SUPPORTING PAPERS
ISBN 979-97243-9-2

INTAKE AND DIGESTIBILITY OF FIBER FRACTION OF FERMENTED RICE STRAW AS AFFECTED BY INTRAMUSCULAR VITAMIN A SUPPLEMENT IN SHEEP

Budi Haryanto

Indonesian Research Institute for Animal Production. Ciawi-Bogor. PO Box 221 Bogor 16002

ABSTRACT

An experiment has been carried out to investigate the effect of intramuscular supplementation of vitamin A in sheep fed with solely fermented rice straw as fibrous source. Thirty young male sheep with an averaged liveweight of 24.0 $\pm$ 2.7 kg were divided into 6 groups to receive one of 5 different pulse dose of intramuscular supplementation of vitamin A, i.e., none, 0, 28, 56, or 84 days after the commencement of feeding the fermented rice straw, following two weeks preliminary period and assigned as R0, R1, R2, R3 and R4, respectively. The rice straw was fermented using a mixture of probiotic and urea for 21 days. The fermented rice straw was fed ad libitum allowing some residual feed in the following day. Concentrate feed with crude protein content of 13.57% was given at 200 g head^{-1} day^{-1} and offered before feeding the fermented rice straw. The intake and digestion trial was carried out for 7 days at the end of feeding trial (during the week 13th). The feed intake, and fecal output were recorded every day. Samples of feed offered and fecal output were taken and analyzed for the fiber fraction contents. Results indicated that the daily intake of neutral detergent fiber (NDF) fraction from fermented rice straw were not significantly different among treatments, with an average of NDF intake at 12.8 g kg^{-1} body weight. The mean of daily acid detergent fiber (ADF) intake from fermented rice straw was 12.6 g kg^{-1} body weight. The concentrate contributed approximately 3 g NDF kg^{-1} body weight or 2 g ADF kg^{-1} body weight to the total intake. The digestibility of NDF ranging from 36.2 to 47.0% which were not significantly different among treatments with a mean of 42.7%. Similarly, the digestibility of ADF were not significantly different among treatments, ranging from 39.6 to 48.2% with a mean of 44.8%. It was concluded that intramuscular supplementation of vitamin A may not be necessary for sheep fed with entirely fermented rice straw as source of fiber, especially during a relatively short period of time.

Key Words: *Fermented Rice Straw, Vitamin A, Fiber Fraction, Sheep.*

INTRODUCTION

Feed intake regulation in ruminants involves the role of central nervous system (CNS) and the rumen physical capacity to hold the bulky feed. Regardless the CNS, therefore, the intake of fibrous feed will be determined by its rumen fill, rate of digesta comminution, and digesta out flow passage to the lower digestive tract (Ribeiro, 1989). The feed intake is affected by physical condition of the materials and

SUPPORTING PAPERS
ISBN 979-97243-9-2

metabolisability of the nutrients in the animal tissues. It is also affected by the size and physiological conditions of the animal (Romney and Gill, 2000).

Rice straw has not been widely used as feed for small ruminants due to the low palatability and its low nutritive value. The low nutritive value was associated with the high lignocellulosic material and low in nitrogen contents. In terms of energy requirements, the components of fiber in the rice straw may be used as source of energy because the degradability and fermentation of fibrous components in the rumen resulted in the formation of volatile fatty acids which are the primary source of energy in ruminants (Hungate, 1966).

The degradability of fibrous component is affected by the availability of fibrolytic enzymes produced by rumen microbes. The structural entity of fiber and the amount of fiber-degrading enzymes are the main factors in the fiber digestion. The adhesion and attachment of microbes to the feed particles become an important factor in affecting the feed digestion (Akin and Barton, 1983; Cheng et al., 1990).

