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Improved varieties of cowpea (*Vigna unguiculata* (L.) Walp) for eradication of malnutrition

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Abstract
Improved varieties have agronomic advantages over local varieties,but not much attention has been given to understand the nutritional content of the improved cowpea varieties released. This study investigated the physical and nutritional properties of improved cowpea varieties released in GBPUAT, Pantnagar. Five released varieties were analyzed for physical and chemical properties. The results showed that there were variations in seed weight as the values ranged between 10.0 and 18.0 g per 100 g seed weight. The protein content ranged from 22.51-29.6%. Contents of iron ranged from 5.10 to 9.68 (mg/100 g). Zinc content ranged from 2.54 to 5.59 (mg/100 g). The released varieties have high seed weight, which is an essential factor that farmers consider when choosing a variety to adopt. In terms of addressing nutritional security, the crop is suitable for addressing protein-energy malnutrition and formulating blends for baby foods.

Keywords: Varieties, cowpea, *Vigna unguiculata* (L.) Walp, eradication, malnutrition

Introduction

Cowpea (*Vigna unguiculata*) is often referred to as the poor man’s meat as it is a significant sourceof protein, minerals, and vitamins (Tharanathan, 2003) for the rural poor who have limited access to protein from animal sources such as meat and fish (Akpapunam, 1997) [2]. The cowpea plant is a drought-tolerant food crop, well adapted to a diverse range of climate and soil types, and widely cultivated throughout the tropics and subtropics of Africa, Latin America, and Southeast Asia, as well as in the United States (Appiah, 2011) [3]. In Africa, cowpea is mainly cultivated in West and Central Africa, with an annual production of 3 million tons (Onyenekwe, 2000) [4]. Cowpea plays a significant role in the diets of rural and urban communities. In other countries, the grain has been used to fortify cereal-based weaning foods, in which it forms complementary amino acid profiles and improved protein quality (Bressani, 1985) [6]. The crop is, therefore, gaining industrial importance in food formulation (Hamid, 2016) [5] from its nutritional and functional benefits. Consumption of legumes has been associated in many clinical studies (Bouchenak, 2013, Anderson, 2002 and Tovar, 2014) [7, 8, 9]. with a reduction in cholesterol and the risks associated with coronary heart diseases. Whether improvements in the crop production performance of cowpea have also led to changes in the nutritional and physical characteristics of the grainhas, however, not been documented.

The present study was done to determine and compare the physical and chemical properties of the improved cowpea varieties. Knowledge generated from this study would be used by researchers, processors, dieticians, and policymakers in planning (for example) hospital and school-feeding programs where there would need to match varieties to specific purposes for various needs (Ajeigbe, 2008) [10] based on their chemical characteristics.

Materials and Methods

The cowpea materials used for this study were planted and harvested during the Kharif 2019 cropping season at GBPUAT, Pantnagar. Planting distance was kept at 45cm between the rows and10cm between the plants. Four row plot was planted. The Randomized Complete Block Design with three replications, was used to install the trial. Treatments included five released varieties. Two seeds were planted per hill. The planting depth was 3 cm. Weeding was done twice during the planting season to ensure weed-free conditions.

Grain yield was determined by weighing seed/plot and yield/ha was calculated, based on the area harvested. The cowpea samples were processed into flour using the adapted method of (Alamu *et al*. 2016) [11]. Clean and sorted cowpea grains of a representative sample of each variety were carefully selected, milled (sieve size, 0.5 mm), packed in a well-labeled polyethylene whirl- pack and stored at 4 °C prior to analysis. All three replications from the field were sampled for laboratory analysis.

Determination of physical properties

The cowpea varieties used for the assessment (Table 1) were Pant Lobia-1, Pant Lobia-2, Pant Lobia-3, Pant Lobia-4 and Pant Lobia-5 that were released in GBPUAT, Pantnagar. Physical properties were estimated for each of the five varieties using the following methods:

- Seed weight (g):100 seeds of each variety were randomly selected and weight (g) was recorded.
- Seed color: The seed color was determined visually and from breeder's information that was provided during the application for release.

Determination of proximate composition

Crude Protein content was determined by the Kjeldahl method using Kjeltec™ Model 2300, as described in Foss Analytical AB manual (Foss, 2003) [13]. A conversion factor of 6.25 was used to convert from total nitrogen to the percentage of CP.

Determination of iron and zinc

Iron (Fe) and zinc (Zn) contents were determined using the method described in AOAC (AOAC, 2005) [12]. Five grams (5 g) of each flour sample was gently heated over a Bunsen burner flame until most of the organic matter was destroyed. The remaining material was further exposed to high temperatures in a muffle furnace for several hours until white-grey ash was obtained and then cooled. About 20 ml of distilled water and 10 ml of dilute hydrochloric acid were added to the ash material. This mixture was boiled, filtered into a 250 ml volumetric flask, washed thoroughly with hot water, cooled, and made up to volume. Contents of Fe and Zn in each sample were analyzed using Atomic Absorption Spectrophotometer (PYE Unicon, UK, and Model SP9).

