group during storage. Therefore, it would appear that feeding RRB gave negative effects on growth performance and lipid stability of meat in broiler chicks.

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