Effects of bean husk feeding on gastro-intestinal fermentation and microbiota of rats

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1. Introduction

Bean husks, rich in fiber, can be considered as feed material for various animals. Lablab bean (*Dolichos lablab*) and chickpea (*Cicer arietinum*) husks were found to increase digestibility of rice straw diet by stimulating specific rumen bacteria in sheep (Tin *et al.*, 2012; Fuma *et al.*, 2012). Lablab bean husk containing oligosaccharides was also found to stimulate beneficial intestinal bacteria (lactobacilli and bifidobacteria) in pure culture study (unpublished). Other bean husks might have a similar potential. In the present study, feeding experiments were conducted to evaluate functions of three different bean husks in intestinal fermentation and microbiota of rats. Such research may contribute to future application of bean husks to mono-gastric animals including dogs, cats and even humans.

2. Materials and Methods

Two experiments were carried out using 5-week-old 20 rats (Exp. 1) and 15 rats (Exp. 2), respectively. In Exp.1, rats were equally divided into 4 groups and fed either of the following diets for 3 weeks: purified diet (AIN93G) containing 5% cellulose (Cellulose), same diet in which cellulose was replaced by corn starch (Starch), lablab bean husk (Lab) or soybean husk (Soy). In Exp.2, rats were equally divided into 3 groups and fed either Cellulose, Starch or the purified diet in which cellulose was similarly replaced by chickpea husk (Chick). Feed intake and body weight were measured daily and weekly, respectively. Rats were sacrificed at 8 week of age to take blood and digesta samples and then weights of organ and digesta were recorded. Glucose and cholesterol were analysed in the blood plasma. The pH, fermentation products (short chain fatty acid, lactate, succinate, ammonia, indole and skatole) and microbes were monitored in ileal and cecal digesta. Microbiota was characterized by PCR/ DGGE and real-time PCR.

3. Results and Discussion

In Exp.1, feed intake, body and organ weights, blood components, cecal ammonia and succinate were not different among diets. Cellulose, Soy and Lab, especially Lab, lowered cecal indole and skatole levels. Rats on Lab and Soy showed higher concentrations of cecal short chain fatty acid and lactate than those on Cellulose, accompanying with lower pH. Ileal bacteria were occupied by lactobacilli and not greatly affected by diet. However, changes with diet in cecal microbiota were apparent by different DGGE banding patterns and higher abundance of lactobacilli in rats fed husks especially Soy. The abundance of *Akkermansia muciniphilus* was higher in Lab. In Exp.2, no apparent change with Chick was observed in parameters except the followings. Chick lowered total cholesterol level in the blood, cecal pH, indole and skatole, while increased cecal butyrate level with alteration of cecal microbiota determined by DGGE. All 3 bean husks are equally effective for lowering harmful fermentation products (indole and skatole). Lab and Soy are more favorable in stimulating beneficial cecal bacteria (*Akkermansia* and lactobacilli, respectively). Only Chick is indicative of blood cholesterol–lowering action. Based on these, bean husks tested in the present study are considered to be a functional feed for promoting the health of monogastric animals.