

Title:

Physical and Engineering characteristics of Red Kidney Beans (<i>Phaseolus vulgaris</i>)

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Abstract:

Introduction: Red kidney bean (*Phaseolus vulgaris*) is one of the important tropical grain legumes that can be used as an edible cereal-based diet in many cultures worldwide. It is an excellent source of vegetable proteins, carbohydrates, dietary fibre, vitamins, natural antioxidants and minerals. However, beans contain several toxic and anti-nutritional substances which must be destroyed by optimized processing before use. Moreover, it is pertinent to study the physical properties such as size, shapes, porosity, volume, density, and coefficient of friction of beans to design a suitable system for harvesting, transporting, cleaning, separating, packing, storing, processing, etc. Furthermore, structural loads are caused by bulk density and porosity. Keeping in view of the above perspectives, in this paper, we, thus, report the physical and engineering properties of red kidney beans (variety: VL Rajma 63), which is not well studied.

Methods: Moisture content was determined using microwave method and AOAC (1960) standards. Mass of the samples was measured by digital analytical balance. Physical dimensions (length, width and thickness) of the beans were measured using a Digital Vernier Caliper. Surface area, sphericity, roundness, volume, bulk density, true density and porosity of the samples were also determined in this study. Capacitance and dielectric losses were studied at different frequencies using Agilent E4980A Precision LCR meter and Keithley 4200 parameter analyzer.

Results: The average length, width, thickness, arithmetic means diameter, geometric mean diameter, sq. mean are found to be in the range of 4.37-8.57 mm, 2.84-4.18 mm, 2.00-3.43 mm, 3.07-5.39 mm, 2.91-4.97 mm and 2.07 -2.98 mm, respectively. It is observed that roundness, bulk density, true density, porosity and specificity vary significantly in the range of 0.078-0.116, 0.564-0.572 gm/cm³, 2.14- 2.80 gm/cm³, 73.45-79.80 % and 58.01-66.75 %.

Discussion: In this work, physical and engineering properties of microwave heated red kidney beans are studied. Dielectric properties of the beans are analyzed at different frequencies. Dielectric constant and loss factor are found to increase with moisture content. Significant correlation is observed between dielectric constant and bulk density. Dielectric constant of the beans exhibits positive regression which is linear in nature. Hence, the microwave treatment affects the moisture content of the red kidney beans. Thus, physical and engineering properties of the red kidney beans changes profoundly.

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