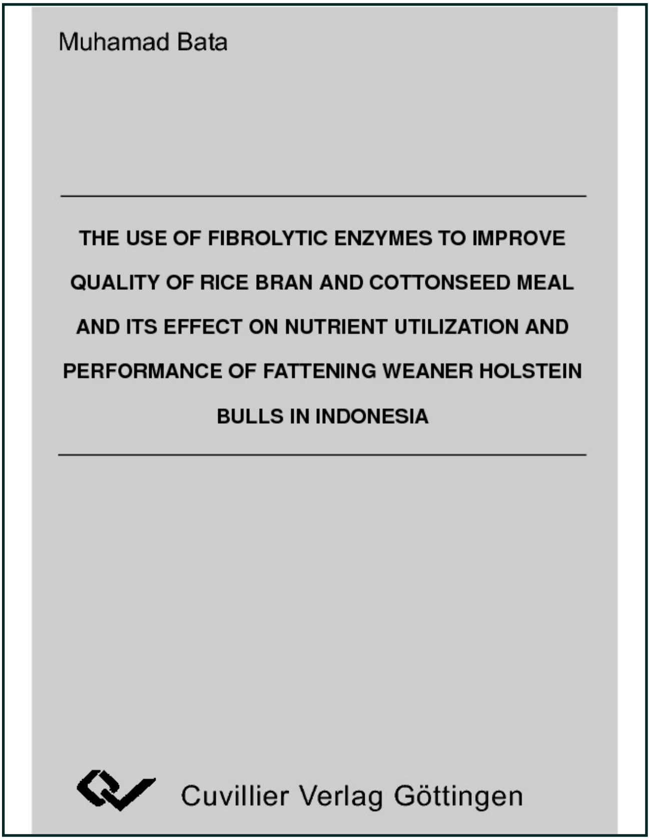
Muhamad Bata (Autor)

The Use of Fibrolytic Enzymes to improve Quality of Rice Bran and Cottonseed Mael and its Effect on Nutrient Utilization and Performance of Fattening Weaner Holstein Bulls in Indonesia


Muhamad Bata

THE USE OF FIBROLYTIC ENZYMES TO IMPROVE QUALITY OF RICE BRAN AND COTTONSEED MEAL AND ITS EFFECT ON NUTRIENT UTILIZATION AND PERFORMANCE OF FATTENING WEANER HOLSTEIN BULLS IN INDONESIA

Cuvillier Verlag Göttingen

https://cuvillier.de/de/shop/publications/3012

I. INTRODUCTION

High ambient temperature and humidity together with low quality feedstuff leads to a conflict between production and adaptation for domestic animals in the tropics. Generally, endogenous breeds (local animals) have adapted to those conditions, but exotic breeds with high growth rate like the Holstein breed imported from temperate areas will have problems. High growth rate will cause an increased heat production, which it is difficult for the animals to dispose of. Therefore, the animals will reduce heat production by decreasing feed intake and finally, the growth rate will also decrease. To anticipate this phenomenon, Holstein weaner bulls in fattening regimes must be fed more concentrate to manipulate rumen fermentation to increase propionate and/or to decrease acetate production and thereby reduce heat production and prevent heat stress.

Farmers in Indonesia use rice bran (RB) and cottonseed meal (CSM) in ruminant diets as energy and protein sources, respectively. Their high crude fibre content limits utilisation of these feedstuffs. Their fermentation in the rumen of feeds with high crude fibre content leads to a predominance of acetate production. Efficiency of utilisation of metabolizable energy (ME) from acetate is lower compared to propionate or butyrate (AMSTRONG and BLAXTER, 1957). Utilisation of acetate for fat synthesis requires an adequate supply of NADPH (AMSTRONG, 1965). NADPH will be more readily available if ample supplies of absorbed amino acids or glucose are present (ANNISON and BRYDEN, 1999). Improving feed quality especially concentrate by reducing crude fibre or optimalization of rumen condition is one alternative to overcome this problem.

Utilisation of specific fibrolytic enzymes to treat these by-products for ruminant animals is a newer technique for improving the feeding value of high fibre concentrates (BEAUCHEMIN *et al.*, 1997). Generally, enzyme treatment have been extensively used in diets for monogastrics but positive effects of adding exogenous fibrolytic enzymes added to ruminant diets have also recently been reported. Enzyme additives have been shown to enhance colonization of feed by ruminal microorganisms and increase the rate of degradation in the rumen (HRISTOV *et al.*, 1998 and MORGAVI *et al.*, 2000) and to survive passage to the duodenum, suggesting that exogenous enzymes may function ruminally and postruminally. Addition of fibrolytic enzyme mixtures to forage diet has led to improved live weight gain in cattle by as much as 35 percent and feed conversion ratio by up to 10% (BEAUCHEMIN *et al*., 1995). While addition of fibrolytic enzymes to concentrates in lactating dairy cows has led to increased nutrient digestibility and milk production (RODE *et al*., 1999). Enzyme mixtures may also be beneficial in high concentrate diets and may help to overcome the depression in fiber digestion that occurs when using high concentrate diets (BOYLES *et al.,* 1992; HUNT *et al*., 1996; BEAUCHEMIN *et al*., 1997; KRAUSE *et al*., 1998). Factors such as substrate specificity, moisture level of the feed, time required for enzymes to interact with the substrate, pH, and temperature of the feed during treatment are important factors in determining efficiency of enzyme use.