Fermented rice straw has been reported to have a higher nutritive value as compared to fresh untreated rice straw. The degradability of fiber fraction is relatively greater when the rice straw has been fermented. Fermentation of rice straw could be carried out using microbes originated from the rumen of ruminant livestock. Meanwhile, the use of direct-fed microbials in affecting the ruminant microbial fermentation and ruminant performance that has been reviewed by Yoon and Stern (1995) indicated only about 40% of the reports showed positive effect. The nutritive value of fermented rice straw varied depending on the bioprocess procedures. However, in general, the nutritive value was improved despite of the possibility of deficient in vitamin A content.

Sheep requires approximately 47 IU vitamin A kg^{-1} body weight day^{-1} to maintain a normal epithelial tissues. Some reports indicated that feeding rice straw may resulted in developing symptoms of vitamin A deficiency in sheep such as night blindness and *polioencephalitis* (NRC, 1985). For a longer period of time, feeding rice straw of deficient in vitamin A to ewes may develop a pregnancy failure which may be associated with unsuitable condition of epithelial tissues in the reproductive organs.

The objective ot the present experiment was to investigate the intake and digestibility of fibrous component of fermented rice straw by sheep when intramuscular supplement of vitamin A was given at different time after the commencement of feeeding fermented rice straw.

MATERIALS AND METHODS

Thirty heads of growing male sheep with an averaged liveweight of 24.0 $\pm$ 2.7 kg were divided into 6 groups to receive 5 different treatments of supplement of vitamin A administered intramuscularly and given at different times after two weeks of adaptation period from the commencement of feeding the fermented rice straw , i.e., none, 0, 28, 56, or 84 days, and assigned as R0 (control), R1, R2, R3 and R4, respectively. Pulse dose of vitamin A was at 500,000 IU (1 ml) $head^{-1}$ regardless the body weight as recommended by the factory. Concentrate feed was offered at 200 g $head^{-1}$ day^{-1} for all individuals before feeding the fermented rice straw.

The fermented rice straw was offered ad libitum. Drinking water was available at any time. Feeding trial was carried out for 12 weeks, while the feed intake and

SUPPORTING PAPERS
ISBN 979-97243-9-2

digestibility study was done at the end of the feeding trial. A 7-day total fecal collection was carried out. Alliquotes of feed offered and fecal samples were analyzed for the neutral detergent fiber and acid detergent fiber contents. However, only 20 heads of sheep were used for the intake and digestibility study. The chemical composition of fermented rice straw and concentrate used in the present experiment are indicated in Table 1. The data showed that the hemicellulose content in the fermented rice straw was relatively small and may be assumed to be negligible. Analysis of NDF and ADF were carried out according to the procedure of Goering and Van Soest (1970) with a slight modification. Data of intake and digestibility for NDF and ADF were analyzed statistically in a completely randomized design (Steel and Torrie, 1980).

Table 1. *Chemical composisiton of fermented rice straw and the concentrate used in the present experiment (based on dry matter)*

Components	Composisiton, %		
	Untreated rice straw	Fermented rice straw	Concentrate
Protein (N X 6.25)	5.36	9.82	13.57
NDF	74.86	70.63	49.38
ADF	68.50	69.45	33.49
Hemicellulose	6.36	0.18	15.89

RESULTS AND DISCUSSION

Figure 1 describes the values of intake (g kg^{-1} body weight day^{-1}) for dry matter, neutral detergent fiber and acid detergent fiber as affected by treatments.

Figure 3. *Relationship between neutral detergent fiber intakes (g kg^{-1} body weight day^{-1}) and its digestibility* Intake of dry matter from fermented rice straw fell between 478 and 547 g head^{-1} day^{-1} which were approximately 75% of the total dry matter intake (645 and 715 g head^{-1} day^{-1}). The total dry matter intakes were equal to 23.3 to 24.5 g kg^{-1} body weight day^{-1}. These values were lower than those reported by Haryanto (2001) which were in the range between 34.6 to 39.2 g kg^{-1} body weight day^{-1}. The dry matter digestibility of the present experiment ranged from 45.6 to 49.8% with a mean of 48.1%. The intake of crude protein (N x 6.25) were in the range from 70 to 76 g head^{-1} day^{-1} with a mean value at 72 g head^{-1} day^{-1} .

