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Structural and functional properties of three genotypes of common bean proteins (*Phaseolus vulgaris*)

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Introduction: Proteins are food ingredients with critical functional properties and participation in developing food products. So far, functional properties of several plant proteins such as pea, chickpea and lentil, groundnut, beach pea and bayberry have been investigated. Nowadays, there is an increasing demand for plant proteins because they are available and inexpensive. Legume proteins are important plant protein sources. However, except for soy, due to the inadequate information about their structural and functional properties, they do not have appropriate application as functional ingredients in food products. Beans are a great source of nutrients such as protein, carbohydrate, dietary fiber, minerals and vitamins. Based on the several research reports, different dry beans have 15-25% protein and they are the second group of legume seeds, after soy, cultivated throughout the world. As mentioned earlier, insufficient information about structure of legume proteins is the main reason why they are unexploited in food industry. Therefore, the goal of this research was to evaluate the functional properties of proteins from three types of common bean (Speckled Sugar, Red Mexican and Great Northern bean). We also have attempted to evaluate the structure-function relation of these three sources of bean proteins because it is known that there is a direct relation between chemical conformation and the function of a protein which must be considered in food processing.

Materials and methods: Protein of three types of common bean (Speckled Sugar, Red Mexican, and Great Northern) was extracted (pH 9, water flour 10:1). Afterwards, their physicochemical (including protein electrophoresis pattern, solubility, hydrophobicity), and functional properties (including emulsifying capacity, heat stability, gelation and foaming capacity) were evaluated to understand how bean protein structure influences its structure. Electrophoresis pattern was obtained based on 2 dimensions (pH and molecular weight). Protein solubility was evaluated by biuret method at pH range 3-9. ANS (8-anilino-1-naphthalenesulfonic acid) was used to measure surface hydrophobicity (pH 3-7).Emulsion samples (1% protein, 25% sunflower oil, pH 3-7) were produced, then emulsion capacity and emulsion heat stability (80°C for 30 min) were evaluated. Gelation of proteins was evaluated at protein concentration of 4-12% at different pH values (3-7). Foaming capacity (%) was measured as the difference between volume after and before whipping. Foam stability (%) was recorded during 90 minutes.

Results and Discussion: Results showed that all proteins were rich in Phaseolin. In fact, this fraction was the major building fraction of all three bean proteins. Evaluation of solubility indicated that isoelectric point of three proteins was located at acidic pH range (pH 4.5). Results confirmed an indirect relation between protein solubility and hydrophobicity. All three protein isolates, similar to the other legumes protein, were more soluble at alkaline pH, while the highest surface hydrophobicity was observed at pH 3. Generally, Speckled Sugar bean protein had the most solubility, while Great Northern bean protein showed the highest surface hydrophobicity. Among three bean protein isolates, Speckled Sugar bean protein performed better as an emulsifier, whereas Great Northern bean protein formed gel at the lowest concentration (6% at pHs 3 and 7). In addition, foaming was higher at acidic pH (pH 3). Therefore, it was concluded that emulsifying capacity is mostly influenced by protein solubility, while gelation and foaming properties are affected by protein hydrophobicity. As the main consequence, the results achieved in this research confirmed that there is a direct relation between structure and the function of a protein. In fact, special structural properties are responsible for special functions.

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