Nutritional Properties of Three Different Origins Of Indonesian Jatropha *(Jatropha Curcas)* Meal For Ruminant

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Abstract

An experiment to explore the nutrition properties of Indonesian Jatropha curcus meal for ruminant has been conducted. Three different origins of Indonesian jatropha (Lampung, Kebumen and Lombok) have been investigated for their nutritional values such as chemical compositions, amino acid profiles, fermentability and in vitro digestibility. Anti nutritional and toxic compounds are also determined. It was found that chemical compositions and amino acid profiles of the Jatropha meal vary according to the origin of Jatropha. The jatropha meal from Lampung had the highest CP (% DM) content (42.58%) compared with jatropha meal from another region (Kebumen 37.93%, Lombok 32.94%). The CP (%Solid Non Fat) content of jatropha meal from Lampung (58.59%) was higher than CP content of soybean meal (50.71%). The jatropha meal from three different regions in Indonesia showed a significant difference ($p<0.01$) in IVDMD and IVOMD, which is the jatropha meal from Lampung (60.23%) and Kebumen (60.73%) was higher than from Lombok (49.8%). Toxic and anti-nutritianal factors that studied in this reseorch are curcin, phorbolester and phytate. The phytate and curcin level was highest in jatropha meal from Lampung. But the level of phorbolester was not detectable in this meal. The contents of toxic and anti-nutritional factors did not affect on digestibility and ruminal fermentation products.

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Introduction

Jatropha curcas L. is known as a prospective renewable energy source which to be developed in Indonesia. *Jatropha curcas* represent annual crop which hold up dryness so that able to grow and expand better in marginal land as in region of East Indonesia (Hambali, 2006).

The oil from the kernels of *Jatropha curcas* came through processing phase. Jatropha seed extraction can be conducted by using simple expeller machine. Jatropha meal is the residue from seed processing. The extraction will obtained 30-40% oil and 60% jatropha meal. The residue in the form of jatropha meal has potential as animal feed. However, due to the toxicity further research need to be conducted to have the basic information from jatropha meal.

The objective of this research were to get the basic information of jatropha meal include the information of the nutrition, anti nutrition and toxic factors which is the main constraint of *Jatropha curcas*, and to study the characteristics of jatropha meal as animal feed especially for ruminant.

Materials and Methods

Sample Preparation

The jatropha seeds used were from three different regions from Indonesia (Lampung, Kebumen and Lombok). The seed were dehulled, dried and ground manually. The kernel was defatted using manual hydraulic press machine. The defatted and ground kernel is referred to as the meal and used for next analysis. Soybean meal was used for some analysis as comparison.

Chemical Analysis

Chemical compositions of jatropha meal were determined according to AOAC (1980) procedure. The amino acids analysis was conducted using HPLC, while the gross energy was measured using Bomb Calorimeter. The concentration of phorbolester of jatropha meal was carried out by de procedures describes by Makkar *et al.* (1997), while lectin/cursin was carried out by heamagglutination assay (Aregheore *et al.* 1998). The concentration of phytate was determined using spectrophotometry procedure.

In Vitro Digestibility

The *in vitro* dry matter and organic matter digestibility were determined using the two-step method according to Tilley and Terry (1963).

Gas Production

Gas production of jatropha meal was measured using Hohenheim Gas Method (Close and Menke, 1986). Samples (230 mg) were put in shyring glasses and then added 30 ml suspension of rumen fluid and McDougall buffer. The samples were incubated in water bath at 39°C for 0, 4, 8, 12, 16, 20 and 24 hours. Gas production can be calculated using the formula:

Gas production (ml/200mg DM, 24h) = [(Gb24-Gb0)*200]/DM samples

where:

Gb 0 = gas production 0 hour
Gb 24 = gas production 24 hour
DM = dry matter

NH_3 Concentration and VFA Total Production Analysis

The analysis of ammonia concentration conducted with Conway Microdiffusion method and VFA total production analysis conducted with Steam Distillation technique (General Laboratory Procedure, 1966).

Statistical Analysis

The data were subjected to analysis of variances using the general linear model procedure of the SPSS package program. The differences between means were tested using the Duncan's Test.

Results and Discussion

Nutritional Composition

The nutritional composition and gross energy of jatropha meal are shown in Table 1. There was some variation in the contents of lipid, crude protein, crude fiber and gross energy. Generally the nutritional composition (%DM) of jatropha meals in this study was relatively higher than the soybean meal, except for the crude protein content.

However, if the crude protein content was calculated in percentage from Solid Non Fat (% SNF), the crude protein content of jatropha meal was higher than soybean meal.

Table 1. Chemical composition of jatropha meal from three different origins in Indonesia

Compositions	Origin			Soybean meal
	Lampung	Kebumen	Lombok	
Dry Matter (%)	93.19	93.24	94.10	89.51
Ash (% DM)	7.31	7.01	6.78	6.33
Lipid (% DM)	20.52	22.38	29.62	2.45
Crude Protein (% DM)	42.58	37.93	32.94	44.15
Crude Protein (% SNF)	58.59	53.53	51.09	50.71
Crude Fiber (% DM)	13.82	12.97	6.58	3.20
Gross Energy (cal/g)	5062	4713	4915	-

Amino acid composition

The amino acid composition of jatropha meal is shown in Table 2. The amino acid content of jatropha meal from three different regions was similar. A comparison between the amino acid composition of jatropha meal and soybean meal reveal a different pattern for all essential and non-essential amino acids, except methionine and arginine. The level of this amino acid was higher in the jatropha meal.

