Analysis of the Kinetics Fermentability, Degradability, and Nutritive Value of Soybean Groats and Lemuru Fish Oil Protected by *in-Vitro*

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Abstract

Objective of the research was to compare kinetics fermentability, degradability and nutritive value of protected soybean groats and lemuru fish oil using in-vitro study. Soybean groats were protected using formaldehyde whereas the lemuru fish oil was protected by Ca-salt. The protected soybean groats and lemuru fish oil were given as supplements of 5% and 10% of cattle's dry matter ration, respectively. The experiment was conducted in the cow house experiment, the Laboratory of Biochemistry Faculty of Gadjah Mada University and the Laboratory of Nutrition and Animal Feed Faculty of Agriculture, Animal Husbandry Department, Sebelas Maret University. Fermentability and degradability of the rations were observed at 0, 3, 6, 9, 12 hours after incubation in the rumen fluids. The collected data were analyzed to calculate their mean and standard deviation, and mentioned descriptively. Results of the research showed that the kinetics of pH, VFA, NH3 and the production of ruminal microbes of soybean groats share the same pattern. Protected lemuru fish oil indicated higher kinetics in pH, VFA and microbial protein production, but lower for NH3 results. The protected soybean groats have a higher dry matter consumption compared to that of lemuru fish oil, but its organic matter and crude protein digestibility is lower. It was concluded that suplementation of protected soybean groats and lemuru fish oil gave similar kinetics fermentation, rumen degradability as well as nutritional values to the cattle rations therefore could be used as PUFA feed additive sources in cattle ration.

Keywords: degradability, fermentability, lemuru fish oil, protection, soybean groats

Introduction

Implementation of productivity improvement method of beef cattle through the use of Poly Unsaturated Fatty Acid (PUFA) fodder source material is very important

to take note of these days. Unsaturated fatty acids can improve the function of the corpus luteum (Mattos *et al*., 2000), ovarian follicle (De Fries, 1998). Beef cattle on feedlot fed with protected PUFA fodder source material that contain vegetable and animal oils produced beef with high linoleic acid content (Gillis *et al*., 2004), and with improved quality of beef (Scollan *et al.*, 2001 and Riyanto *et al*., 2011). PUFA source material can be derived from animals and vegetables. Both linoleic and linolenic acids in the form of Saturated Fatty Acid (SFA) in the rumen escape the process of biodehydrogenase (Lourenc *et al*., 2010). The fat consumed by cattle beef will be hydrolyzed by microorganisms in the rumen and attached to feed particles and microbial fermentation in the rumen thereby disrupting the structural carbohydrates (Bauman *et al*., 2003). To extract post-ruminal PUFA, protective treatment is needed. Soybean protection is conducted using, among others, non-enzimatic microwave irradiation (Nobar, 2011), and formaldehyde (Madsen, 1982). The current research is conducted to evaluate the fermentability and degradability kinetics of basal ration (fermented straw and basal concentrate) with protected PUFA fodder source material of lemuru fish oil and soy groats

Materials and Methods

The research is conducted at Laboratory of Nutrition and Feed Animal Science Department of Agriculture Faculty of Sebelas Maret University, Laboratory of Biochemistry and Chemistry of Pusat Antar Universitas of Gadjah Mada University, and at the Laboratory of Biochemistry, Faculty of Animal Science of Gadjah Mada University.

Two ruminally fistulated Ongole breed cattle were employed in this study as the ruminal fluid donors. Both of them were fed with fermented straw (40%) and concentrate (60%). The latter is composed of a mixture of basal concentrate, soy groats, and protected lemuru fish oil. The lemuru fish oil protection method refers to that of Cabatit (1979) cit Widiyanto (2008), that is, by saponification using KOH and $CaCl_2$. Soy groat protection method is conducted in accordance with that of Widyobroto *et al*., (1999), that is, by spraying 37% formaldehyde that constitutes 2 percent of dry feeding material. Basal feed (control) contain 12.2% crude protein, 5.2% crude fat, 16.9% crude fiber, and 55.2% TDN.

