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Comparative Study of Proteins and Some Amino Acid composition in the Foliage's of Various Plant Species

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Abstract

A Green leafy vegetable particularly the underutilized plant species contains an important source of proteins and amino acid. These proteins and amino acids are very essential as they determine the nutritional quality of any foodstuffs. The present study aims to evaluate the protein content and some amino acid composition from the leaves of eight different plant species which are Berseem (*Trifolium alexandrium* L.), *Alysicarpus vaginalis* L. var. stocksii., *Alternanthera paronychioides* St. Hil., Cabbage (*Brassica oleracea* L. var. capitata), Radish (*Raphanus sativus* L.), Adulsa (*Adhatoda vasica* Nees.), Bauchi (*Psoralia corylifolia* L.) and Jowar (*Sorghum bicolor* L.). The prepared leaves samples have 5.21-30.83% crude protein and 1.78-6.04% soluble protein. The content of amino acids like methionine and tryptophan ranges from 0.069-10.520 g/16g N and 0.078-0.467 g/16g N respectively.

Keywords: - Protein, Amino acid, Leaves, Methionine, Tryptophan etc.

Introduction and Review of Literature

India and many developing countries in the last few decades are facing the problem of malnutrition, especially protein-calorie malnutrition. In most, developing nations about 31% of all children under the age of five years have been affected by hidden hunger (Andini, et. al. 2013). Secondly, the increased population growth and urbanization are coupled with increased demand for food to cope with the problem of malnutrition in peri-urban areas (Amata and Lebari, 2012). To maintain proper physical and mental human health it is essential to have balanced nutrition in the daily diet (Nurzynska-Wierdak, 2015). Therefore, it is necessary to search for some alternate source of protein. Green leaves represent an ample source of good-quality proteins, the proteins in the leaf are metabolically active components,

mostly enzymes, involved in physiological activities in plants. However, only the leaves of a few species, mostly leafy vegetables are at present utilized by man.

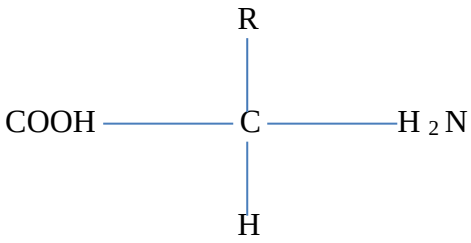


Fig. General structure of amino acids

During the last few decades, various workers in this field acknowledge that wild or semi-wild plants are nutritionally valuable due to the presence of high proteins, amino acids, vitamins, minerals, essential fatty acids and fibre contents etc. Some plants also add taste and colour to diets (Gafar et. al, 2010).In developing countries like West Africa and Nigeria, since there is a shortage of food and secondly, the cultivated green leafy vegetables are much more expensive as it is not affordable to the peoples of rural communities. So these peoples mostly rely upon wild and semi-wild leafy vegetables as the prevalent source for their consumption (Kubmarawa et. al. 2008). Wild edible plants provide substantially to the diet of the population, particularly during the shortage of food supply (Glew et. al, 2010). Leafy vegetables are a prominent source of supplementary protein and calories as well as vitamins, ascorbic acid, niacin, riboflavin and thiamine and minerals, calcium and iron content (Ayodele and Olajide, 2011; Athanase, et. al, 2018). The green leafy vegetable has long been acknowledged as an inexpensive and ample conceivable source of protein (Adeyeye and Oyarekua, 2015). The utilization of leafy vegetables is associated with diverse health advantages since it is a constant source of medicinal properties and high nutritional value (Ijarotimi et. al, 2021). Leafy vegetables are chief conservational food, highly useful for the improvement of health and avoidance of diseases. They contain beneficial food constituents that can be used to develop and restore body tissues (Aja, et. al. 2021).

Therefore in light of all these published reports, In the present study, a total of eight plant species have been selected since the leaves of these plants are under-utilized or wasted and the leaves of these plants are readily available abundantly and because some of them are

recognized as popular additions to the diet. These leafy plants are inexpensive and rich sources of several nutrients and have been eaten for many years.

Materials and Methods

During the present investigation, eight different wild and some cultivated plant species are underutilised viz. Berseem (*Trifolium alexandrium* L.), *Alysicarpus vaginalis* L. var. stocksii., *Alternanthera paronychioides* St. Hil., Cabbage (*Brassica oleracea* L. var. capitata), Radish (*Raphanus sativus* L.), Adulsa (*Adhatoda vasica* Nees.), Bauchi (*Psoralia corylifolia* L.) and Jowar (*Sorghum bicolor* L.) were chosen as a protein source. These plant materials were authenticated at the Department of Botany, RTM Nagpur University, Nagpur. The starting material i.e. the fresh leaves of these plants was harvested from the field at its vegetative stage and processed within 2 – 3 hours after being obtained from the field. The samples were prepared and assessed for protein and amino acid composition.

