Proximate and Mineral Composition Profiling in Cowpea ((*Vigna unguiculata* LWalp.)

ABSTRACT

Micronutrients are most important growth promoting elements for crops as well as for humans. As per some reports (Gosh, *et al.*, (2019)) more than two billion of the global populations are malnourished. Micronutrient malnutrition among the people of every age is very common in developing countries like India. Cowpea one of the vital grain legumes in India is the cheapest sources of proteins, vitamins and micronutrients and can be supplied to the people through daily diet. In this regard profiling of the proximate composition and mineral contents in seeds of diverse cowpea genotypes was done at Seed Unit, UAS, Dharwad. The results revealed significant differences for different of proximate and mineral contents of cowpea varieties evaluated. Highest protein content of 21.12% and fibre content of 11.30 % was observed in samples of PL -2 and PL-5 respectively. Fe content in cowpea variety PL-2 was found to be the highest (99.1ppm) than the rest of minerals *viz.*, Zinc (56.3 ppm) and manganese content (9.8 ppm) among the genotypes indicating that cowpea is good sources for these micronutrients *viz.*, iron, zinc and manganese. Of all the minerals evaluated, concentration of iron (Fe) was found to be the highest in all the cowpea genotypes, thus indicating that the cowpea genotypes have ability to improve the haematology indicators of cowpea consumers. Thus, these cowpea genotypes serve as source of useful genetic resources for cultivar development for grain nutrients composition.

Keywords: Cowpea, malnutrition, minerals, proximate composition

Introduction

Report of the World Health Organization (WHO) estimates that over 820 million people are hungry, two billion have micronutrient deficiencies and nearly another two billion are obese or overweight, indicating a paradigm shift toward nutritional security (UNEP 2021). Further during the COVID-19 pandemic period also, the importance of micronutrients in maintaining a well-functioning immune system was well established. Efforts to increase bioavailability of micronutrients through dietary supplementation, food fortification and dietary diversification have been made and is going on to reduce micronutrient malnutrition. However, the potential and effective way for reducing global micronutrient deficiency is being anticipated through the production of nutri-rich staple food crop cultivation.

Arid legumes are the most important group of crops having special significance in sustainable farming and nutritional security as they provide excellent sources of protein, minerals, vitamins and crude fiber. They are considered as healthy vegetable food as well as offer nutritional security to millions of people, especially in South Asia and Africa (Langyan *et al.*, 2022) and are most valued as relatively cheaper source of protein and energy as compared to animal proteins. Legumes do also contain several nutritional factors whose beneficial effects on human health need to be fully exploited. Cowpea is one of the food legume mainly cultivated in Asian and African countries as a dual purpose crop. Cowpea is oftenly called as "black-eyed pea" due to its black or brown ringed hilum and also as "vegetable meat" or "poor man's meat" as it serves a major role in human nutrition. It is considered one of the best climate resilient legumes and has suitable agronomic features for cultivation on dry lands under low input condition of marginal lands (Prabhamani and Potdar, 2018). Its nutritional value is comparable with other commonly consumed pulses like chickpea, pigeonpea, mung, lentil and serves as a cheap source of nutrition for unprivileged rural communities residing in inaccessible areas (Langyan *et al.*, 2022).

Cowpea has a nutritional profile similar to other pulses with a relatively low fat content and a 25 percent total protein level, which is two to four times higher than cereal and tuber crops (Abebe, & Alemayehu, 2022). As in other pulses, in cowpea grain is rich in lysine and tryptophan which are limiting amino acids in cereal crops. Besides being a rich source of protein, cowpea grain has a good profile of vitamins and minerals (Abebe, & Alemayehu, 2022). .

In India, cowpea is commonly consumed as whole grains, used in preparing various region specific dishes like curry, vada in south region and curry in north region. Presently, efforts are being made towards genetic improvement of cowpea varieties in India; this research therefore aims to assess the protein and micronutrients contents of five cowpea genotypes, to enhance the of effort breeders in this regards.

Material and Methods:

The experiment was carried out with five cowpea genotypes collected from diverse sources (Table 1.) in a randomized complete block design with three replications during the year 2020-21 and 2021-22 at Seed Unit, University of Agricultural Sciences, Dharwad. Each genotype was sown in a plot size of 4 x 2.25 m^2 area having 6 rows. Row to row and plant to plant distance were maintained at 45 and 10 cm respectively. All the recommended agronomic practices were followed to raise healthy crop. At maturity, yield and other component traits were recorded. Seeds were cleaned and some nutritional parameters were evaluated on the seeds.

