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A Physical and Nutritional Quality Determination of the date of Harvest of the Cowpea (cv. Ife Brown) Pod as a Vegetable

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Abstract

An evaluation study of the cowpea as a green vegetable was conducted by determining the physical and nutritional quality changes of a cowpea cultivar (cv. Ife Brown) during pod development, with a view to finding a solution to the incessant post-maturity pest and fungal attack of the pod in the humid tropics. The results show that pod length continued to increase till 20 days after anthesis (DAA). However, maximum pod diameter, seed diameter, pod wall thickness and a corresponding minimum void space were attained at 14 DAA. Noticeable change in pod colour occurred in 15 DAA the same time that the pod became slightly stringy. Maximum ascorbic acid content was obtained at 11 DAA while the minimum level of protein per fresh weight occurred at 15 DAA. Crude fibre content also rose sharply after 15 DAA. Taste panel investigation results indicated a significant preference for cowpea pods harvested 11-13 DAA compared to a commercial variety of green benas.

Introduction

Cowpea (*Vigna unguiculata* sub sp. *unguiculata*) is the most important grain legume in Nigeria where it provides as much as 60% of the total protein intake for the large population that are unable to afford animal protein. It is also a good source of minerals and vitamins (Ogunmodede and Oyenuga, 1968).

The enormous popularity of cowpea and its adaptation to the various forms of local dietary preparations make it to be grown all over Nigeria even though it is better adapted to the less humid Guinea savannah vegetation zone. In the humid forest zones, yield losses ranging from 30% to 100% have been reported due to a slight delay in harvesting, especially when the harvesting is done in wet weather (Nangju, 1976). Most of the losses of mature pods are due to insect attack (Singh *et al,* 1978) and weathering-induced fungal attack (Onesirosan, 1978). Since it is not possible to avoid grain yield losses due to weathering in cowpea grown during the rain season, one solution is to harvest and use the pods green. However, cowpea is hardly consumed in the green state. But several species of bean are cultivated as green vegetables (Hackett and Carolane, 1982). Vegetables, in general, are evaluated for quality in terms of their aesthetic and nutritional attributes (Hackett and Carolane, 1982). For green beans, aesthetic quality is conferred mainly by the physical characteristics of the pod. The present study was carried out to evaluate the physical and nutritional quality changes of the cowpea pod during development in order to determine when it is best suited for consumption as a vegetable.

Materials and Methods

The cowpea variety used for the study is a popular cultivar, cv. Ife Brown. Ife Brown is the University of Ife selection H62-1, itself a cross between Alabunch (USA) and a local variety C20-41. Seeds were planted in the late season of 1984 at the Teaching and Research Farm, University of Ife, Nigeria. Standard agronomic practices were followed from planting to maturity. At about 50% flowering stage, 2000 flowers were tagged at anthesis. Pods from these tagged flowers were harvested at random from 5 days after anthesis (DAA) to 25 DAA at intervals of 5 days except between 10 DAA and 15 DAA when pods were harvested daily. Each harvest consisted of 200 pods. The pods were taken to the Laboratory where they were subjected to various tests as described below.

Thirty pods taken at random were used for the following aesthetic physical analyses: Each pod had its length measured following which it was held at both ends, snapped and scored for ease of snapping on a scale of 1 (very easy) to 3 (difficult). The break point surface of each pod snapped were examined for strings or cleanness-of-break and each pod scored as 0 (smooth, not stringy), 1 (slightly stringy or 2 (very stringy). An approximate 2 cm segment of each pod used for stringiness test was split longitudinally with a razor blade and using the Steadtler meter rule with millimeter calibration, the following characteristics were measured: pod diameter, seed diameter, pod wall thickness and void space. The colour of each pod was measured on a scale of 5 to 1 using a limegreen cardboard whose colour matched the colour of the immature pod as the standard green colour scale 5. Deviations from this were rated subjectively as 4 = pale-green, 3 = yellowish-green, 2 = beige and 1 = ripe-brown.

The 30 pods used for aesthetic physical quality analyses were pooled with the unused pods. Duplicate 50g samples were taken for moisture content and dry matter determination by oven drying at 100°C for 24 hr. The oven dried samples were combined, ground, and duplicate samples were taken for fibre content and crude protein content determination (AOAC 1975).