SUPPORTING PAPERS
ISBN 979-97243-9-2

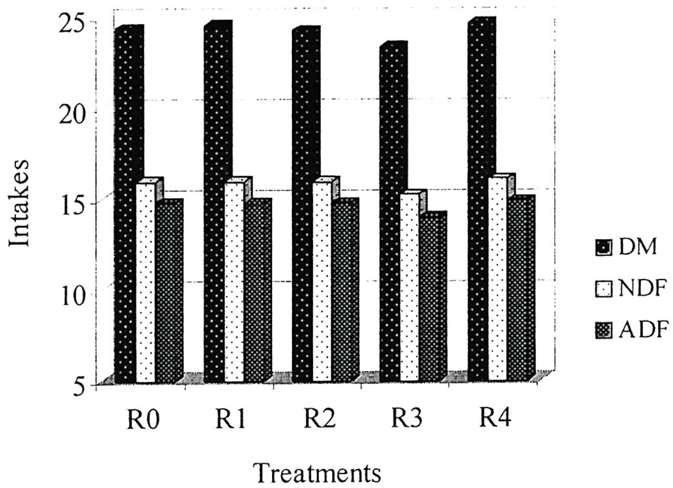


Figure 1. *Dry matter, neutral detergent fiber and acid detergent fiber intakes (g kg^{-1} body weight day^{-1}) as affected by treatments.*

Table 2. *Intake and digestibility of fiber fractions by sheep as affected by treatments.*

PARAMETER	TREATMENT[1]					Mean
	R0	R1	R2	R3	R4	
Dry Matter Intake, g $head^{-1}day^{-1}$	678	648	715	645	667	669
Rice straw	511	481	547	478	500	502
Concentrate	167	167	167	167	167	167
NDF Intake	444	423	469	420	436	437
Rice straw	361	340	387	338	353	355
Concentrate	83	83	83	83	83	83
ADF Intake	411	390	436	388	403	405
Rice straw	355	334	380	332	347	349
Concentrate	55	55	55	55	55	55
Dry Matter Digestibility, %	49.8	47.6	45.6	49.1	47.9	48.1
NDF Digestibility, %	47.0	39.4	36.2	42.2	45.0	42.7
ADF Digestibility, %	46.7	39.6	45.5	48.2	43.6	44.8

[1]R0 : CONTROL TREATMENT, WITHOUT VITAMIN A SUPPLEMENTATION; R1 : VITAMIN A SUPPLEMENT AT DAY 0; R2 : VITAMIN A SUPPLEMENT AT DAY 28; R3 : VITAMIN A SUPPLEMENT AT DAY 56; R4 : VITAMIN A SUPPLEMENT AT DAY 84

