NUTRITIVE VALUE OF FERMENTED WHEAT POLLARD IN TEGAL AND MUSCOVY DUCK

Yono C. Raharjo and Pius P. Ketaren[1]

ABSTRACT

The aim of this experiment is to determine nutritive value of non-fermented (NFP) and fermented (FP) wheat pollard in both Tegal and Muscovy ducks. Eighteen mature males of each Tegal and Muscovy ducks were allocated individually in all wire cages, based on a 2 X 2 factorial design, 3 replicates of 3 birds each. Nutritive value of NFP and FP was determined based on a force-feeding method. Fermentation significantly increased crude protein (CP) content from 16.3 to 34.6 % and decreased neutral detergent fibre (NDF) and gross energy (GE) from 38.4 to 28.7 % and from 4109 to 3918 Kcal, respectively. Fermentation also significantly (P<.05) increased apparent metabolisability of CP and NDF from 22.0 to 47.6 % and from 30.3 to 43.2 %. Apparent metabolisability of GE however was significantly (P<.05) decreased from 59.1 to 50.8 %. In contrast, true metabolisability of CP was not significantly (P>.05) affected by fermentation as approximately 26.8 - 54.9 % of excreta originated from endogenous CP. Nutritive values of NFP and FP were not significantly different between Tegal and Muscovy ducks, eventhough the NDF apparent and true metabolisability of FP in Tegal ducks were higher than the values in Muscovy ducks.

Key word: Fermentation, Wheat pollard, Nutritive value

INTRODUCTION

Wheat pollard is one of wheat by–products from wheat flour milling which have been commonly used as ingredient in poultry diet. However, its inclusion in poultry diet is limited by high fibre content. Crude fibre is poorly digested and has a little contribution to meet the energy requirement of poultry (NRC, 1994). Nevertheless, Crampton and Harris (1969) estimated that 20 – 30 % of crude fibre is digested in the caecum of poultry. Tangendjaja *et al.* (1986) in evaluating rice bran for poultry diet predicted that ducks had a better ability to utilize high fibre diet than chickens. Sinurat (1994) and Sinurat *et al.* (1992) also reported that metabolisable energy value of rice bran in drakes were significantly higher than values obtained for cockerels and the difference could be due to ability of the birds in digesting crude fibre. Leeson and Summers (1991) suggested to include wheat bran or other wheat by products in poultry diets not more than 20 and 25% respectively. Its inclusion level can be improved by means of fermentation. Sinurat *et al.* (1996) reported that fermentation of coconut meal using *Aspergillus niger* improved protein content and its metabolisability in chickens. They also found that crude fibre content of fermented coconut meal was reduced. Similar results were also reported by Faridah (1994) who fermented palm kernel cake using *Aspergillus niger*. Fermentation also significantly reduced crude fibre content in cassava as cellulase enzyme was produced during fermentation process (Purwadaria *et al.*, 1997).

Nutritive value of ingredients can be determined by metabolisability of nutrients. One of the commonly method used in the force-feeding method following the procedure of true metabolisability energy (TME) evaluation by Sibbald (1989). Because of the low intake applied in this method, the presence of endogenous secretion (Raharjo and Farrell, 1985) and possible interference of cecal microbial protein (Raharjo *et al.*, 1984), especially for

[1] Balai Penelitian Ternak, P.O Box 221 – Bogor 16002, Indonesia

metabolisable protein determination should imperatively be taken into account.

The aim of this experiment is to study the effect of fermentation on the nutritive value of wheat pollard in both Tegal and Muscovy ducks by means of metabolisability of nutrient.

MATERIALS AND METHODS

Fermentation procedures

One kg of wheat pollard (NFP) was mixed thoroughly with 900 mls of water and mineral mixture of: 36 g $(NH4)2 SO4$, 20 g urea ,7.5 g $NaH2PO4$, 2.5 g $MgSO4$ and 0.75 g KCl. The mixture was steamed for 30 minutes, cooled and then 10 % v/v of *Aspergillus niger* inoculant was added, placed in a plastic tray and fermented at 28 °C for 3 days. Fermented wheat pollard (FP) was then placed in sealed plastic bags (anaerobe fermentation) and kept in an oven at 50 °C for 3 days to allow enzymatic process to take place. Wet fermented product was then dried in the oven at 60 °C for 2 – 3 days and ground.