Quantification of Methionine and Tryptophan: - The estimation of amino acids like methionine and tryptophan was done according to Sadasivam and Manickam (1996) from fresh leaf samples of selected plants.

Quantitative estimation of crude protein (CP):-It was estimated by the Micro-kjeldahl method suggested by Davys *et al*. (1969).

Protein estimation by Lowry's method:-Protein estimation of fresh leaf samples was done by following Lowry's method given by Sadasivam and Manickam (1996).

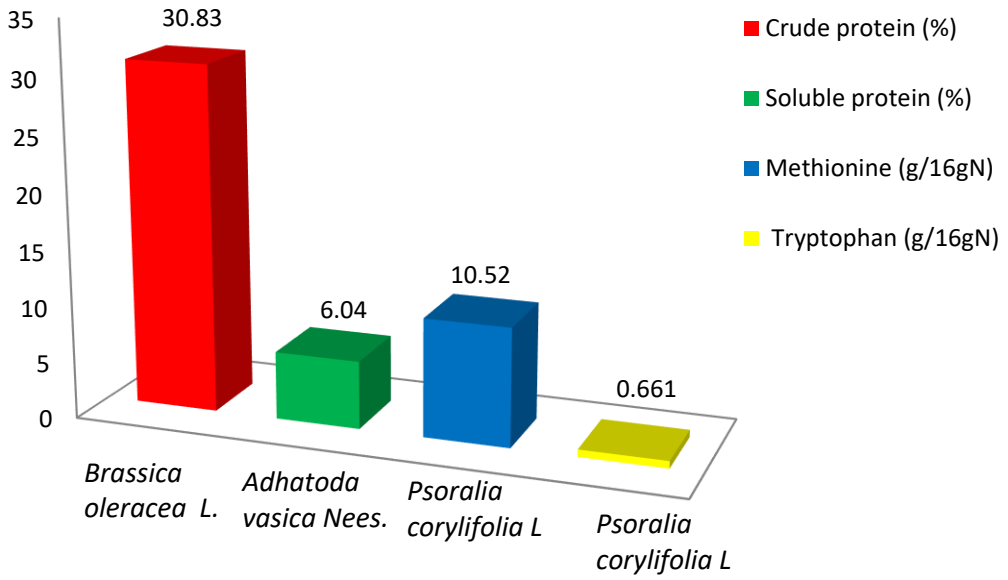
Results and Discussion: -The comparative findings on protein and amino acid composition of the fresh materials of the various plant species under investigation were illustrated in fig.1 and Table No. 1. The highest amount of crude protein content was reported in *Brassica oleracea* L.(30.83 %), the lower amount in *Alternanthera paronychioides* St. Hil. (5.21%) whereas remaining plant species shows the crude protein content in the ranged between 7.03-11.80%. The maximum amount of soluble protein content was quantified in *Adhatoda vasica Nees. (*6.04%) followed by *Alysicarpus vaginalis* L.(5.04%), the minimum amount in *Brassica oleracea* L. (1.78%), however, the remaining plant species exhibits the quantity of soluble protein in between 2.96-4.74%.

The results on amino acid content showed that the maximum amount of methionine and tryptophan content was observed in *Psoralia corylifolia* L.i.e. 10.520g/16gN and

0.661g/16gN, the minimum in *Brassica oleracea* L. which was 0.069 and 0.078 g/16gN respectively. The remaining plant species exhibits an appreciable amount of methionine content which ranges from 0.947 g/16gN -7.327 g/16gN. The values of tryptophan content in the remaining plant species were lower as against methionine content which ranges between 0.123 g/16gN -0.661 g/16gN.

With the use of software (Graph Pad Prism 4), all the findings were statistically analysed.

Fig.1. Proteins and Amino acid composition of Selected Plant Species.



Several studies have documented the proximate content of proteins and amino acid profiles in the leaves of various plant species. Ravichandran and Ravichandran, (1988) reported the values of crude protein content in different maturity stages of *Cassava* leaves as 38.1%, 28.6% and 19.7% in very young, young and mature leaves respectively which is quite similar in the present study as it was comparable with the *Brassica oleracea* L., they also reported methionine content as 2.0, 1.8 and 1.3g/16g N in very young, young and mature leaves respectively. Similar results were also reported by Kubmarawa et. al, (2008) in the leaves of *Sesamum indicum* and *Balanites aegyptiaca* which show (18.59 % & 15.86%) of crude protein content and (1.08 & 0.73 g/16gN) of methionine content respectively. During the present study in fresh materials, the crude protein content of wild plants was comparatively

less than that of *Brassica oleracea* L. Various workers have reported crude protein content on dry wt. basis of sorghum as 12.1 % (Mungikar, 1999b), 8.3 % (Dakore et al. 1986) and 7.68% (Madibela et al. 2002), but in the present investigation it was 6.76%. This crude protein content variation might be due to soil and seasonal variations. It is also reported that the crude protein content of the plants varied from region to region. The crude protein content of berseem was found to be near the value reported by Mungikar (1999b). The protein content of fresh wild plant materials showed a higher value than that of *Brassica oleracea* L.