Estimation of nutritional parameters:

Proximates were estimated from seeds by as per the standard protocols given by the Association of Official Analytical Chemistry (AOAC), 2005. Seeds were powdered using pestle and mortar and oven dried to determine the moisture content of the sample and stored in desiccators. The dry powder was used to estimate the ash content in a muffle furnace. The dry powder was also used to determine the fat content (FC) by using Soxhlet extraction apparatus (SOCS PLUS six place automatic solvent extraction systemmodel SCS 6 AS DLS, Pelican). Protein analysis was done for the same sample by micro-Kjeldahl method as described in Sadasivam and Manickam (1992) with minor modification. The crude fiber (CF) was assessed from the defatted samples using alkali and acid digestion followed by ash estimation. Micronutrients magnesium, potassium, manganese, zinc, phosphorus, calcium, iron were estimated using Inductively Coupled Plasma-Mass-Spectrometry.The data were summarized as the means of three replicates with standard deviation as the measures of variability.

Results and Discussion:

The result obtained for thirteen different nutrient components in five genotypes is presented in the Table 2. The results revealed the presence of variation for each one of the nutrient components. Among the genotypes evaluated, protein content ranged from 17.52 % to 21.12 % and highest protein content was recorded in PL-2 (21.12 %) while, DC-15 (17.52 %) recorded lowest value. Fibre content is very important in the digestion process of human being. Highest fibre content of 11.30 % was recorded in PL-5 however no much variation in the fibre content was observed among the genotypes. Carbohydrate concentration was showed range of variation (51.13 % - 55.67%) the genotype PL-3 recorded highest value of 55.67 %. Ash content varied from 2014 % to 3.75 % with highest ash content in PL-3 (3.75%). Similar results were obtained by Massey and Nautiyal. (2020), Belane and Dakora. (2019).

Cowpea seeds in addition to protein also contain high levels of important dietary nutrients which are highly are required for human nutrition and health, especially for overcoming trace element deficiency and promoting brain development (Belane and Dakora., 2011). Present study also exhibited a wide range of variation for these nutrients in cowpea seeds. In this study, micronutrients distribution in cowpea seed also differed markedly among the genotypes under study with a range of 26.2-56.3ppm for Zinc (Zn), 47.1-99.1ppm for Fe, 3.3-9.8 ppm for Manganese (Mn) and 0.12-0.78 % for magnesium the most abundant minerals in cowpea grains. The report by Dakora and Belane. (2019), Bolbhat and Dhumal. (2014) supported such wide variation observed in the present investigation.

Results obtained from this study revealed that Fe (99.1 ppm) and Zn (56.3 ppm) were the micro minerals with highest concentrations in all cowpea genotypes studied indicating that the cowpea genotypes are good sources of these micronutrients. and identification of genotypes with high amounts of Fe and Zn could contribute significantly to improve the micronutrient status of the diet of consumers. These results are in accordance with the findings of Belane and Dakora. (2019), Bolbhat and Dhumal. (2014). The genotype PL-2 was the most nutrition dense cowpea genotype studied, as it had the highest concentrations of carbohydrate, protein, iron (Fe) and zinc (Zn) (Fig 1) indicating there is huge scope for genetic enhancement of cowpea genotypes for nutritional parameters.

Conclusion:

The present study has showcased the presence of wide range of variation for different nutritional parameters in the cowpea genotypes studied. High concentration of protein, Fe and Zn was showed by PL-2 cowpea genotype implies ample opportunity for development of genotypes with enhanced nutritional parameters. Thus, in the present climate change scenario, to meet the nutritional security along with food security, genetic enhancement in cowpea is of appropriate choice.   The nutrition rich genotypes identified in the present study will be a promising genetic material for plant breeders in feature.

Disclaimer (Artificial intelligence)

Option 1:

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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Table 1. Details of cowpea genotypes used for study.

Sl no.	Genotype	Source of Collection
1	DC-15	Seed Unit, UAS, Dharwad
2	PL-2	RIIPR, Dharwad
3	PL-3	RIIPR, Dharwad
4	PL-4	RIIPR, Dharwad
5	PL-5	RIIPR, Dharwad

Table 2. Proximate profile in diverse cowpea genotypes.