Toxic and Anti-nutritional factors

Toxic and anti-nutritional factors are the main constraint of utilization of jatropha meal as animal feed. Cursin is a toxic protein compound of jatropha. However, recent report showed that cursin is not major toxic principle in *Jatropha curcus* meal (Aderibigbe *et al.* 1997). The toxicity of cursin can be reduced by heat treatment. The level of cursin of jatropha from three regions varied from 0.67 – 0.72%.

Porpholester is a major toxic of *Jatropha curcas* (Makkar and Becker, 1997). The phorbolester was found in high level in the sample from Lombok. Generally, the phorbolester content of jatropha from Indonesia was relatively lower (0.99 – 1.33 mg/g) than toxic varieties from Cape Verde, Nicaragua, and Nigeria (more than 2 mg/g sample) (Makkar *et al.*, 1998).

Phytate is the anti-nutritional factor that being observed in this research. Hyatt level have been implicated in decreasing protein digestibility by forming complexes and also by interacting with enzymes such as try sin and pepsin (Reddy and Pierson, 1994). The hydrate level in jatropha meal was high (6.65%-7.39%), these values

are much higher that of soybean meal (Table 3). The highest phytate level was found in the sample from Lampung.

Table 2. Amino acid composition of jatropha meal from three different origins in Indonesia

Amino Acids (%)	Origin			Soybean meal
	Lampung	Kebumen	Lombok	
Essential				
Methionine	0.18	0.44	0.29	0.37
Lysine	1.04	1.19	1.11	2.22
Valine	1.30	1.56	1.44	1.91
Isoleusine	1.12	1.33	1.24	1.86
Leusine	1.94	2.33	2.21	2.99
Tyrosine	0.78	1.02	0.91	1.45
Phenilalanine	1.31	1.53	1.44	1.97
Histidine	0.72	0.84	0.78	0.96
Threonine	1.03	1.24	1.12	1.53
Non-essential				
Aspartic acid	2.93	3.54	3.16	4.92
Serine	1.42	1.75	1.59	2.08
Glutamic acid	5.46	6.77	6.07	9.22
Glycine	1.23	1.50	1.41	1.57
Alanine	1.39	1.66	1.58	1.74
Arginine	3.57	4.39	4.07	3.04
Total amino acids	25.42	31.09	28.42	37.83

Table 3. Toxic and anti-nutritional factors of jatropha meal from three different origins in Indonesia

Toxic and Anti-Nutrition	Origin			Soybean meal
	Lampung	Kebumen	Lombok	
Curcin (%)	0.72	0.70	0.67	-
Phorbolester (mg/g seed	Nd	0.99	1.33	-
Phytate (%)	7.39	6.65	7.00	-

Digestibility

The *in vitro* dry matter and organic matter digestibility (IVDMD and IVOMD) is shown in Table 4. There was significant differences ($p<0.01$) in the IVDMD and IVOMD of jatropha meal from different regions. The digestibility of jatropha meal from Lampung and Kebumen was significantly higher than from Lombok. The digestibility of jatropha meal was also similar with soybean meal.

Table 4. DMIVD and OMIVD of jatropha meal from three different origins in Indonesia

Digestibility	Origin			Soybean meal
	Lampung	Kebumen	Lombok	
IVDMD (%)	60.23±3.90[a]	60.73±4.89[a]	49.48±5.96[b]	63.54±4.38
IVOMD (%)	59.63±2.93[a]	60.82±3.63[a]	48.57±5.35[b]	63.64±4.61

[a] *The different superscript in the same rows showed a significant differences ($p<0.01$)*

Gas Production

The ruminal fermentation of carbohydrates, proteins and lipids will produce gas. The gas production measurement is to estimate digestion process in the rumen. The fermentable feed will be degraded faster and produced higher gas. Jatropha meal from Lampung showed the highest gas production. The highest increase is presented at the 0-8-h of incubation (Figure 1).

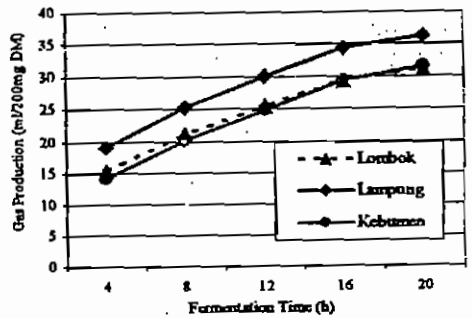

Figure 1. Ruminal gas production of jatropha meal

Ammonia and VFA's concentration

Ammonia is the main nitrogen source of the amino acid synthesis for rumen microbes. Those metabolism process reveal that protein for ruminants is depend on the rumen protein synthesis process. The product of protein hydrolysis was degraded to produce the ammonia. VFA's is the main product from the carbohydrate fermentation in ruminants. Polysaccharide is being hydrolyze to get the monosaccharide and then to get the volatile fatty acids, CO_2 and H_2.

The ammonia concentration and VFA total production is shown in Table 5. The mean of ammonia concentration and VFA total

production showed non-significant differences. It reveals that the anti-nutritional and toxic of jatropha meal did not affect the microbes' activity in fermentation of carbohydrates and proteins.

Table 5. Ammonia and total VFA's concentration of jatropha meal from three different origins in Indonesia

Concentration	Origin			Soybean meal
	Lampung	Kebumen	Lombok	
Ammonia (mM)	14.58±4.99	15.70±4.64	11.24±1.84	12.65±9.50
VFA (mM)	131.39±8.34	147.56±25.15	148.02±12.63	159.42±6.77

Conclusions

The physical and chemical characteristics of jatropha meal in this research showed some variation. It can be concluded from this research that the contents of toxic and anti-nutritional factors did not affect on digestibility and ruminal fermentation products. Nevertheless, it can't be concluded that the jatropha meal is safe to be given as animal feed.

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