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Determination of nutritional quality of some less known wild edible legumes and their microgreens by using phytochemical analytical tools

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Abstract
Legumes are an essential part of the human diet in many parts of the world, particularly in underdeveloped countries, where they supplement the lack of protein in grains, roots, and tubers. Legume seeds contain a variety of nutritious components, some of which are proteinaceous and others that are not. Aside from the seeds and pods, microgreens of legumes had a high nutritional profile. Microgreens are immature plantlets picked after about one week of growth. The present study is to evaluate the significant changes in the chemical composition of five pairs of wild under exploited legume seeds and their microgreens. The selected species are *Vigna vexillata, Phaseolus lunatus*, *Canavalia maritima*, *Calopogonium mucunoides* and *Peuraria phaseoloides.* The specimens were subjected to dry weight determination, qualitative as well as quantitative biochemical analysis. Moisture, fiber, pectin, total carbohydrate, total starch, reducing sugar, soluble sugar, total protein, free amino acid content, total antioxidant activity and some anti-nutritional components were also estimated quantitatively. The compounds such as carbohydrate, sugar, starch and protein were found higher in seeds whereas fiber content and antioxidant composition were found increasing on germination. Studies depicts that anti-oxidant components have the potential to lower the risk of several disease. So that both enzymatic as well as non-enzymatic antioxidants were also analysed for all the seeds and microgreens. These show interesting variations in results.

Keywords: legume, microgreen, phytochemicals, antioxidants

Introduction

Legumes occupy an important place in the world food and nutrition [1]. The high protein content makes them desirable crops in agriculture. Recently it is being acknowledged that food proteins are not only a source of constructive and energetic compounds as the amino acids, but also they may play bio-active roles by themselves and can be the precursor of biologically active peptides with various physiological functions [2]. The consumption of legumes has also been reported to be associated with numerous beneficial health attributes [3] such as hypocholesterolemic, antiatherogenic, anticarcinogenic and hypoglycemic properties [4].

Vigna species contain a number of bioactive substances including enzyme inhibitors, lectins, phytates, oligosaccharides and phenolic compounds that play metabolic roles in human and prevent them from many diseases. Globulins and glutelins were the major protein fractions found in *Vigna species* followed by albumin. *Vigna* is also rich with minerals (like Cu, Mg, Mn, Zn), vitamins (thiamin, riboflavin, pyridoxine etc.) and secondary metabolites like saponin, phytic acid, tannin etc. [5]. Phytic acid protects DNA damage due to its antioxidant activity [6].Germination increased the crude protein, iron and total phosphorus but decreased the carbohydrate, fat and total poly phenols content [7].

Canavalia is a legume that offers good possibilities for getting protein, fiber, amino acids (rich in lysine), minerals etc. [8]. But studies reveal that pressure cooking and roasting will reduce lysine levels [9]. Anti-nutrients usually found in legume seeds typified by lectin, phytin, tannin, cyanide etc. [10].On eating *Phaseolus* we get essential amino acids such as isoleucine, leucine, lysine, methionine, phenylalanine, threonine and valine [11]. More over Phaseolus contain high amount of protein, crude fiber, fat and minerals [12]. *Calopogonium mucunoides* and *Peuraria phaseoloides* are legumes well known as cover crops and widely used as forage/ grazing crop [13]. This study is to evaluate the significant changes in the chemical composition of five pairs of wild legumes and the microgreens produced from them. The five legume species selected for the present study are *Vigna vexillata, Phaseolus lunatus, Canavalia maritima, Calopogonium mucunoides* and *Peuraria phaseoloides* (Fig.1)

Fig 1: A. Habit of *Vigna vexillata, B. Phaseolus lunatus, C. Canavalia maritima, D. Calopogonium mucunoides* and *E. Peuraria phaseoloides.*

Materials and methods

1. Study area and Identification of plants

Extensive field surveys have been conducted to collect the selected species of the wild edible legumes from Kozhikkode, Kannur, Kasaragod and Wayanad districts of Northern Kerala. The distribution of the selected plants were done by using the check list released by Kerala Forest

2. Phytochemical methods adopted

The amount of material left after the removal of the moisture was the dry matter. Dry matter and moisture of the material were determined by the method of AOAC [14]. Then the seeds were tested for the percentage composition of Ash [14], fat [15], crude fiber [16] and pectic substance [17]. Then these were quantitatively estimated for total starch [15], Total carbohydrates [18], reducing sugar [19], total soluble sugar [20], total protein [21], total free amino acid [22] and proline [23]. The seeds were also tested to know their total anti-oxidant activity [24]; and both enzymatic (SOD and Catalase) [25, 26] as well as non-enzymatic anti-oxidants (Polyphenols and Ascorbic acid) [27, 28].