Sl no	Genotype	Carbohydrate (%) {mean ±SD}	Ash (%) {mean ±SD}	Fat (%) {mean ±SD}	Fibre (%) {mean ±SD}	Protein (%) {mean ±SD}	P (%) {mean ±SD}	K (%) {mean ±SD}	Mg (%) {mean ±SD}	Ca (%) {mean±SD}	Zn (ppm) {mean ±SD}	Fe (ppm) {mean±SD}	Mn (ppm) {mean ±SD}
1	DC-15	52.13 ±0.14	3.14 ±0.11	0.19 ±0.01	10.9 ±0.96	17.52 ±72	4.15 ±0.49	1.07 ±0.20	0.12 ± 0.05	0.12 ± 0.01	26.2 ± 1.65	47.1 ± 0.67	19.8 ± 1.34
2	PL-2	55.67 ±1.15	3.45 ±0.05	0.95 ±0.05	10.8 ±1.12	21.12 ±1.02	3.31 ±0.31	0.90 ±0.04	0.18 ±0.02	0.10 ± 0.05	56.3 ± 2.06	99.1 ± 2.62	3.3 ± 0.77
3	PL-3	55.26 ±1.59	3.75 ±0.13	0.97 ±0.08	11.1 ±0.63	18.72 ±0.85	3.87 ±0.83	1.04 ±0.051	0.18 ±0.07	0.10 ± 0.08	180.2 ± 5.91	76.9 ± 3.10	9.8 ±1.10
4	PL-4	54.61 ±1.52	3.49 ±0.11	0.99 ±0.06	10.9 ±1.06	20.65 ±0.71	4.03 ±0.46	1.01 ±0.31	0.78 ±0.17	0.09 ± 0.06	66.6 ± 1.46	51.2 ±1.50	7.4 ±1.02
5	PL-5	51.13 ±1.05	3.56 ±0.29	1.002 ±0.10	11.3 ±0.46	18.53 ±0.51	2.83 ±0.22	0.099 ±0.12	0.48 ±0.07	0.06 ± 0.10	86.2 ± 0.87	60.4 ± 1.22	4.6 ±0.47
MEAN		53.76	3.48	0.82	11.00	19.31	3.64	0.82	0.35	0.09	37.76	66.94	66.94
MINIMUM		51.13	3.14	0.19	10.80	17.52	2.83	0.10	0.12	0.06	26.20	47.10	47.10
MAXIMUM		55.67	3.75	1.00	11.30	21.12	4.15	1.07	0.78	0.12	56.30	99.10	99.10
RANGE		51.13-55.67	3.14-3.75	0.19-1.002	10.8-11.3	17.52-21.12	2.83-4.15	0.099-1.07	0.12-0.78	0.06-0.12	26.2-180.2	47.10-99.10	3.30-9.80

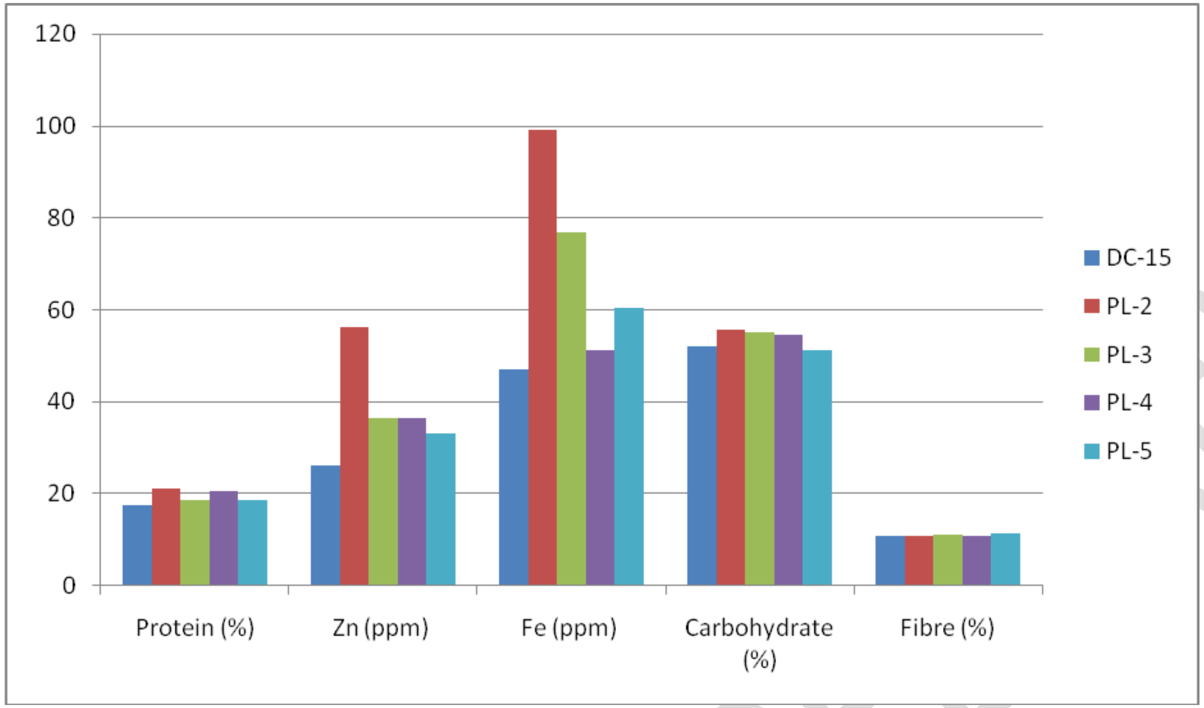

Fig 1. Protein, Iron, Zinc, carbohydrate and fibre content variation in cowpea genotypes