100g fresh pods were blended and duplicate samples were analysed for ascorbic acid content using the Indolephenol method (Ruck, 1963). The remaining fresh samples were further chopped into pieces, immersed in about 1.5 l boiling water inside a covered 2.5 l capacity aluminum cooking pot and cooked for 3 min after which they were taken out and allowed to cool for 1 min. An equal quantity of the French bean purchased from a grocer of exotic vegetables was also chopped and cooked for 3 min. Both were placed before a panel of 10 randomly picked untrained tasters who scored their preference on a scale of 0 for outright rejection, to 10 for most preferred. The same panel was used throughout the duration of the experiment. Relative preference value (%) for cowpea was calculated as:

$$\frac{\text{average panel score (a.p.s.) cowpea} - \text{a.p.s. bean}}{10} \times 100\%$$

Results

Pod length had an initial rapid increase till 10 DAA and a gradual increase thenceforth, reaching a peak of about 17 cm at 20 DAA (Fig. 1). Similarly, pod diameter and seed diameter increased with pod length development but over 80% of the overall pod development with respect to pod and seed girth were attained 10 DAA. Maximum pod void space occurred at 10,DAA while minimum void space was achieved at 14 DAA. Pod wall thickness increased steadily reaching a peak at 14 DAA, and it thereafter fell. Appreciable change in pod stringiness started at 14 DAA. Also there was no significant change in pod colour until 15 DAA.

There was an initial increase in ascorbic acid content (Fig. 2), reaching a peak of 20.6mg/100g fresh wt. at 11 DAA after which it fell. Crude protein content rose steadily throughout development but with a slight dip between 10 and 15 DAA. Crude fibre content was fairly constant until 15 DAA after which it started to rise, with a more steep rise between 20 and 25 DAA. Percent moisture content was highest at 5 DAA when evaluation started and it decreased throughout development. Rapid decrease in moisture content occurred between 15 and 20 DAA. Changes in dry matter content followed a direct inverse pattern of the moisture content. Taste panel results showed a preference range of between 10 and 35% for cowpea pods harvested between 11 and 13 DAA over the fresh, commercial green bean. There was no difference between cowpea pods harvested at 10, 14 or 15 DAA and the commercial green beans but those harvested at other times were poorer in taste quality.

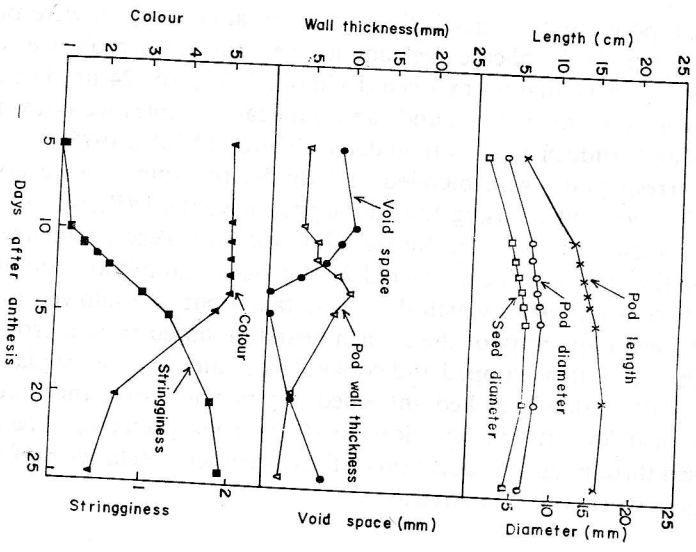

Fig. 1. Changes in the physical characteristics of the Cowpea (cv. Ife Brown) pod during development. Each point represents the average of thirty pods.