The study parameters include ruminal pH, VFA (*Volatile Fatty Acids*) production, NH_3 concentration, microbial protein kinetics, consumption (dry materials, organic materials, and crude protein), and digestibility (dry materials, organic materials, and crude protein). Measurement of ration fermentability is conducted in specified time to determine the ruminal kintetics, 0, 3, 6, 9 and 12 h after feeding. The collected data were analyzed to calculate their mean and standard deviation, and mentioned descriptively.

Results and Discussion

The kinetics of ruminal fluid pH, NH_3 concentration, VFA total production, and microbial protein are illustrated in Figures 1 and 2 as the results of lemuru fish oil and protected soy bean groats supplementation in basal feed.

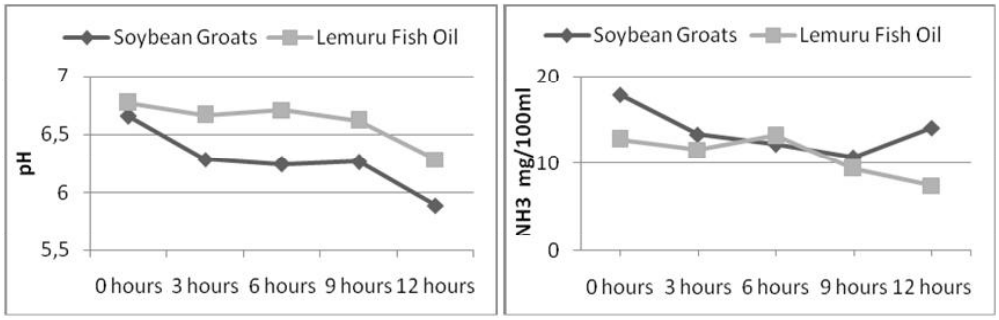

Figure 1. pH Kinetics and NH_3 Concentration

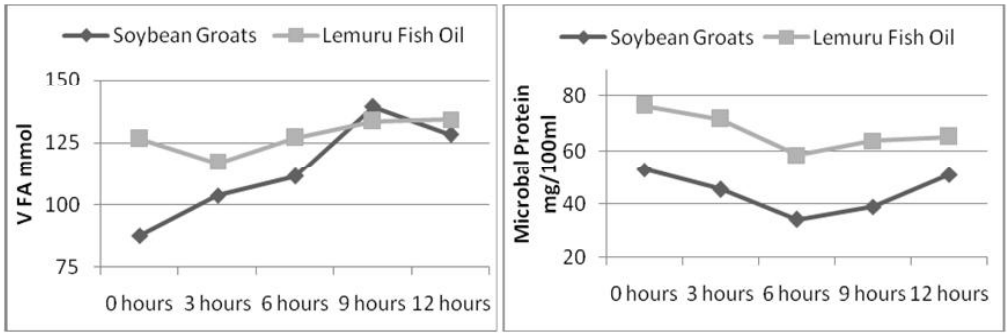

Figure 2. VFA Production and Microbial Protein

The pH kinetics of the protected soy groats is 6.26±0.24 (5.89-6.65) and of the protected lemuru fish oil is 6.60±0.17 (6.28-6.76) (Figure 1). The fluctuative pattern of pH decrease on SG and lemuru fish oil treatment as PUFA source fodder is related to its organic substance content. Ørskov (1992) higher non-fiber organic substance made the pH fluctuation in ruminal liquid possible. While the mean concentration of NH_3 of soy bean groats supplementation is 13.61±2.65(10.69-17.77) mg/100ml higher than that of NH_3 with lemuru fish oil supplementation 10.89±2.39 (7.51-13.17), both are still within the normal range (Figure 1). It is in accord with what Leng (1980) suggested that NH_3 concentration ranges from 1 to 34 mg/100ml, for maximum growth and activity of microbe the necessary NH_3 concentration ranges from 5.0 to 23.5 mg/100ml. VFA Concentration of lemuru fish oil 127.46±6.89 (116.83-133.96) mmol is higher than that of soy bean groats 114± 20.02 (88.21-139.01) mmol with similar kinetics pattern (Figure 2). The VFA ruminal fluid

