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Breeding Pepper for Enhanced Food Nutrients

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ABSTRACT

Improvement in crop production for human nutritional satisfaction is one of the aims of breeders. In this study, two species of pepper (*Capsicum annuum* and *Capsicum frutescens* L.) were crossbred to raise $F_{1.}$ Thereafter, proximate analysis of various parts (leaves, seeds and fruits) of F_1 and the parental species were carried out so as to assess the impact of breeding for enhanced food nutrients (moisture, carbohydrate, protein, ash, fat and fibre) in pepper. This was done using standard methods. Results were analyzed using ANOVA. Result showed that parental species and F1 all contained significantly varied quantities of these nutrients. The F1 contained significantly higher quantities of carbohydrate, protein and ash than the parental species indicating that breeding could greatly enhanced food nutrients in pepper. Thus, breeding of pepper for other parameters like pungency which makes some people not to consume pepper is highly encouraged for pepper is really another power house of nutrition.

Key words: Breeding, *Capsicum frutescens, Capsicum annuum,* F_1, food nutrients

INTRODUCTION

An important aspect of nutrition is the daily intake of nutrients. Nutrients consist of various chemical substances in the food that makes up each person's diet. Many nutrients are essential for life and an adequate amount of nutrients in the diet is necessary for providing energy, building and maintaining body organs and for various metabolic processes. Nutrients are essentials to human diet if they meet two characteristics: Firstly, omitting the nutrient from the diet leads to a nutritional deficiency and a decline in some aspect of health. Secondly, if the omitted nutrient is put back into the diet, the symptoms of nutritional deficiency will decline and the individual will return to normal, barning any permanent damage caused by its absence. Humans require at least 49 nutrients to meet their metabolic needs. Inadequate consumption of even one of these nutrient will result in adverse metabolic disturbances leading to sickness, poor health, impaired development in children and large economic costs to society (Branca and Ferrari, 2002; Golden, 1991; Grantham-McGregor and Ani, 1999; Ramakrishnan *et al*., 1999).

Not all foods were created equal; some are so packed with vitamins, minerals, antioxidants, essential fatty acids and other beneficial substances that they have been deemed a “super food”.

Pepper, as a spice is among the several vegetable substances used to season or flavor food. They stimulate appetite by increasing the flow of gastric juice. Otunola *et al*. (2010) reported the importance of pepper as antioxidant nutritive therapy used to treat cardio-vascular diseases, diabetes, erectile dysfunction and respiratory diseases. Peppers are packed with vitamin C and vitamin C is not naturally found in grains but it is added to some fortified breakfast cereals. The body uses vitamin C for the biosynthesis of collage, L-Carnitine and certain neurotransmitters and it is also involved in protein metabolism. In addition to its biosynthetic and antioxidant functions, vitamin C plays an important role in immune function and improves the absorption of nonheme iron. Vitamin C deficiency causes scurvy.

Researches have shown that variations exist among crop species. Preliminary screening of several hundred wheat accessions showed four to five fold variability for grain Fe and Zn concentrations (Velu *et al*., 2011).

