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Selected Physico-chemical Properties of Five Varieties of Cowpea

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ABSTRACT

*Physico-chemical characteristics; namely, moisture, dry matter, amylose content, cooking time, maximum swelling capacity and maximum swelling time were determined in five varieties of cowpea (*Vigna unguiculata*). The varieties were: Nigeria B7 (B7), Kano 1696 (K1696), Vita 5 (V5), Farin Juda C (FJC), and Ife Brown (IB). These physico-chemical properties, with the exception of moisture and dry matter, were subject to varietal and/or seasonal variations. A significant correlation ($r = -0{\cdot}7$; $p < 0{\cdot}02$) was found between amylose content and maximum swelling time during cooking. The results suggest that low amylose content is associated with slower rate of swelling.*

INTRODUCTION

Various reports have indicated that certain varieties of *Vigna* constitute important food items in different parts of the world (Aykroyd & Doughty, 1964; Elias & Bressani, 1973; Elias *et al.*, 1976). Luse and Okwuraiwe (1975) have claimed that cowpea contributes up to 80% of the total dietary protein intake in some parts of Nigeria.

Dovlo *et al.* (1976) reviewed the methods of cowpea preparation in West Africa. They indicated that processing cowpea into various foods usually involves soaking, dehulling, wet- or dry-milling, or cooking. Two or more of these processes may be used in combination. Williams (1974) studied the various qualities that determined consumer preference and identified the following, in descending order of priority: ability to swell when cooked, good binding properties, and desirable flavour and texture; some of these and related factors were used to evaluate five of the cowpea varieties recently developed in Nigeria.

MATERIALS AND METHODS

Materials

The samples of the dried seeds of B7, K1696, FJC and IB were obtained from the Legume Programme of the National Cereals Research Institute, Ibadan. The chosen varieties were those considered to have leading genetic and agronomic traits. They were obtained from harvests of two successive years and designated years 1 and 2 harvests. The year 1 samples were stored in a cool room (4°C) and analysed together with the year 2 samples soon after the harvest of the latter.

Methods

Chemical Analyses
Protein (N × 6·25) and amylose were determined in the milled samples in accordance with the procedures of the AOAC (1975).

Estimation of Cooking Time and Swelling Properties
Cooking time and swelling properties were determined empirically. A 200 g batch of each variety was covered with approximately 2·2 litre tap water in an aluminium pot and heated on a gas cooker. The temperature was brought to 100°C within 20 min and maintained there until cooking was accomplished. Cooking time was estimated by recording the length of time (to the nearest 5 min) of heating required to render the peas tender enough to be eaten. This was achieved by first stirring the boiling contents of the pot at intervals, and removing spoonfuls for tasting by a panel of two women and a man.

Swelling was monitored at 10-min intervals by removing, randomly, 100 seeds from the pot, wiping away adhering water and weighing. This was continued until a plateau was reached for weight gain and the time was recorded. Swelling was expressed as percentage weight gain.

Statistical Analyses
A two-way analysis of variance was run on the data collected from the experiments (Snedecor & Cochran, 1967). The Least Significant Difference

(LSD) method was used subsequently to identify pairs of means that were significantly different. Correlation and regression analyses were also performed on some of the pooled years 1 and 2 data.

RESULTS AND DISCUSSION

The differences in the year 1 (Table 1) amylose content of K1696, V5 and IB were not significant ($p > 0.05$), but the other varietal differences were ($p < 0.05$ to $p < 0.01$). The trend was similar in year 2 (Table 2), with the exceptions that IB had a significantly higher value than the rest ($p < 0.05$ to $p < 0.001$), and the differences between B7 and FJC were not significant ($p > 0.05$). The year 1 amylose content of K1696 was higher than year 2 ($p < 0.05$), but the seasonal differences among the other varieties were not.

Within year 1, the cooking time for IB was lower than the others except FJC ($p < 0.01$ to $p < 0.001$), but the differences among the others were not significant ($p < 0.05$). The year 2 values indicated IB to have the lowest time ($p < 0.01$ to $p < 0.001$) and K1696 to be lower ($p < 0.05$) than the rest except FJC. Comparing the two years revealed that seasonal differences in all the varieties were not significant ($p > 0.05$).