Experimental procedures

The procedure was based on method described by Sibbald (1989). Eighteen males Tegal ducks and eighteen males Muscovy ducks were each randomly divided into 3 replicates and placed in individual cages. Basal diet was fed to the ducks before being fasted for 32 hours; water was provided *ad lib*. Then each of Tegal and Muscovy ducks was forced-fed 40 g and 75 g of NFP respectively. Feces was then collected for 32 hours period followed by a 24 hours feces collection for measuring fecal endogenous nutrients, weighed and dried. The same procedure was also applied to FP.

Chemical and statistical analysis

Dried fecal samples were taken for DM, CP, NDF, and GE analysis based on AOAC (1984) procedure. Nutritive values of NFP and FP were determined by means of metabolisability of nutrients and calculated based on the difference between nutrient intake and nutrient content in the feces. The data were statistically analyzed using a factorial design of 2 x 2 factors.

RESULTS AND DISCUSSIONS

Effect of fermentation on nutrient composition of wheat pollard

Fermentation increased CP content of wheat pollard from 16.3 % to 34.6 % but decreased NDF and GE level from 38.4 % to 28.7 % and from 4109 Kcal/kg to 3918 Kcal/kg respectively (Table 1).

The increase of protein level was closely related to the growth of the *Aspergillus* in the substrate. Similar results were also reported by Kompiang *et al.* (1994) and Sinurat *et al.* (1998), who worked with fermented peeled cassava tuber and coconut meal respectively, who found that the increase of the protein content was due to the increase of microbial protein and hence it could be classified as a single cell protein. The decrease of the NDF value was caused by the hydrolysis of carbohydrates including some crude fibre component by the actions of enzymes produced during fermentation. The decrease of crude fibre content of fermented coconut meal was also reported by Sinurat *et al.* (1998) who used *Aspergillus niger* inoculant for the fermentation. GE content of FP was slightly lower than NFP.

Table 1. Nutrient content of non-fermented and fermented wheat pollard

Nutrient	NFP	FP	Change (%)
Crude protein (%)	16.3	34.6	+111
NDF (%)	38.4	28.7	-25
Gross energy (Kcal/kg)	4109	3918	-5

Apparent metabolisability of nutrients

Apparent metabolisability of CP were significantly higher (P<.01) in FP than that of NFP while GE level was significantly lower (P<.05) in FP (Table 2). Apparent metabolisability of CP and NDF increased from 22.0 % to 47.6 % and from 30.3 to 43.2 % respectively. The increase of NDF metabolisability in FP was possibly due to the presence of enzymes in the fermented wheat pollard and the fibre in fermented product may had also been loosen by mould and hence became more easily attacked by the enzyme. On the other hand, apparent metabolisability of GE was decreased from 59.1 to 50.8 %.

Fermentation did not affect DM apparent metabolisability of wheat pollard. In general, the nutrient metabolisability of NFP and FP were not significantly interacted with the Tegal and Muscovy ducks. At less degree of confidence, the NDF apparent metabolisability of FP in Tegal ducks was significantly higher (P<0.10). The apparent metabolisability of NDF was higher in Tegal than the value in Muscovy ducks, which were 41.0 % and 32.6 % respectively. Tegal ducks tended to utilize NDF better than Muscovy ducks particularly in FP. This is also indicated by the data where the NDF apparent metabolisability of Tegal ducks fed FP was higher than the values in Tegal ducks fed NFP. On the other hand, the NDF apparent metabolisability values in Muscovy ducks were very similar between FP and NFP. There was no interaction between type of feed processing and duck breeds.

True metabolisability of nutrients

True metabolisability of DM and NDF was significantly (P<.05) increased by fermentation (Table 3). True metabolisability of DM increased from 56.9 to 64.8% and NDF metabolisability increased from 34.7 to 47.1%. True metabolisability of GE was significantly (P<.01) decreased by fermentation. The true metabolisability of GE in FP was 55.4% compared to 64.9% in NFP value, which was 64.9%. The reason for this could be due to some of the soluble carbohydrates in NFP were used by the *Aspergillus* and left more lignin and undegradable fractions of the fungi.