kinetics, after reaching an optimum concentration, decreases irregularly. This is related to the absorption of VFA as an energy source through the rumen wall; the lower the ruminal pH, the higher the VFA absorption (Owens and Goestch,1988). Microbial protein production in diets supplemented with protected lemuru fish oil is 67.06±6.97 (58.53-76.37) mg/100ml, and the that supplemented with protected soy bean groats is 44.58±7.73 (34.50-52.80) mg/100ml (Figure 2). It is caused by the synchronization of the nitrogen source provision required by the microbes in the form of NH3 and VFA. Lemuru fish oil can provide a source of microbial protein precursor compilers more than soybean groats. According to Henning *et al*., (1993), the efficiency of microbial protein synthesis is influenced by the availability of all precursors in sufficient concentration in the ruminal fluid. The microbial protein compiler precursors are NH_3 as N-source, energy, carbon skeleton, mineral and other nutritional elements.

Consumption and digestibility of dry materials, organic materials and crude protein from protected soybean groats and lemuru fish oil obtained from this research are shown in Table 1. The protection carried out by coating the micro granules of vegetable oils containing unsaturated fatty acids using protected formaldehyde shown to increase the amount of unsaturated fatty acids deposited in the ruminant tissues (Scott and Ashes, 1993). This treatment prevents the process of unsaturated fatty acids biohydrogenase in the rumen and also increases the amount of feed intake. The efficacy of triglycerides or fatty acid added to ruminants' diets depends on their digestibility and their influence on the digestibility of other nutrients in the diet. Because energy intake results from dietary energy concentration and intake of dry matter (DM), the influence of the supplemental fat on food consumption also has to be taken into account (Voigt, dkk., 2006). Organic material consumption in the forms of protected soybean groats and lemuru fish oil is in accord with the dry material

Table 1. Intake and degradibility parameter of protected supplemented soybean groats and lemuru fish oil

Parameters	Soybean groats protected	Lemuru fish oil protected
Intake :		
Dry matter (g/d)	6260.85±103.50	5965.87±1613.93
Organic matter (g/d)	5550.24±81.84	5569.29±1501.58
Crude protein (g/d)	896.05±24.43	770.00±219.82
Degradibility :		
Dry matter (%)	59.28±3.80	54.00±15.55
Organic matter (%)	65.01±3.29	71.8±711.22
Crude protein (%)	66.59±11.03	80.48±6.63

consumption. Consumption of organic material is closely related to the consumption of dry matter; the more consumption of dry matter, the more consumption of organic material (Van Soest, 1994). The increasing amount of ruminel microbes allows them to work more effectively to fermentatively degrade the components of crude fibers, and thereby increasing the dry matter digestibility of the consumed feed.

Higher digestibility of protein compared to that of dry matter and organic matter account for the availability of nutrients in cow diets. This means that the provision of rations with a high fat content did not affect the protein, organic matter and dry matter digestibility. Mahadevan, dkk., (1983) the rates of in vivo ammonia appearance and in vitro proteolysis were highly correlated (r--0.966, $P<0.01$) between 1130 h and 1200 h. These rates of rumen ammonia appearance reflected the in vivo rate of proteolysis. Both bacterial and protozoa protein content decreased significantly at the higher levels of formaldehyde treatment

Conclusions

It was concluded that suplementation of protected soybean groats and lemuru fish oil gave similar kinetics fermentation, rumen degradability as well as nutritional values to the cattle rations therefore could be used as PUFA feed additive sources in cattle ration

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