Results and Discussion

The plants selected for the present study are *Canavalia maritima, Calopogonium mucunoides, Phaseolus lunatus, Peuraria phaseloides* and *Vigna vexillata*. In which *Canavalia maritima* is a perennial tropical legume usually growing in sand dunes of beaches [29] and *Calopogonium mucunoides, Phaseolus lunatus* and *Peuraria phaseloides* are known potential forage crops [30, 31, 32]. Medicinal properties of *Phaseolus lunatus* [33], *Peuraria phaseloides* [34] and *Vigna vexillata*[35] were also studied because of the presence of several bioactive components and secondary metabolites. *Peuraria phaseloides* and *Vigna vexillata* are used widely as grazing forage crops for live stocks [36 & 37]. Moreover it is proved that incorporation of *Calopogonium mucunoides* as a green manure along with inorganic fertilisers will produce higher yields than using organic fertilisers alone [38]. The amount of moisture in the seeds is the most important factor influencing seed viability during storage. Generally seeds with higher moisture content will have a lower shelf life. Lowest moisture content is found in seeds of *Calopogonium mucunoides* and highest moisture content is recorded for seeds of *Canavalia maritima.* In the case of moisture content percentage of microgreens *Vigna vexillata* stands first and *Phaseolus lunatus* came last. Dry weight content is always seen very much higher in seed tissues (Fig. 2).

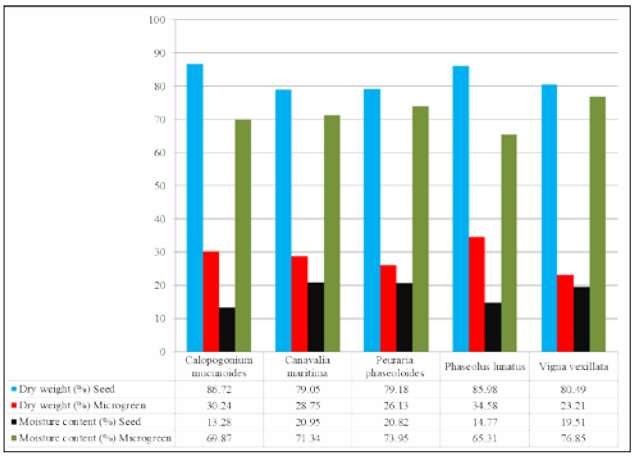

Fig 2: Moisture content and dry weight percentage of legume seeds.

The qualitative tests were done to screen the presence of ten compounds. Every genus shows its own uniqueness during the test. Among the ten compounds tested, saponin, flavonoid, tannin and coumarin were present in all the three genera. Then coming to the quantitative estimations the compounds such as ash content, pectic substance and fat content, they were generally found higher in seeds of wild edible plants when compared to their microgreens whereas crude fiber is drastically increasing in microgreens, especially in *Phaseolus lunatus, Vigna vexillata* and *Peuraria phaseoloides* (Table.1).

Table 1: Results of Ash content, Fat content, Crude fiber and Pectic substance.

Plant name	Ash content (%)		Fat content (%)		Crude fiber (%)		Pectic substance (%)	
	Seed	Microgreen	Seed	Microgreen	Seed	Microgreen	Seed	Microgreen
Calopogonium mucunoides	3.647	1.723	2.843	0.038	12.08	18.92	2.331	0.135
Canavalia maritima	4.201	2.991	4.065	0.534	9.932	14.53	1.623	0.027
Peuraria phaseoloides	4.352	1.324	5.024	0.831	10.54	21.25	2.345	0.952
Phaseolus lunatus	2.076	1.045	4.057	0.179	11.53	19.47	1.099	0.037
Vigna vexillata	4.305	1.207	2.188	0.095	4.827	18.28	1.952	0.332

Both the seeds and microgreens of *Canavalia maritima* are having higher carbohydrate content while other components like total starch, reducing sugar and soluble sugar are significantly higher in microgreens of *Calopogonium mucunoides* (Table. 2). Legume seeds are repositories of protein, here the qualitative test results shows that seeds and microgreens of *Canavalia maritima* is highly proteinaceous. Their seeds contain 382.1 mgs of protein in one gram of sample and 188.5 mgs of protein is available in one gram of microgreens.

Then the compounds like total free amino acid and proline were found significant increase in microgreens of *Calopogonium mucunoides* and *Phaseolus lunatus* respectively (Table. 3).

Table 2: Amount of total carbohydrate, total starch, reducing sugar and soluble sugar in legumes.