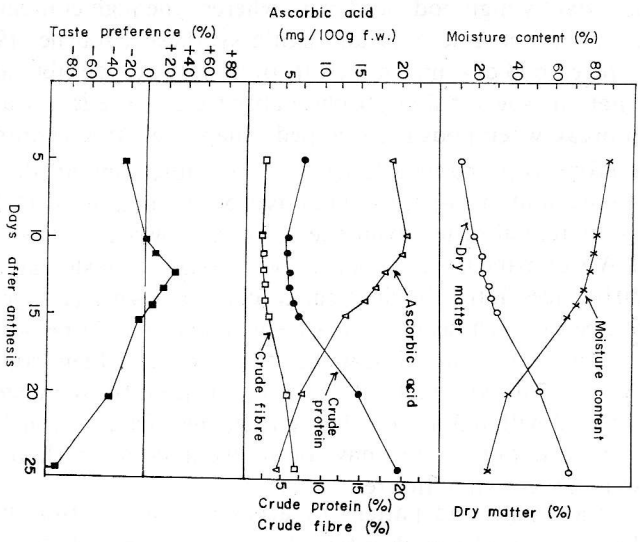

Fig. 2. Changes in the nutritional characteristics of the cowpea (cv. Ife Brown) pod during development. Each point represents the average of duplicate samples of over thirty pooled pods.

Discussion

The initial rapid increase in pod length, pod diameter and seed diameter obtained in this study are in agreement with the exponential phase of a growth curve (Leopold and Kreidman, 1975). The similarity in the growth pattern of both the seed and the pod is in agreement with the results of previous workers who also showed that pod development is probably controlled by the seed from the time of fertilization onwards (Jones and Corner, 1962). The increase in seed diameter was as expected, and it was due to assimilate deposits at the sink, whereas the simultaneous decrease in pod wall thickness after 14 DAA was probably due to the collapse of the endocarp (Watada and Morris (1967). The increased stringiness at later stages of pod growth was probably due to increased layer of sheath cells and fibre sclereids (Drijflhout 1970; Stark and Mahoney 1942) and the general thickening of the hemicellulose-pectin matrix. Colour change in the pod was due to chlorophyll degradation.

The high protein content at the early stages of pod development was probably mainly due to enzyme and RNA synthesis which normally accompany and are responsible for increased growth activities. The increase in protein content after 15 DAA was probably due to both storage protein synthesis in the seed (Briarty et al., 1969; Hall et al., 1971) as well as the general decrease in pod moisture content. Synthesis of storage protein can begin early in seed development as in *Vicia faba* (Millard *et al.*, 1971) or get initiated later when the seed has attained 10 mm length as in *Phaseolus vulgaris* (Hall et al., 1971). The results obtained in this study indicate that in cowpea, storage protein synthesis begins after 15 DAA which is about two days after the seed has attained

maximum diameter. Crude fibre content at the early stages of pod growth was due to the predominantly high pod: seed ratio whereas the high content at the latter stages was due to fibre sclereid and lignin synthesis (Bourne, 1976) as well as ageing-induced pod drying. The results of both the crude fibre and stringiness determinations suggest that absolute absence of fibre is not a prerequisite for clean break when pods are snapped. Snappiness (the reciprocal of stringiness), therefore, is probably a function of the fibre content, the parenchyma ground tissue, and intra-parenchyma hydrostatic pressures (DeMan *et al.*, 1976). The preferential taste advantage accorded cowpea pods harvested between 11-13 DAA by panelists may be, simply, a result of taste habituation to the crop or differences in the simple sugar content of cowpea (Longe, 1981) as compared to green French beans. It has been shown that 53-66% of total sugar content of snap beans can be lost within 24 hr under ambient conditions (Bautista and Data, 1976). Although all cowpea pods used for the taste panel assessment were tested within 3 hr after harvesting, the "fresh" French beans bought over the grocery counter must have been several hours, perhaps 2 days old, since they were not grown in Ile-Ife.

In conclusion, the values and pattern of accumulation of crude protein, crude fibre and ascorbic acid found in this study are comparable to those of the top varieties of cowpeas and bean tested by Del Rosario et al. (1981) and Lee (1985). It is known that the quality of green beans is a function of both its aesthetic and nutritional characteristics rather than of its dry matter *per se.* Some dry matter will inevitably be lost by harvesting before physiological maturity. However, some nutrients, especially ascorbic acid will be saved in addition to the freshness of the produce and the universal digestive adventage of a green vegetable. Taste panel investigation has shown, in this study, that the cowpea pod is at its best as a green vegetable at 13 DAA. Therefore, in order to take full advantage of the aesthetic and nutritional qualities of Ife Brown cowpea as a vegetable, the pods should be harvested for consumption between 10 and 14 DAA.

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