Breeds did not significantly affect the true metabolisability of nutrients. True metabolisability of NDF in Tegal and Muscovy ducks were 44.7% and 37.1%

Table 2. Apparent metabolisability of dry matter, crude protein, neutral detergent fibre and gross energy of non-fermented and fermented wheat pollard in Tegal and Muscovy ducks

		NFP	FP	Means
1. DM	T	53.6	62.3	57.9
(%)	M	50.8	51.7	51.3
	Means	52.2[a]	57.0[a]	
2. CP	T	23.1	49.4	36.3
(%)	M	20.9	45.8	33.3
	Means	22.0[a]	47.6[b]	
3. NDF T	T	30.0	52.0	41.0
(%)	M	30.6	34.4	32.6
	Means	30.3[a]	43.2[b]	
4. GE	T	64.1	51.5	57.8
(%)	M	54.1	50.1	52.1
	Means	59.1[a]	50.8[b]	

Means in the same row with different superscripts showed significant difference (P<.001 for CP; P<.05 for GE and NDF)

Table 3. True metabolisability of dry matter, crude protein, neutral detergent fibre and gross energy of non-fermented and fermented wheat pollard in Tegal and Muscovy ducks

		NFP	FP	Means
1. DM	T	55.2	68.5	61.9
(%)	M	58.6	61.1	59.9
	Means	56.9[a]	64.8[b]	
2. CP	T	61.9	56.6	59.3
(%)	M	67.2	66.6	66.9
	Means	64.5[a]	61.6[a]	
3. NDF T	T	34.0	55.4	44.7
(%)	M	35.4	38.7	37.1
	Means	34.7[a]	47.1[b]	
4. GE	T	68.8	55.2	62.0
(%)	M	61.0	55.5	58.3
	Means	64.9[a]	55.4[b]	

Means in the same row with different superscripts showed significant difference (P<.05 for DM and NDF; P<.01 for GE)

respectively. The values were not statistically different due to high variation between individual ducks that was indicated by high standard error of means within breeds. It was also found no interaction between breed and feed processing.

True metabolisability of CP was not affected by the fermentation. This is interesting, as the apparent metabolisability of CP was significantly (P<.001) higher in FP. This could be due to high endogenous CP level in the feces and substantially low intake of CP originated from the feed, as also reported by Raharjo and Farrell (1985).

Pattison (1989) stated that endogenous nutrients were mainly consisted of abraded cells of digestive tract, product of bacterial fermentation, residual digestive secretions, and other endogenous proteins. It was noted in this experiment that fraction of endogenous CP in the total excreta was extremely high compared to DM, NDF, and GE (Table 4). The fraction of endogenous CP in duck excreta were ranging from 26.8 % to 54.6 % while other endogenous nutrients were ranging from 6.3 % to 18.3 %. The presence of those endogenous nutrients in the excreta was the main reason for the difference between apparent and trues digestibility values particularly the value for CP true metabolisability. Contribution of endogenous CP in ducks fed NFP was twice (54.6 %) of the values in ducks fed FP (26.8

Table 4. Fraction of endogenous nutrients in Tegal and Muscovy ducks excreta fed fermented and non-fermented wheat pollard

	DM (%)	CP (%)	NDF (%)	GE (%)
NFP	9.9	54.6	6.3	14.1
FP	18.3	26.8	6.8	9.4
T	9.3	36.1	6.3	10.0
M	17.7	50.4	6.7	12.9

%). Low endogenous CP in ducks fed NFP was probably due to low CP content in NFP and hence low CP intake.

In addition, higher dietary NDF content of NFP contribute to the higher endogenous secretion, as indicated by the result of Raharjo and Farrell (1984). This also partly explains why true metabolisability of DM in FP significantly higher than that of NFP, while the difference in the apparent metabolisability is not significant.

