Use of Bacillus Subtilis Var. Natto in Production of Fermented Animal Feed

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ABSTRACT

Soybean meal contains rich proteins and is considered as the most economically beneficial feeds for animals, but its anti-nutritional ingredients make its nutrition value and application vulnerable to limitation. On the other hand, the prohibition of antibiotics supplementation in the animal feeds by European Union countries have impacted the operation of animal farmers and feed producers. Bacillus subtilis var. natto (B. natto) bacteria can enhance the immunity of livestock and exhibits probiotic effects. It can secrete many kinds of hydrolytic enzymes with powerful fermentation abilities and is the best alternative for substituting antibiotics in the feeds. However, the price of B. natto probiotics on the market is substantially high and cannot be extensively used in animal feeds. However, if B. natto is directly used for fermentation of soybean meal, it can both increase its nutritional value by degrading its antinutitional factors and hydrolyzing other ingredients, and let fermented soybean contain a large number of B. natto spores with probiotic benefits and low feeding cost. The study applied solid-state fermentation method to fermentation of soybean meal by direct use of B. natto powder for production of fermented feeds, able to efficiently raise the number of B. natto spores in the feed. Direct inoculation of 0.1% commercial B. natto spore powder in the fermentation resulted in 109 CFU/g of spores formed in fermented feeds after 24 hours fermentation. The higher ratio of water to soybean meal led to the more growth of vegetative cells and more formation of ammonium nitrogen in fermentation of soybean meal by B. natto. Fermentation at higher temperature shortened the lag phase of cellular growth and therefore fastened cellular growth, but resulting in less formation of spores. Stirring of soybean meal during solid-state fermentation might create an environment for maintaining appropriate humidity and aeration and thus helped growth of B. natto but not formation of spores. Fermentation of sterilized soybean meal produced less ammonium nitrogen and also less spore formation. Addition of wheat bran as supplement in soybean meal during fermentation did enhance growth of cell and formation of spores but in turn increase production of ammonium nitrogen. Spiking of corn meal could increase the vegetative cell number but not significantly help formation of spores in the harvested product. Fermentation of soybean meal under room temperatures with 0.8 water ratio took only 20 hours to produce 3 × 108 CFU/g of B. natto spores with a few amount of ammonia nitrogen (0.05%) in fermented soybean meal. And when a 0.6 water ratio was used, it took 28 hours to obtain 3 x 108 CFU/g of B. natto spores with a few amount of ammonia nitrogen (0.02%), and even only took 32 hours to have 109 CFU/g of B. natto spores with a low amount of ammonium nitrogen (0.03%) in fermented soybean meal. To the operation of ordinary farmers and small entrepreneurs, fermentation of soybean meal by B. natto was best conducted at 37 ° C with a water / meal ratio of 0.6, capable of yielding a spore number reaching 109 CFU per gram of fermented feeds with a low amount of ammonium nitrogen (0.06%) after 20 hours fermentation.

Keywords : solid-state fermentation ; soybean meal ; Bacillus subtilis var. natto ; spore ; ammonium nitrogen ; fermented feed

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