IB in year 1 had the highest swelling capacity of $144 \pm 0\%$ ($p < 0.01$), while V5 had the least ($121 \pm 0\%$) ($p < 0.001$). The values for B7, K1696 and FJC were practically the same as the group mean of $133 \pm 7\%$. The year 1 B7 ($134 \pm 0\%$) and K1696 ($134 \pm 0\%$) values were higher ($p < 0.001$ and $p < 0.02$, respectively) than the $119 \pm 0\%$ and $129 \pm 0\%$, respectively, for year 2. Conversely, the year 2 V5 value of $145 \pm 0\%$ was higher ($p < 0.001$) than in year 1 ($121 \pm 0\%$). There were no differences between the IB and FJC values for the two years. All varietal differences within year 2 were significant ($p < 0.001$), with the exception of that between IB ($144 \pm 0\%$) and V5 ($145 \pm 0\%$).

Maximum swelling was attained in 45 ± 5 min in year 1 K1696 which was lower than the rest ($p < 0.02$ to $p < 0.01$), with the exception of V5 (55 ± 5 min). At the other extreme, FJC had the longest time (80 ± 0 min) which was significantly different ($p < 0.05$ to $p < 0.01$) from the others, with the exception of IB (70 ± 0 min). The year 2 values were the same as year 1 for B7 (65 ± 5 min), and V5 (55 ± 5 min). However, higher values were found for K1696 (65 ± 5 min) and FJC (80 ± 0 min), and conversely a much lower value for IB (25 ± 5 min), but only the difference in IB was significant ($p < 0.02$). The IB value was also different ($p < 0.01$) from the other varieties.

A significant correlation ($r = -0.73$) ($p < 0.02$) was found between the amylose content and maximum swelling time (Fig. 1). The correlation between amylose and cooking time ($r = -0.39$) was not significant ($p < 0.10$). The other parameters were also not significantly correlated ($p > 0.10$).

TABLE 1
Physio-chemical Properties of Five Varieties of Cowpea—Year 1

Physico-chemical properties	*Nigeria B7*	*Kano 1696*	*Vita-5*	*Farin Juda C*	*Ife Brown*	*Group mean (±SD)*
Moisture (%)	7.5 ± 0.2	8.3 ± 0.0	8.3 ± 0.0	7.9 ± 0.1	8.0 ± 0.0	8.0 ± 0.3
Dry matter (%)	92.5 ± 0.0	91.7 ± 0.0	91.7 ± 0.0	92.1 ± 0.2	92.0 ± 0.0	92.0 ± 0.3
Amylose (%)	16.2 ± 0.2^{a}	18.6 ± 0.4^{b}	17.7 ± 0.7^{bd}	14.4 ± 0.2^{c}	17.8 ± 0.3^{bd}	16.9 ± 1.5^{ad}
Cooking time (min)	50 ± 0^{a}	50 ± 0^{a}	53 ± 3^{a}	48 ± 3^{ab}	33 ± 3^{b}	47 ± 7^{a}
Max. swelling (%)	134 ± 0^{a}	134 ± 0^{a}	121 ± 0^{b}	133 ± 2^{a}	144 ± 0^{c}	133 ± 7^{a}
Max. swelling time (min)	65 ± 5^{ab}	45 ± 5^{c}	55 ± 5^{ac}	80 ± 0^{d}	70 ± 0^{bd}	63 ± 12^{ab}

^{a,b,c,d} Each value represents the mean ± standard deviation for duplicate determinations; values not bearing same superscript are significantly different by LSD ($p < 0.05$ to $p < 0.001$).