Gafar et. al. (2010) shows the methionine content as 0.77 g/100g in fresh plant leaves of *Indigofera astragalina.* Roy et.al. (2013), studied the free and bound amino acid profile in different developmental stages i.e. young, mature and senescent leaves of Sunflower and reported (4.58, 3.91, 3.35 g/16gN) of free methionine & (5.20, 3.64, 3.49 g/16gN) bound methionine content respectively which is quite comparable with the present study. Edelman and Colt,(2016) did a comparative study of minerals and amino acid profile of seed vs. leaf and showed that the values of tryptophan content were (1.6, 1.8, 2.0 %) and methionine content was (2.1, 1.8, 2.1 %) in Spinach, Broccoli and Duckweed leaf respectively. Ijarotimi et. al. (2021), reported the protein, methionine and tryptophan content as (24.17, 1.65 and 4.16 g/100g) respectively in wild lettuce extracts. Glew et. al. (2010) also reported the methionine (1.16mg/g) and tryptophan (3.18mg/g) content in *Cadaba farinosa* leaves. Ayodele and Olajide, (2011), determined the protein and methionine content in leaves of *Celosia argentea* and reported 5.17% of protein and 1.08 g/16gN of methionine content. Amata and Lebari, (2012) studied the comparative analysis of amino acid profiles from fresh leaves of four tropics plant species viz. *Myrianthus arboreus, Gmelina arborea, Terminalia catappa* and *Dacroydes edulis.* They reported 1.87-4.83 g/100g tryptophan content whereas the methionine content ranges between 2.85-5.60 g/100g. Andini et. al. (2013) studied the proteins and amino acid profile in leaves of grain, vegetables and weedy type of Amranthus and shows comparable results with the present findings. Adeyeye and Oyarekua, (2015), quantified the crude protein (28.9%) and methionine (1.88g/100g protein) content in the leaves of tea bush. Ayalew et. al. (2017), reported comparable results with the present study on crude protein, methionine and tryptophan content in the leaf of *Coccnia abyssinica.* Athanase et.al. (2018) performed the comparative study on proteins and amino acid composition of five plant species i.e. *Abelmoschus esculentus, Corchorus olitorius, Ipomea*

batatas, Solanum melongena and Vigna unguiculata., they reported (12.55-19.15g/100g) of protein and (0.72-1.42 g/100g) of methionine content. Aja et. al. (2021), studied the amino acid compositions of three commonly consumed leafy vegetables i.e. *Solanum aethiopicum, Amaranthus hybridus* and *Telfairia occidentalis* and reported (2.21, 1.68, 2.05 g/100g) of tryptophan and (4.27, 1.07, 1.33 g/100g) of methionine content respectively. Alagbe, (2020) studied the comparative evaluation of fresh leaves of *Indigofera tinctoria* and reported (33.53%) crude protein, (1.45%) tryptophan and (3.94%) methionine content.

All these above discussed results reported by various workers were comparable and the values were nearer to the present findings, however, in some cases, a little bit of variation may occur. Such variation in the values of constituents might be due to the regional, soil or seasonal differences, plant species variation and the variability in the stage at which the leaf material has been harvested for analysis.

Conclusion

To evaluate the plants' suitability for consumption by humans or animals, an essential criterion to be considered is the chemical composition. Hence for the present work, crude protein, soluble protein, methionine and tryptophan were evaluated. The study has revealed that the test materials, the leaves of underutilized, wild or semi-wild plant species can provide appreciable amounts of protein, particularly concerning to amino acids, for human or animal and livestock diets in the form of leaf meals.

Conflict of Interests

The authors declare that there is no conflict of interest regarding the publication of this paper.

Table No. -1: Analysis of Proteins and Amino acid composition of selected plant species (fresh weight basis).

Name of the plant's	Crude protein	Soluble Protein	Methionine	Tryptophan

	(%)	(%)	(g/16g N)	(g/16g N)
Alysicarpus vaginalis L.	9.02	5.04	1.632	0.462
Trifolium alexandrium L.	7.55	4.74	6.183	0.356
Alternanthera paronychioides St. Hil.	5.21	2.96	2.643	0.123
Raphanus sativus L.	7.03	3.00	7.327	0.420
Brassica oleracea L.	30.83	1.78	0.069	0.078
Psoralia corylifolia L.	7.98	4.01	10.520	0.661
Adhatoda vasica Nees.	11.80	6.04	1.864	0.280
Sorghum bicolar L.	10.94	4.02	0.947	0.467
Mean	11.3	3.95	3.90	0.356
Std. Deviation	8.17	1.35	3.68	0.192
Std. Error	2.89	0.48	1.30	0.068
Coefficient of variation	72.35%	34.22%	94.53%	53.95%

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