ISBN 979-97243-9-2

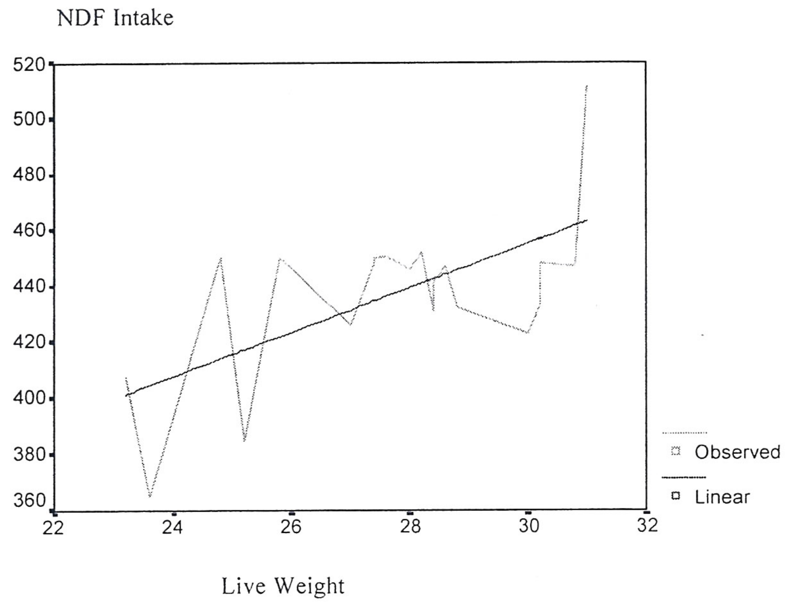
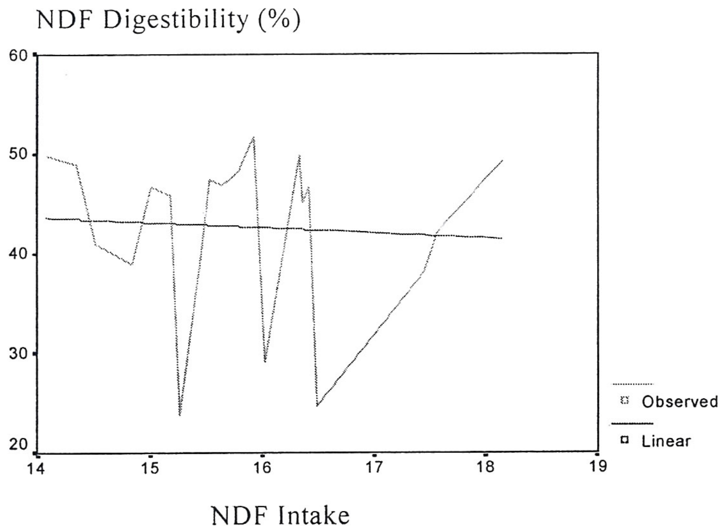


Figure 2. *Relationship between neutral detergent fiber intakes (g head^{-1} day^{-1}) and liveweight of the animals(kg).*



The data of intake and digestibility for neutral and acid detergent fibers are summarized in Table 2. Neutral detergent fiber intakes ranged from 420 to 469 g head^{-1} day^{-1} which were equal to 15.2 to 16.1 g kg^{-1} body weight day^{-1}. These values were not significantly different among treatments, indicating that supplementation of vitamin A intramuscularly at different time after the commencement of feeding fermented rice straw in sheep did not affect the intake of NDF. The contribution of concentrate to the total NDF intake was nearly 19%. Similarly was indicated by the intake of acid detergent fiber which ranged from 388 to 436 g head^{-1} day^{-1} or equal to 14.0 to 14.9 g kg^{-1} body weight day^{-1}.

The digestibility of NDF was relatively low which fell within a range from 36.2 to 47.0% when compared to earlier finding (Haryanto et al., 2004). However, these

ISBN 979-97243-9-2

values were higher than that for the unfermented rice straw. A higher digestibility of NDF will bring about a greater production of volatile fatty acids and therefore providing a greater source of energy for the animal.

The digestibility for acid detergent fiber ranged from 39.6 to 48.2% which were also fell within a slightly lower values as compared to previous finding. The greater values of digestibilities for ADF as compared to NDF in treatment R2 and R3 were definitely due to wider variability among individuals in the NDF digestibilities which may resulted in the reduction of the value of mean. The mean of maximum values of NDF digestibility from all treatments was 51.8% while the mean of minimum values was 23.8%. The mean of maximum values of the ADF was 52.2% while the mean of minimum values of ADF digestibility was 32.3%.

The fact that NDF values were approximately the same as those of the ADF values indicated that the hemicellulose content in the fermented rice straw was negligible or has been completely utilized during the fermentation process. Hence, the values of digestibilities for NDF and ADF should be the same as well, given that the digestibility of NDF from concentrate was unchanged; therefore, further experiment may be necessary to elucidate these differences.