IMPLICATION

Fermentation increased the nutritive values of wheat pollard. However, endogenous nutrients content in feces has to be taken into account in the determination of nutrient digestibility of wheat pollard, particularly when using Sibbald (1989) method. It is preferable to use true digestibility value in formulating diet for ducks particularly for CP values.

REFERENCES

AOAC. 1984. *Official methods of analysis of the association of official analytical chemist.* 14th ed. AOAC Inc. New York, USA

Crampton, E.W.and L.E.Harris. 1969. *Applied Animal Nutrition.* W.H. Freeman and Company. San Fransisco.

Faridah, E. 1994. *Pengaruh Fermentasi Bungkil Inti Sawit dengan Asperigillus niger NRRL337 dan Eupenicillium javanicum terhadap Peningkatan Daya Cerna.* Fakultas Teknologi Pertanian, Universitas Djuanda. Bogor, Indonesia.

Kompiang, I.P., A.P. Sinurat, S. Kompiang, T. Purwadaria and J. Dharma. 1994. Nutritional value of protein enriched Cassava: Cassapro. *Ilmu dan Perternakan,* 7 (2) :22 – 25.

Leeson, S. and J.D. Summers. 1991. *Commercial Poultry Nutrition.* University books. Guelph, Ontario, Canada.

NRC. 1994. *Nutrient Requirements Of Poultry.* (9th revised ed.). National Academy Press. Washington D.C., USA.

Pattison, M. 1989. Problems of diarrhea and wet litter in meat poultry. In: *Recent Development In Poultry Nutrition* D.J.A. Cole and W.Haresign (Eds.). Anchor Press Ltd. Tiptree, Essex, Great Britain.

Purwadaria, T., T. Haryati, A.P. Sinurat, I.P. Kompiang, Supriyati and J. Darma. 1997. The correlation between amylase and cellulase activities with starch and fibre contents on the fermentation of cassapro (cassava protein) with *Aspergillus niger. Biotechnology conference.* Jakarta, Indonesia.

Raharjo, Y and D.J. Farrel. 1984. A new biological method for determining amino acid digestibility in poultry feedstuffs using a simple cannula and the influence of dietary fibre on endogenous amino acid output. *Animal Feed Science and Technology,* 12:29-45.

Raharjo, Y.C., D.J. Farrell and R.B. Cumming. 1984. Effects of caecectomy and dietary antibiotics on the digestibility of dry matter and amino acids in poultry feeds determined by excreta analysis. Aust. *J. Exp. Agric. Anim. Husb.,* 24:516-521.

Sibbald, I.R.1989. Metabolisable energy evaluation of poultry diets. In: *Recent Developments in Poultry Nutrition.* D.J.A. Cole and W. Haresign (Eds.). Anchor Press Ltd. Tiptree, Essex, Great Britain.

Sinurat,A.P., K. Zulkarnain and J. Bestari. 1992. A method of measuring metabolisable energy of feed stuffs for ducks. *Ilmu dan Peternakan,* 5(1): 28 – 30.

Sinurat,A.P. 1994. Peningkatan produktivitas ternak itik. *Bunga Rampai Hasil Penelitian Ternak Unggas dan Ruminansia Kecil.* Balai Penelitian Ternak, Ciawi, Indonesia.

Sinurat,A.P., P. Setiadi, T. Purwadaria, A.R. Setioko and J. Dharma. 1996. Nilai gizi bungkil kelapa yang difermentasi dan pemanfaatannya dalam ransum itik jantan. *Jurnal Ilmu Ternak dan Veteriner*, 1 (3):161-168.

Sinurat, A.P., T. Purwadaria, A. Habbie, T. Pasaribu, H. Hamid, J.Rosida, T. Haryati dan I. Sutikno. 1998. Nilai gizi bungkil kelapa terfermentasi dalam ransum itik petelur dengan kadar fosfor yang berbeda. *Jurnal Ilmu Ternak dan Veteriner* 3 (1):15-21.

Tangendjaja, B., R. Matondang and J. Diment. 1986. Perbandingan itik dan ayam petelur pada penggunaan dedak dalam ransum selama phase pertumbuhan. *Ilmu Peternakan*, 2(4):137-139.