There is currently no information on the use of these fibrolytic enzymes to treat rice bran and cottonseed meal for ruminant diets. The objectives of this study were to evaluate the effect of CelluPract AS 100® enzyme treatment of rice bran and cottonseed meal on efficiency of diet use and growth performance of Holstein weaner bulls in Indonesia

2. LITERATURE REVIEW

2.1. Characteristics of cottonseed meal and rice bran as animal feed

2.1.1. Cottonseed as protein source

Kapok plant or kapok (Ceiba pentandra) is a tropical plant that can easy grow anywhere (SETIADI, 1983) and the main product of this plant is fibre (SIHOMBING and SIMAMORA, 1979). According to data of BPS (1988), the kapok production in 1987 reached 50.000 ton from a planted area of 397.300 ha. Every kapok plant produced in average in Indonesia 4000 – 5000 fruits or 125 kg of seed per year with an oil content of 25–30% (SIHOMBING and SIMAMORA, 1979).

Kapok seed or whole cottonseed or klenteng (javanese language) is one by-product from fibre of cotton. When oil is extracted from the whole cottonseeds, cottonseed meal, another by-product, is produced (CLOSE and MENKE, 1986). Cottonseed oil can be extracted by using a solvent or a mechanical process. Those processes have effect to quality of cottonseed meal. For example, the high temperature-high pressure method may result in lower digestibility and in denaturation of the protein. This does not occur to the same extent with solvent extraction (CLOSE and MENKE, 1986).

Cottonseed meal is an excellent source of protein, energy and fibre for dairy cattle (LANE and STUART, 1990) and this product contains 40 to 50 % crude protein (LINDSEY, 1980). Whole cottonseed meal and cottonseed meal is important as protein sources for ruminants. However, they contain the toxic polyphenolic pigment gossypol, which adversely affects liver function, erythrocyte oxygen-carrying or releasing capacity, respiration rate, feed intake and production and reproductive capacity (LINDSEY *et al.*, 1980; CALHOUN *et al.*, 1990 and GRAY *et al.*, 1990). Generally, plasma haemoglobin concentrations decrease. Skeletal and cardiac muscles are affected and liver function is reduced especially if gossypol is fed for an extended time (LANE and STUART, 1990). Gossypol also has an inhibitory effect upon the digestive enzymes (CLOSE and MENKE, 1986).

The concentration of free gossypol in cottonseed meal is influenced by method of oil extraction (RANDEL *et al.,* 1992). Methods of oil extraction currently in use are screw pressing, pre-pressed solvent extraction and direct solvent extraction (GOETSCH and OWENS, 1995). High temperatures and pressures favour the formation of stable bonds between gossypol and other molecules. This „ bound gossypol" is generally considered to be physiologically inactive (RANDEL *et al.,* 1992) but this leads to denaturation of the protein and lowering its nutritive value (CLOSE and MENKE, 1986). LINDSEY *et al.* (1980) showed that gossypol intoxication could occur in adult Holstein cows that were fed diets high in CSM.

Compared to Soybean meal (SBM), cottonseed meal (CSM) has slightly lower CP and NEL values, but much higher ADF (19 VS 10 %) and lignin (6 VS 1 %). The fibre in CSM is major detractant for simple stomached species, but not for ruminants (COPPOCK and WILKS, 1993). The NRC (1989) gives 65 and 57 % for protein degradability of SBM and CSM. As noted for whole cottonseed meal (WCS), heat reduces ruminal degradation of CSM (BRODERICK and CRAIG, 1980) and increases the delivery of amino acids to the small intestine from these feeds (COPPOCK and WILKS, 1993). There is a wide range in the degradation of commercial samples of CSM. Thus, it is difficult to use protein degradability successfully in routine diet formulation (COPPOCK and WILKS, 1993).

The most negative side effect of using cottonseed as fed is reproduction problems. For fattening Brahman cross breeds in Indonesia, SOEPRAPTO (1998) reported that 21% cottonseed meal in a diet with a Napier grass to concentrate DM ratio of 30 : 70 did not significantly reduce ADG, although it tended to be lower than with a level of 14%. FERNANDEZ *et al*. (1980) reported that steers fed sugar cane and molasses supplemented with 750 g cottonseed meal per day (11% DM intake) had about 100 % higher live weight gain as the control (without cottonseed meal supplementation).

2.1.2. Rice bran

The two main by-products obtained from rice milling are the hulls and rice meal. The hulls are high in fibre content and can contain up to 210 g /kg DM of silica. They have also sharp edges, which may irritate the intestine, and should never be given to animals.