Results and Discussions

Table 1: Physical characteristics of the five cowpea varieties.

Varieties	Pant Lobia-1	Pant Lobia-2	Pant Lobia-3	Pant Lobia-4	Pant Lobia-5
Plant type	Erect	Semi-erect.	Erect bush.	Erect bush.	Erect bush
Flower colour	White	Purple	Purple	White	Dark purple
Days to 50% flowering	40-45	45-50	40-45	40-45	40-45
Mature Pod colour	straw	straw	straw	straw	straw
Pod Length (cm)	13	15-20	16-18	14-16	16-18
Seeds/pod	14-18	14-18	14-16	12-14	12-14
Seed colour	White	Red	Dark Brown	White	Brown
Seed size	Medium	Medium	Medium	Medium	Bold Large
Protein content in grain	27	30	27	25	25
Photosensitivity	Photoinsensitive	Photoinsensitive	Photoinsensitive	Photoinsensitive	Photoinsensitive
Days to maturity	60-70 days	65-75 days	65-70 days	60-65 days	65-70 days
Yield potentiality	20q/ha	25q/ha	18-20 q/hac	14-18 q/ ha	16-20 q/ ha
Resistance to biotic and abiotic stresses	*Resistant*	*Resistant*	*Resistant*	*Resistant*	*Resistant*

Seed coat color

The analyzed varieties had the following colors: Pant Lobia-1(white), Pant Lobia-2 (red), Pant Lobia-3 (brown), Pant Lobia-4 (white) and Pant Lobia-5'(tan). Seed color in cowpea is an essential feature because it directly influences the marketability of the grain (Lopes, 2003) [14].

Seed weight and size

The value of 100 seed weight are as follows, PL-1 (14-15), PL-2 (13-15), PL-3 (10-11), PL-4 (13-14) and PL-5 (17-18). The results are similar to the findings of (Kabambe *et al*., 2014), who found that IITA-improved varieties were superior in terms of seed weight. This is a vital marketing trait as the heavier the seeds, the better the price they command. In processing, seed weight is also an essential information for designing the appropriate processing machines that could handle a maximum weight of seeds. Seed size in cowpea is crucial because it directly indicates the productivity of the variety and, together with color standards, determines grain quality for commercialization (Lopes, 2003) [14]. In most of the cowpea lines, the seed size varies, some varieties weigh less than 10 g per 100 seeds and some weigh approximately 30g (Ehlers, 1997) [15]. The size of the grains indicates the quality of seeds because vegetative growth is usually affected by the initial quality of the seeds that were planted. Good quality seeds contribute15–20% to increases in yield (Ambika, 2014) [16].

Grain yield

Grain yield was determined by weighing harvested seeds/ plot and calculated yield/ hectare was based on the area harvested. All the improved varieties gave higher seed weight and higher seed yield performance in the field as shown in Table 1.

Table 2: Data on Quality Characteristics

Item	Pant Lobia-1	Pant Lobia-2	Pant Lobia-3	Pant Lobia-4	Pant Lobia-5
Protein Content (%)	27.4	29.6	25.21	24.75	22.51
Iron (mg/100 g)	8.95	9.01	9.68	5.10	6.60
Zinc (mg/100 g)	3.20	2.54	4.19	3.57	5.59
Manganese (mg/100 g)	1.11	1.10	1.14	1.18	1.30

Proximate composition of cowpea varieties

Results from proximate analysis (Table 2) indicate that the Protein content range from 22.51-29.6%. This finding agrees with those reported by authors (Ajeigbe, 2008, Fatokun, 2000, Mamiro, 2011) [10, 17, 18], who found that the protein content of most of the IITA-improved varieties ranged between 20% and 27%. The high protein contents in these varieties could address high levels of protein deficiency such as kwashiorkor. The presence of iron and zinc in all the cowpea varieties is vital as these are micronutrients responsible for essential body functions, and a deficiency in these minerals can lead to severe medical conditions. The iron content range from 5.10 to 9.68 (mg/100 g). Iron is needed for the transfer of oxygen to body tissues and other organs (Beigi, 2015) [22]. The Zinc content range from 2.54 to 5.59 (mg/100 g). This range of values is similar to reports by Central Statistics Office (CSO) and UNICEF (CSO, 2011) for a study that was done in Iringa location, Tanzania. Zinc plays an essential role in the body in terms of metabolism, and it prevents illnesses by supporting the immune system (Beigi, 2015) [22]. The Manganese content range from 1.10 to 1.30 (mg/100 g). The result of this study agrees with the report of Singh. The results show that the improved varieties are nutritionally good. The findings are in agreement with Mamiro *et al*. (Mamiro, 2011) [18].

Conclusion

The results of this study have shown that the released cowpea varieties that were released in GBPUAT, Pantnagar have a high seed weight that is an important factor for the design of industrial grain processing machines for both small and medium scale cowpea processors. In terms of nutritional content, the studied varieties have high protein and Iron and Zinc contents, and would be suitable for addressing protein-energy malnutrition as well as in formulating blends for baby foods.

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