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Influence of Tannin on Phaseolus vulgaris Protein Digestibility and Quality

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Beans (Phaseolus vulgaris) are an important source of protein in many areas of the world. Poor digestibility and biological utilization of bean protein from cooked beans of the colored cultivars have been directly related to the tannin content of these beans (Elias et al., 1979). These investigators suggested that bean tannins and related polyphenols can react with proteins, decreasing protein digestibility and, therefore, protein quality.

Various methods of estimating protein nutritional quality are available, each method with its own advantages and disadvantages (Bodwell, 1977b). The Tetrahymena bioassay has received considerable attention in recent years. Compared to other biological assays, the Tetrahymena bioassay is simple, rapid, and inexpensive. The amino acid requirements of Tetrahymena are similar to those of the growing rat (Kidder and Dewey, 1951) and human beings (FAO/WHO, 1973). Tetrahymena assays have also been shown to correlate well with rat PER bioassay of commercial foods, r = 0.90 (Evancho et al., 1977), and of several commercial and experimental protein sources, r = 0.93 (Dryden et al., 1977).

This study has two objectives: (1) investigate the possibility of using an enzyme-Tetrahymena bioassay to evaluate the influence of tannin on bean protein quality and (2) study protein-complexing characteristics of isolated black bean tannin and the digestibility of tannin-complexed protein.

The enzyme-Tetrahymena thermophila bioassay can be used to evaluate the influence of tannin on protein digestibility and quality in beans. In vitro digestibility and t-PER were inversely related to tannin content.

Bioavailability of black bean globulin G_1, in the presence of black bean condensed tannin, was directly related to the in vitro digestibility of the protein. When a constant concentration of 6.25 mg/ml G_1 was mixed with 0 to 0.5 mg/ml bean tannin, in vitro digestibility correlated closely (r = 0.95) with Tetrahymena growth.

Black bean condensed tannin complexed readily with black bean globulin G_1 to form insoluble precipitates over a broad pH range from pH 2.0 to pH 8.0. Bean tannin-G_1 precipitates, at tannin to G_1 ratios of 0.55 or greater, were resistant to pepsin digestion at pH 2.0. Digestion of bean tannin-G_1 precipitates was 69% to 74% at pH 8.0, using a multi-enzyme system of trypsin, chymotrypsin and peptidase.

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Odor and Analysis of Geosmin and 2-Methylisoborneol in Processed Dry Beans

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Geosmin and 2-methylisoborneol (MIB) are microbial metabolites associated with the earthy, musty off-flavors in public water supplies, fish flesh, table beets and dry beans. The presence of part per billion (ppb) concentrations of contaminating volatile compounds in dry beans (Phaseolus vulgaris) can result in objectional off-flavors since the flavor of dry beans is bland. An accurate and precise method to analyze volatile flavor contaminants in dry beans has not been developed. The objectives of this research were to develop an analytical method to quantitate geosmin and MIB in processed dry beans and other food products at odor threshold concentrations, determine the odor threshold concentrations of geosmin and MIB in processed dry beans and distilled water, determine consumer acceptability and threshold concentrations of geosmin and MIB that impart an off-flavor to process dry beans and isolate and quantitate geosmin and MIB in off-flavor dry bean products.

Geosmin and MIB were synthesized by established methods. Gas chromatographic standard curves were prepared for geosmin and MIB using 1-undecanol and d-camphor, respectively, as internal standards. Recoveries of geosmin and MIB were determined in processed dry beans by simultaneous distillation and extraction (SDE) followed by quantitation by gas chromatography. Recoveries of geosmin and MIB averaged 91.4% $\pm$ 5.7% and 95.0% $\pm$ 4.4%, respectively.