Studies have shown that there are significant differences in carbohydrate, protein, fat and oil, vitamin, mineral and moisture contents of pepper species (notably *Capsicum annuum* and *Capsicum frutescens* L.). Furthermore, the scientific method of crop improvement was necessitated by the demands by modern man for good quality food crops, crops with good taste, crops that contain most of the essential food nutrients and crops that can provide the immediate needs of man in terms of food and raw materials (Ilodibia *et al*., 2014a). Importantly, the primary source of all nutrients for people comes from agricultural products. If agricultural systems fail to provide enough products containing adequate quantities of all nutrients during all seasons, dysfunctional food systems result that cannot support healthy lives. Unfortunately, this is the case for many agricultural systems in many developing nations in the Global South (Graham *et al*., 2001; McGuire, 1993; Schneeman, 2001). Plant breeders therefore try to substitute the undesirable qualities in plant with desirable ones so that it would result in higher yield of crops of improved quality and this is achieved through the process of crossbreeding or hybridization. Within the agricultural community, plant breeding efforts greatly contributed to advances in staple plant food productivity (mostly cereal crops) during the 'green revolution'. Such breeding efforts, along with improved agriculture technologies, succeeded in providing enough calories and protein to prevent the threatening massive starvation and famines predicted in the early 1960s in many world regions. Importantly, plant breeding can again be used as a powerful weapon to use in fighting 'hidden hunger'. Breeding for micronutrient-enriched staple plant foods is a possibility that should be pursued (Bouis, 1996; Graham *et al*., 1998, 1999; Graham and Welch, 1996). Success in such a breeding effort would target those groups of people most at risk of developing micronutrient malnutrition because these sectors of societies are dependent on these foods for their sustenance. Further-more, a plant breeding approach would be sustainable; once micronutrient-dense lines of staple plant foods are developed; there is little additional cost to continue their lineage in ongoing breeding programs for the foreseeable future (Bouis, 1996). Synthetic hexaploids were developed at CIMMYT by crossing *Aegilops taushii* and high Zn and Fe containing accessions of *T. dicoccon* (Velu *et al*., 2011). Hence, the research on crossbreeding of two species of pepper *Capsicum annuum* and *Capsicum frutescens* L. to produce a hybrid that might combine the qualities of the two species. This would be followed by determination of the proximate composition of the two species and their F_1 hybrid using their extracts (leaves, seeds and fruits) so as to assess the impact of breeding for enhanced food nutrients in pepper. Accordingly, the problem and focus of this research was to compare the nutritional composition of two the species of pepper with their F_1 hybrid.

MATERIALS AND METHODS

Sources of materials: The two species were collected from Agricultural and Natural Resources Department Market Garden Awawbia, Awka South Local Government Area Anambra State, Nigeria. The *Capsicum* species were authenticated by a plant taxonomist in Department of Botany, Nnamdi Azikiwe University Awka, Anambra State where the voucher specimens were deposited. The breeding experiment was carried out using the method described by Ilodibia *et al*. (2014b).

Preparation of plant materials for proximate analysis: Dried leaves, seeds and fruits of two species of pepper (*Capsicum annuum* and *Capsicum frutescens*) and those of their hybrid (F_1) were ground into fine (100-mesh screen) powder. The ground samples were then examined for moisture, ash, protein, crude fat, crude fibre and carbohydrate using the methods described by AOAC (1990), Pearson (1976) and James (1995).

Statistical analysis: Data obtained was statistically analyzed using analysis of variance (ANOVA). The Duncan's multiple range test significance was used to test the difference among treatments at 0.05% level. Results were presented in Mean±Standard Error.

RESULTS AND DISCUSSION

The result showed significant difference in the nutrient contents of the *Capsicum* species and F_1 and also in their various parts assayed (Table 1). This tally with the report of Velu *et al*. (2011), that several hundred wheat accessions showed four to five fold variability for grain Fe and Zn concentrations.

There was a significant difference in the moisture content of different parts of *Capsicum* species and F_1 assayed (Table 1). The fruit of *Capsicum annuum* contained significantly the highest percent of moisture with a mean value of (9.30±0.01) when compared to other parts, respectively (Table 1, Fig. 1). This showed that *Capsicum annuum* contained the highest percent of moisture when compared to *Capsicum frutescens* and F_1, respectively. The high content of moisture in the fruit of *Capsicum annuum* showed that the fruit is more prone to deterioration since food with high moisture contents are prone to perishability (Fennema and Tannenbaum, 1996; Ilodibia *et al*., 2014a).