The rumen capacity was responsible for the level of animal intakes of high fiber diet. This will be more significant when the rate of fiber degradation in the rumen was slow that resulted in a longer retention time of digesta in the rumen. Regardless the effect of treatments, the NDF intake in the present experiment was significantly associated with the liveweight of the individual animals ($P<0.01$) as indicated by the regression equation of $Y=218.0 + 7.904 X$; where Y was NDF intake (g head^{-1} day^{-1}) and X was liveweight (kg) as described in Figure 2. It has been observed earlier that the NDF intake, especially those of the indigestible NDF was responsible for the total feed dry matter intake (Haryanto, 1989).

The association between NDF intake and the digestibility of NDF was not significant as illustrated in Figure 3. Generally, the higher NDF intake to a certain extend will be followed by a lower digestibility which is due to principle of metabolic regulation, however, despite of the wide variability of NDF intakes in the present experiment, it was indicated that the NDF digestibility was relatively constant. The NDF digestibility seemed to be constant at approximately 42% when the NDF intake fell within the range from 14 to 18 g kg^{-1} body weight day^{-1}.

CONCLUSION

It was concluded that supplement of intramuscularly injected vitamin A in sheep fed with fermented rice straw as the main source of fiber may not be necessary, especially within conditions similar to those in the present experiment.

REFERENCES

Akin, D.E. and F.E. Barton. 1983. Rumen microbial attachment and degradation of plant cell walls. Fed. Proc. 42: 114-121

Cheng, K.J., T.A. McAllister, H. Kudo and J.W. Costerton. 1990. The importance of adhesion in microbial digestion of plant materials. In: The Rumen Ecosystem. S. Hoshino, R. Onodera, H. Minato and H. Itabashi (eds.). JSSP. Tokyo. 129-135

ISBN 979-97243-9-2

Goering, H.K. and P.J. Van Soest. 1970. Forage fiber analysis. USDA Agriculture Handbook No. 39. Washington.

Haryanto, B. 1989. Serat yang tidak tercerna sebagai faktor pembatas konsumsi bahan kering pada ternak ruminansia kecil (Undigested fiber as a possible factor controlling voluntary intake in small ruminants). Pros. Pertemuan Ilmiah Ruminansia. Jilid 2. Ruminansia Kecil. Pusat Penelitian dan Pengembangan Peternakan. Bogor. 199-203

Haryanto, B. 2001. Improvement of fibre utilization as source of energy in sheep through cellobiose supplementation. In: Energy Metabolism in Animals. EAAP Publ. No. 103, 2001. Denmark. 153-156.

Haryanto, B., Supriyati dan S. N. Jarmani. 2004. Pemanfaatan probiotik dalam bio-proses peningkatan nilai nutrisi jerami padi untuk pakan domba. Prosiding Seminar Nasional Teknologi Peternakan dan Veteriner. Pusat Penelitian dan Pengembangan Peternakan. Bogor. 298-304

Hungate, R.E. 1966. The Rumen and Its Microbes. Academic Press. Washington. USA.

National Research Council. 1985. Nutrient requirements of sheep. National Academy of Sciences. Washington, D.C.

Ribeiro, J.M.C.R. 1989. Intake Measurement. In: Evaluation of Straw in Ruminant Feeding. M. Chenost and P. Reiniger (eds). Elsevier Applied Science. New York. 23-35.

Romney, D.L. and M. Gill. 2000. Intake of Forage. In: Forage Evaluation in Ruminant Nutrition. D.I. Givens, E. Owen, R.F.E. Axgord and H.M. Omed (eds). CABI Publishing. CAB International. 43-62.

Steel, R.G.D. and J.H. Torrie. 1980. Principles and Procedures of Statistics. McGraw-Hill Book Co. New York.

Yoon, I. K. and M. D. Stern. 1995. Influence of direct-fed microbials on ruminal microbial fermentation and performance of ruminants: A review. Asian-Australasian J. Anim. Sci. 8 (6): 533-555.