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Effects of replacing soybean meal with dried rumen digesta on feed intake, digestibility of nutrients, rumen fermentation and nitrogen use efficiency in Thai cattle fed on rice straw

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ABSTRACT

This study assessed the feed intake, nutrient intake, apparent digestibility of nutrient, rumen fermentation and nitrogen utilization of beef cattle fed with different soybean meal (SBM) replacement levels with dried rumen digesta (DRD) at 0, 33, 67 and 100%. Four 1.5-year-old Thai native beef cattle steers with initial body weight (BW ± SD) of 92.1 ± 4.59 kg were used in a 4 × 4 Latin square design. All animals were fed rice straw *ad libitum* while additional concentrate was fed at 0.5% BW daily. Replacement of DRD for SBM were not altered ($P > 0.05$) on total DM intake while the intake of rice straw of the 100% DRD diet was higher than that of the other diets, and it significantly increased with increase in the replacement level of SBM with DRD ($P < 0.05$). Intakes of organic matter (OM), crude protein (CP), neutral detergent fiber (aNDF) and acid detergent fiber (ADF), digestible organic matter intake, digestible organic matter fermented in the rumen and metabolizable energy showed no difference when compared to those on the control diet ($P > 0.05$). The experimental diets has no effect ($P > 0.05$) on the apparent digestibilities of DM, OM, CP and ADF while aNDF digestibility increased with an increase of DRD in the diet and was highest when inclusion of 100% DRD. No differences ($P > 0.05$) were found in ammonia nitrogen concentration, total volatile fatty acid (VFA) and VFAs profiles in the rumen fluid of cattle fed with DRD when compared to those on control diet. Similarly, N use efficiencies were not altered with level of DRD in the diet. Based on this study, it could be concluded that replacement of SBM by DRD as feed ingredient in cattle diets up to 100% dietary level resulted in improved rice straw intake and aNDF digestibility in beef cattle, without affecting the rumen fermentation or nitrogen use efficiency.

1. Introduction

Soybean meal (SBM) has long been considered the best source of supplemental protein in concentrate diets because of its high protein content and great amino acid profile

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(Kondo et al., 2004; ørskov, 2007; Campos et al., 2014). The increasing price of SBM, alternative protein sources are required to replace SBM in animal diets for sustainable animal production (Südekuma et al., 2004; Tudisco et al., 2010; Rufino et al., 2013; Calabrò et al., 2014).

One of such is from slaughterhouse namely dried rumen digesta (DRD), a potential alternative protein source from the rumen of ruminant animals (Adeniji and Balogun, 2002; Dairo et al., 2005). DRD is consisted of fermented and non-fermented of dietary feeds at various stages of digestion in the rumen. Tonnes of DRD produced are wasted and constitute serious environmental contaminant in most abattoirs of many developing countries. FAOSTAT (2012) reported that the slaughterhouse in Thailand was generated DRD at 41,000 t of DM/year from 1.2 million of ruminant animals. Therefore, conversion of these wastes into ruminant feed will increase the flexibility of ration formulation and reduce environmental pollution (ørskov, 2002, 2007).

The DRD contains 19.4% crude protein (CP) and 42.2% neutral detergent fiber (NDF) (Cherdthong and Wanapat, 2013a). Furthermore, it is consisted of the end products of microbes metabolic activities such as microbial protein, amino acids, vitamins, volatile fatty acids (VFA) and contains no anti-physiological factors (Okpanachi et al., 2010), which beneficially affects in the rumen and also enhancing the potential for ruminal microbial activity. Recent studies have shown that replacing SBM by DRD to animal diet improve feed utilization and reducing feed cost in fish (Agbabiaka et al., 2011a, 2011b), poultry (Adeniji and Balogun, 2002; Esonu et al., 2006; Esonu et al., 2011), and rabbit (Dairo et al., 2005; Okpanachi et al., 2010; Mohammed et al., 2011, 2013). Our previous work has demonstrated that supplementation of DRD at 8 mg in the rations resulted in improved *in vitro* kinetics gas, rumen fermentation and digestibility in rumen fluid of buffalo (Cherdthong and Wanapat, 2013a). Therefore, this study was undertaken to evaluate the effect of replacing SBM with DRD on feed intake, digestibility of nutrients and N use utilization in Thai native beef cattle fed on rice straw.

2. Materials and methods

2.1. Diet preparation

Fresh rumen digesta obtained from local slaughterhouse at Bann Kok, Khon Kaen Province, Thailand; and sundried for 2 days, then ground to pass a 1 cm sieve (Cyclotech Mill, Tecator, Sweden). The diets consisted of four concentrate replacement levels of SBM by DRD, 0, 33, 67 and 100% on DM basis. The diets were formulated to meet beef cattle requirements according to the National Research Council (NRC), (2001). Rice straw, a single-crop variety of *Oryza sativa indica*, was used as roughage source. The proportions of concentrate ingredients and the chemical composition of the concentrates, DRD and rice straw are shown in Table 1.

2.2. Animals, feed and management

Four 1.5-year-old Thai native beef cattle steers with initial BW of 92.1 ± 4.59 kg were randomly allocated to one at four levels of DRD in concentrate mixture (Table 1) in a 4×4 Latin square design experiment. All animals were fed un chopped-rice straw *ad libitum* while additional concentrate was fed at 0.5% BW daily and offered in two equal meals per day at 7:00 and 16:00 hours. The cattle were kept in individual pens, where water and mineral blocks were provided freely. The experiment was conducted for 4 periods, lasting 21 days per each. The first 14 days were an adaptation period and last 7 days animals were moved to metabolism crates for fecal and urine collection and fed the straw at 90% DM of the previ ous voluntary feed intake of straw. Concentrate was still

Table 1
Ingredient and chemical composition of concentrates, dried rumen digesta (DRD) and rice straw used in the experiment (%DM).

Ingredients	Replacement levels (DRD replacing SBM, %DM)				DRD	Rice straw
	0	33	67	100		
Cassava chips	55.6	55.6	55.6	55.6		
Soybean meal (SBM)	11.0	7.4	3.6	0.0		
DRD	0.0	3.7	7.4	11.1		
Rice bran	10.5	10.3	10.2	10.1		
Coconut meal	8.9	8.9	8.9	8.6		
Palm kernel meal	7.3	7.1	7.0	7.0		
Urea	1.0	1.3	1.6	1.9		
Salt	1.0	1.0	1.0	1.0		
Sulfur powder	1.0	1.0	1.0	1.0		
Mineral and vitamins[a]	1.0	1.0	1.0	1.0		
Molasses	2.7	2.7	2.7	2.7		
Chemical composition						
Dry matter (%)	96.5	95.4	95.4	94.2	98.4	95.4
Organic matter (%DM)	93.3	92.1	91.0	90.6	91.3	86.3
Ash (%DM)	6.7	8.9	8.0	9.4	8.7	13.4
aNeutral detergent fiber (%DM)	18.7	20.2	22.4	24.2	40.5	77.0
Acid detergent fiber (%DM)	6.9	8.7	11.4	13.1	20.1	57.1
Crude protein (%DM)	13.1	13.3	13.2	13.4	19.6	2.3

[a] Minerals and vitamins (each kg contains): Vitamin A: 10,000,000 IU; Vitamin E: 70,000 IU; Vitamin D: 1,600,000 IU; Fe: 50 g; Zn: 40 g; Mn: 40 g; Co: 0.1 g; Cu: 10 g; Se: 0.1 g; I: 0.5 g.