Plant name	Total carbohydrate (mg/ gFW)		Reducing sugar (mg/gDW)		Soluble sugar (mg/ gDW)		Total starch (mg/ gFW)	
	Seed	Microgreen	Seed	Microgreen	Seed	Microgreen	Seed	Microgreen
Calopogonium mucunoides	510.9±0.01	252.5±0.11	8.306±1.33	6.335±2.01	18.76±0.01	9.959±0.23	194.9±0.23	123.3±0.02
Canavalia maritima	614.8±0.04	373.8±0.03	5.778±0.01	3.455±0.03	20.16±1.03	9.411±0.01	341.5±0.03	112.7±0.01
Peuraria phaseoloides	546.1±0.13	211.8±0.01	6.112±1.02	3.847±0.01	24.31±0.11	8.895±0.03	193.6±0.01	99.54±0.11
Phaseolus lunatus	583.8±0.03	199.5±0.01	9.357±0.23	5.885±0.02	21.19±0.01	7.324±2.01	232.4±1.14	113.9±1.03
Vigna vexillata	524.2±2.01	249.4±0.02	4.375±0.03	3.047±1.03	33.05±1.02	13.78±1.02	248.8±1.33	114.5±2.02

Studies depicts that anti-oxidant components have the potential to lower the risk of several diseases [39]. The non-nutrient metabolites, when compared to pharmaceuticals, have a low potency, but being a part of regular diet in considerable amounts, they apparently provide long-term health profiling effects [40]. So that screening to find the amount of anti-oxidants is very significant. Total antioxidant activity shows doubling in values when the seeds become microgreens. Enzymatic antioxidants like catalase and superoxide dismutase also shows drastic increase when the seeds become microgreen while selected specimens do not show such prominent variations in the levels of non-enzymatic antioxidants.

Total antioxidant activity of both seeds and microgreen of *Peuraria phaseoloides* is the highest among all. The seeds and microgreens of *Canavalia maritima* is found superior for catalase activity, while that of *Vigna vexillata* is found higher for the activity of superoxide dismutase. Then coming to non-enzymatic antioxidants like phenolics and ascorbic acid, these two were also quite showing an increase but not that much as in the case of enzymatic antioxidants. Phenolics and ascorbic acid are reported higher for the microgreens of *Vigna vexillata* and *Peuraria phaseoloides* respectively. All the test results are included in the figure 3 given below.

Table 3: Amount of total protein, total free amino acid and proline in legumes.

Plant name	Total Protein (mg/gDW)		Total Free Amino acid (mg/g DW)		Proline (mg/g DW)	
	Seed	Microgreen	Seed	Microgreen	Seed	Microgreen
Calopogonium mucunoides	359.6±0.01	125.5±0.03	1.056±0.11	0.954±0.03	3.015±2.01	4.123±1.03
Canavalia maritima	382.1±0.03	188.5±0.01	1.832±0.23	0.575±0.01	13.74±0.01	17.05±0.02
Peuraria phaseoloides	327.2±0.14	110.3±1.33	0.854±1.03	0.811±0.01	8.992±0.11	15.18±0.01
Phaseolus lunatus	262.2±1.02	125.8±2.01	0.563±0.01	0.525±0.01	12.65±0.03	20.56±0.03
Vigna vexillata	290.3±3.01	118.4±0.02	0.912±2.02	0.857±0.02	9.021±1.34	15.37±0.23

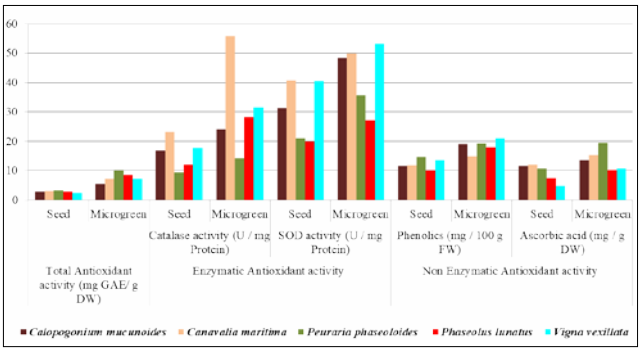

Fig 3: Results of antioxidant analysis in legumes.

Conclusion

Legumes have a high nutritional content, which includes protein, carbs, amino acids, vitamins, minerals, anti-oxidants, and so on. The findings of this study show that neglected and underutilised wild legumes can yield nutritionally dense microgreens. The outcome of this comparative profile of anti-oxidant enzyme activity and phytochemical properties of five pairs of legume seeds and their microgreens suggest that these products need to be highly recommended in everyday diet of man, because microgreens are exclusively rich with dietary fibers and other nutrients like antioxidants. More over microgreens are getting more attention day by day, not only because of its nutritional qualities but also the easiness in their cultivation procedure. These very young vegetable greens are consumable without much delay on cooking or even can be taken up as fresh. On behalf of this study we recommend all to come forward for microgreens because these are immense repositories of nutrients.

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Conflict of interest

The authors have no conflict of interest to report.

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