TABLE 2
Physico-chemical Properties of Five Varieties of Cowpea—Year 2

Physico-chemical properties	*Nigeria B7*	*Kano 1696*	*Vita 5*	*Farin Juda C*	*Ife Brown*	*Group mean (±SD)*
Moisture (%)	8.1 ± 0.0	9.0 ± 0.2	8.6 ± 0.1	8.5 ± 0.0	7.3 ± 0.0	8.3 ± 0.6
Dry matter (%)	91.9 ± 0.0	91.0 ± 0.2	91.4 ± 0.1	91.5 ± 0.0	92.7 ± 0.0	91.7 ± 0.6
Amylose (%)	15.6 ± 0.4^{a}	17.2 ± 0.2^{b}	17.4 ± 0.2^{b}	15.2 ± 0.2^{a}	18.1 ± 0.1^{c}	16.7 ± 1.1^{b}
Cooking time (%)	53 ± 3^{a}	43 ± 3^{b}	53 ± 3^{a}	50 ± 0^{ab}	23 ± 3^{c}	44 ± 11^{b}
Max. swelling (%)	119 ± 0^{a}	129 ± 0^{b}	145 ± 0^{c}	133 ± 0^{d}	144 ± 0^{c}	134 ± 10^{d}
Max. swelling time (min)	65 ± 5^{a}	65 ± 5^{a}	55 ± 5^{a}	70 ± 0^{a}	25 ± 5^{b}	56 ± 16^{a}

^{a,b,c,d} Each value represents the mean ± standard deviation for duplicate determinations; values not bearing same superscript are significantly different by LSD ($p < 0.05$ to $p < 0.001$).

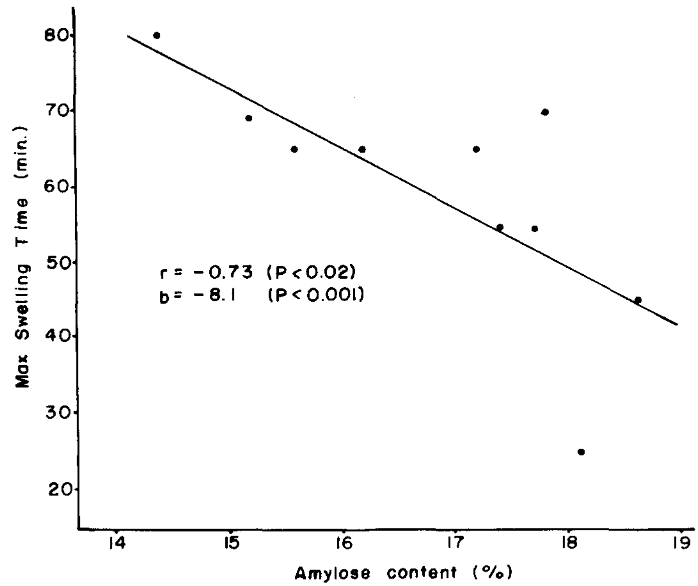

Fig. 1. Correlation between amylose content (%) and length of time (min) required for attaining maximum swelling in five varieties of cowpea.

The results reveal that the differences in the physico-chemical properties may be attributed to varietal or seasonal variations, with the former playing the more dominant role. For instance, significant seasonal variations were not found in the amylose content or cooking time of all the varieties and only in IB was swelling time affected. Only swelling capacity showed significant seasonal variation in three of the five varieties. In contrast, significant varietal differences were found in each physico-chemical property, especially in the amylose content in the two seasons.

Juliano (1979) found that the amylose content of various varieties of rice correlated with certain cooking qualities in such varieties. The present results indicate a lack of significant correlation between amylose and cooking time or between amylose and percentage swelling. However, the length of time required for attaining maximum swelling during cooking is inversely correlated ($r = -0{\cdot}73$) with the amylose content of the various varieties.

Maximum swelling was observed to lag behind cooking (to acceptability) to varying extents, K1696 (year 1) being the only exception. In some varieties, particularly FJC and IB (year 1), the time lag was markedly high (32–37 min). Thus a compromise may be required between cooking and maximum swelling. In this regard, high-amylose varieties may be preferred, although IB (year 1) apparently deviates from this general pattern in having a high swelling time in spite of its high amylose content. The latter observation tends to support the undocumented claim by women who use

IB regularly, that this variety swells with increasing difficulty as the time of storage increases. All the varieties exhibited excellent swelling capacity, reaching at least two-fold in all cases. Genetic manipulation of the amylose content, as in the case of rice (Juliano, 1979), may help in developing varieties with improved physico-chemical characteristics.

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