Cooking-quality of broad-bean varieties as influenced by some physicochemical measurements

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(Received February 25, 1981)

Introduction

The role of broad bean (Vicia faba) as a traditional food item in diets of our population is well recognized. It serves as the major source of the protein intake of humans at all ages, and is widely accepted as a common protein source in Egypt especially for the low income groups. The evaluation of the protein quality of broad bean received considerable interest (1, 2).

There is little information available in the literature regarding the methods for predicting the cooking-quality of broad bean varieties grown in Egypt.

It is now recognized that the plant breeder needs simple tests that might help him in his efforts to produce new lines and varieties of broad bean, not only with acceptable field and harvesting characteristics but also with cooking and processing-behaviour that needs specific consumer requirements.

Good correlation has been reported between the cooking-quality of dry peas and their content of phytic acid (3, 4).

On the other hand, starch comprises approximately 45% of dry broad bean, and viscosity measurements have been used to characterize starch and starch-containing materials.

Therefore the phytic acid content as well as the viscosity and gelatinization characteristics along with measurements of water absorption during the cooking-process have been used to account the differences in cooking-behaviour of the broad bean varieties in this study. Moreover, the protein contents and the amino acid composition of broad bean varieties in relation to their cooking-quality are evaluated in this investigation.

Experimental

Source of samples

Dry broad-bean samples were obtained from 1979 crop of the experimental plots of Legume Research Section, Agricultural Research Centre, Giza (Egypt). Moisture content of the samples was 9–10% since more than 13% moisture deteriorated of texture and flavor occurred (5). The varieties tested were Giza 1, Giza 2, Giza 3, Giza 4, Rebaya 40, Family 402, Family 424, and Hybrid 90/1966/72. Part of the samples
were hand-cleaned and weighed and their seed coats were removed by hand and the percentage of the seed coat and cotyledon fractions were calculated. Another part of the samples was ground into fine flour and subjected for analysis.

*Gelatinization and viscosity measurements*

The broad-bean flour was subjected for the gelatinization and viscosity measurements using Barbender amylograph according to the official methods (6). For the complete curve, a 19% slurry was prepared, and the temperature of the suspension is raised at a constant rate of 1.5°C/min from temperature 20°C to 95°C. Gelatinization temperature was estimated with the range of ± 0.5°C and peak viscosity in Barbender Units (B.U.), which was reproducible to ± 30 B.U.

*Analytical methods*

Total Kjeldahl nitrogen was determined (7) from which protein contents were calculated by multiplying using the factor 6.25. Total free amino acids were determined by ninhydrin colorimetric method (8) using Spekol spectrophotometer for the absorbance reading at 570 nm. The phytic acid phosphorus was determined by colorimetric method (9) using the same spectrophotometer for the absorbance reading at 480 nm.

Amino acid content in dry broad bean varieties of variable cooking-quality were determined by hydrolyzing with HCl 6 N (10). The hydrolyzate was evaporated under vacuum till almost dryness, then dissolved in HCl 0.1 N containing 12.5% sucrose and analyzed for amino acid contents with Technicon amino acid analyzer (11). The Technicon standard mixture of 2.25 U mole each of amino acids was used in calibrating the 75 cm and 0.62 cm diameter column. The average reproducibility of recovery obtained for the 17 amino acids was 100 ± 3 %. Results were expressed as g amino acid per 16 g N, which amounts the same as expressing the results as percent of the protein content.

*Cooking-quality*

The softness of the cooked seeds was measured after 20 g seeds had been cooked for a standard time (8 h) by immersing in 200 ml boiling water in 500 ml beakers. The softness of the cooked seeds was measured by finger-pressing (12) and the soft seeds were calculated as percentage of the total seeds. The percentage of the water absorption was calculated from the weight of cooked seeds per the weight of raw seeds (13). The color intensity of the liquor after cooking in boiling water was measured by the same spectrophotometer at 620 nm (12). The total solids of this liquor was determined by evaporating an aliquot at 105°C till constant weight. The cooking-time was taken as the number of minutes required for softness of the seeds (10 g) after they had been immersed in 60 ml water in 200-ml beakers and autoclaving at 120°C at which the percentage of the water absorption was calculated as before.

*Results and discussion*

*Weight ratio and degree of milling*

Broad bean Giza 2 had higher degree of milling than other varieties, whereas Rebaya 40 had the lower degree of milling. This was indicated by the lower yield of seed coat fraction and higher cotyledon fraction of Giza 2 (table 1). It was reported that the decoated seeds of broad bean contained higher protein and amino acid contents than the whole seed (14). This was confirmed by the findings of Marquardt et al. (15), who stated that low protein and high fiber as well as tannin contents were present in the seed.