EVALUATION OF PHYSICAL PARAMETERS OF CREOLE BEANS

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Common beans plant breeding programs aim to obtain high yielding varieties, combined with disease resistance and seed production with shape, size, color and brightness acceptable by the market. In addition, bean grains must have desirable culinary and nutritional characteristics, such as ease of cooking, good palatability, soft tegument texture, and ability to produce a light and dense broth after cooking. The identification, in the creole cultivars, of the characters lost in the modern cultivars, allows the reinsertion of characters of interest in the genotypes that meet the demands of the consumer market nowadays. The objective of this study was to measure the shapes and sizes of grains (sphericity and volume), as well as their densities, of creole beans grown in the mesoregion of North of Minas Gerais, Brazil.

The measurements were performed at the Biotechnology Laboratory of the Universidade Federal de Minas Gerais, *campus* Montes Claros. It was studied tem accessions of creole beans (*Phaseolus vulgaris* L.), manually collected, with moisture content of approximately 0.92 (d. b.). The drying was carried out at the constant temperature of 40 ºC. The reduction of the moisture content during drying was accompanied by the gravimetric method (mass loss), using an analytical balance of 0.01 g. The drying was performed until the final water content reached 0.13 (d. b.). The water contents of the product were determined by the oven method, 105 ± 1 °C, until it reaches constant weight. The shape and size of the grains were analyzed by sphericity and volume, from the measurements of 300 grains of each accession, according to Moshsenin (1986). The values of the characteristic dimensions and orthogonal axes (Figure 1) were obtained with the aid of a digital caliper with an accuracy of 0.01 mm.

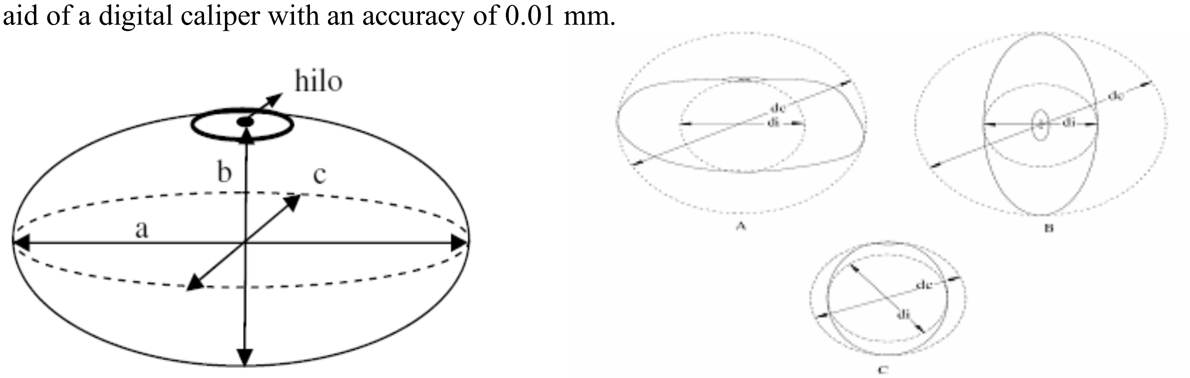

Figure 1. Schematic design of the bean grain, considering the oblate spheroid shape with its characteristic dimensions: (a) largest grain axis in mm; (B) mean grain axis in mm; (C) smaller grain axis in mm; (Cr) circularity in%; (Di) diameter of the largest circle inscribed in mm; (Dc) diameter of the smallest circumscribed circle in mm; (A) major axis, Cr_1; (B) mean axis, Cr_2; (C) smaller axis, Cr_3.

The density (g/cm^3) was determined by dividing the mass of the sample by its volume (Ferreira et al. 2002). The statistical analyses were performed in completely randomized design (CRD), where the mean (μ), the variances (σ^2) and the analysis of variance (ANOVA) were estimated by using the GENES program (Cruz, 2001).

Variance analysis of the physical properties sphericity, volume and density were all significant (Table 1). Thus, it is verified that the analyzed bean grains present variations of their characteristic dimensions (Table 2), as observed for most biological products, which, during drying, irregularly contract in different directions, as already observed by Corrêa et al. (2002). The volumetric changes of the products, due to dehydration, are reported to be the main causes of changes in the physical properties of agricultural grains (Sokhansanj & Lang, 1996). Zogzas et al. (1994) observed that the volumetric contraction of vegetable products during drying is not due only to water content, but it also depends on the process conditions and product geometry. In this study, it can be verified that the characteristic dimensions of the grains reduce with the water content decrease. The sphericity of the grains also reduced during the drying process, while the circularity did not show a definite trend in its values with the reduction of the water content. In addition, the surface/volume ratio of the grains increased with the reduction of the water content during the drying process (Table 2). The theoretical bases for knowing the process of volumetric contraction involve complex laws of mechanical and material deformation (Towner, 1987). Although, there is an increasing tendency for genetic bean enhancement programs to intensify their researches on physical properties of the beans.

Table 1. Summary of sphericity, volume and density variance analyses in grains of creole beans accessions grown in the mesoregion of North of Minas Gerais, Brazil.

ANOVA		DF	SS	MS	F	F critic
Sphericity	**Accession**	9	33,640.4616	3,737.8290	159.0674	1.9122
	Residue	290	6,814.5415	23.4984		
	Total	299	40,455.0031			
Volume	**Accession**	9	318,877.6000	35,430.8444	59.7782	1.9123
	Residue	290	171,884.5430	592.7053		
	Total	299	490,762.1430			
Density	**Accession**	9	0.3840	0.0426	142.000	2.2106
	Residue	290	0.0945	0.0003		
	Total	299	0.4785			

ANOVA: Variance analysis; DF: Degree of Freedom; SS: Sum of Squares; MS: Mean of Squares.

Table 2. Means (μ) and variances (σ^2) of physical parameters in creole bean accessions grown in the mesoregion of the North of Minas Gerais, Brazil.

Accessions of creole beans	Measurements					
	Sphericity (%)		Volume (mm^3)		Density (g/cm^3)	
	μ	σ^2	μ	σ^2	μ	σ^2
Andu Indiano	96.2681	2.4694	154.8063	448.2148	1.2200	0.0004
Andu Manteiga	95.2533	11.1957	105.4824	374.4491	1.1899	0.0009
Andu Preto Precoce	103.0484	17.8583	295.6497	953.0872	1.0861	0.0028
Azuk Claro	113.8209	9.8515	53.2552	975.0596	1.1568	0.0011
Azuk Roxo	110.6989	25.7984	281.7536	267.0881	1.2881	0.0005
Bonina	104.3245	19.7602	134.5898	696.2885	1.2412	0.0005
Branco Mineiro	105.2441	36.1243	141.8934	138.5960	1.3508	0.0011
Campeiro Preto	601.0814	63.1603	601.0814	631.6034	1.3343	0.0001
Carioquinha Precoce	114.3910	41.2260	132.9935	604.5292	1.2843	0.0001
Catador Sisquim	65.7498	10.5395	55.2506	52.5374	1.3422	0.0110

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