F_1 hybrid contained significantly the highest percent of carbohydrate, protein and ash in all parts assayed, with the seed having significantly the highest content of carbohydrate (75.10±0.01) and the leaf having significantly the highest content of protein and ash though it's protein was statistically at par with *C. frutescens* (14.79±0.03 and 14.78±0.01 and ash-5.98±0.01) when compared to other parts respectively (Table 1). The high content of carbohydrate, protein and ash in F_1 hybrid indicated that breeding of *Capsicum* species greatly enhanced its food nutrient thus a better source of carbohydrate, ash and protein than the parental species. This agrees with Velu *et al*. (2011), that competitive Zn and Fe biofortified varieties can be developed and also with that of Ilodibia *et al*. (2014b), who reported that F_1 generation combined the characters of both parents and other genetic attributes.

Table 1: Percent proximate contents of *Capsicum frutescens, Capsicum annuum* and F_1

	Capsicum frutescens			*Capsicum annuum*			F_1		
Parameters	Leaf	Seed	Fruit	Leaf	Seed	Fruit	Leaf	Seed	Fruit
Moisture	$8.35±0.05^{g}$	$8.24±0.01^{h}$	$8.48±0.03^{e}$	$9.25±0.02^{b}$	$8.46±0.33^{e}$	$9.30±0.01^{a}$	$9.00±0.04^{d}$	$8.40±0.02^{f}$	$9.20±0.02^{c}$
Carbohydrate	$60.13±0.02^{f}$	$57.36±0.01^{i}$	$60.00±0.02^{g}$	$61.15±0.05^{d}$	$72.50±0.06^{b}$	$58.94±0.03^{h}$	$68.20±0.03^{c}$	$75.01±0.01^{a}$	$62.10±0.01^{e}$
Protein	$14.78±0.01^{a}$	$12.47±0.01^{d}$	$3.16±0.01^{f}$	$13.75±0.02^{b}$	$12.42±0.01^{e}$	$2.92±0.02^{h}$	$14.79±0.03^{a}$	$13.35±0.02^{c}$	$4.63±0.01^{g}$
Crude fat	$2.73±0.03^{h}$	$3.44±0.04^{e}$	$11.30±0.01^{c}$	$2.20±0.02^{i}$	$3.48±0.00^{d}$	$12.74±0.01^{a}$	$2.75±0.02^{g}$	$2.93±0.01^{f}$	$12.30±0.03^{b}$
Ash	$4.28±0.01^{f}$	$3.36±0.0^{g}$	$5.35±0.01^{d}$	$5.94±0.01^{b}$	$3.19±0.03^{h}$	$5.26±0.02^{e}$	$5.98±0.01^{a}$	$3.36±0.01^{g}$	$5.37±0.01^{c}$
Crude-fibre	$9.75±0.01^{f}$	$5.18±0.01^{I}$	$10.73±0.02^{c}$	$9.78±0.01^{e}$	$5.49±0.01^{h}$	$11.80±0.01^{a}$	$9.80±0.01^{d}$	$5.52±0.01^{g}$	$10.78±0.03^{b}$

Mean values±S.E. in the same row followed by different superscripts are significantly different by Duncan's multiple range test at ($p<0.05$)

Fig. 1(a-d): (a) *Capsicum frutescens*, (b) *Capsicum annuum*, (c) F_1 hybrid and (d) Fruits of parents compared with fruit of F_1

The result showed also that the fruit of *Capsicum annuum* contained significantly the highest contents of fat and fibre with mean values of 12.74±0.01 and 11.80±0.01, respectively (Table 1) indicating that it is a better source of fat and fibre when compared to *Capsicum annuum* and F1 and fruit when compared to other parts, respectively.

Furthermore, fruits and leafy vegetables are good sources of antioxidants that can protect cells against damaging effects of reactive oxygen, such as singlet oxygen, superoxide and peroxyl. This indicated that *Capsicum* species may help reduce the risk of many age related degenerative diseases cause by reactive oxygen species.

CONCLUSION

Result revealed that breeding greatly enhanced food nutrients in pepper. Thus, breeding of pepper for other parameters like pungency which makes some people not to consume pepper is highly encouraged for pepper is really another power house of nutrition.

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