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A ANALYSIS OF SOME NUTRITIONAL FACTORS OF LEAF EXTRACTS AND LEAF PROTEIN CONCENTRATES PREPARED FROM LEAVES OF VARIOUS PLANT SPECIES

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ABSTRACT: The aim of this study was to evaluate the nutritional value of common plant leaves and determine the feasibility of using them as a vitamins and other nutritional supplement. The leafy vegetables are consumed as a source of protein, vitamins and minerals. Leaf protein concentrate (LPC) was extracted from green foliages of some wild and cultivated plants by heat coagulation method. In leaf extract (LE) and leaf protein concentrates (LPCs) the content of crude fat, vitamins like niacin and ascorbic acid has been studied. The plants like *Brassica juncea*, *Brassica napus, Brassica oleracea* (Cultivated). *Chenopodium album, Goniocaulon indicum, Tridax procumbance*, *Vigna trilobata*, *Digera muricata*, *Celosia argentea* and *Ocimum americanum* (wild) were selected for study. The LE and LPC extracted from these plants was used for nutritional studies.

Key words: - Leaf extracts, Leaf protein concentrates, crude fat, Ascorbic acid, Niacin etc.

INTRODUCTION:

The rapid increased growth of population in most of the developing countries has become the major problem of food scarcity specially among the pre-school children, pregnant or nursing women's due to the unavailability of dietary proteins, minerals and vitamins (Aletor and Adebayo, 2012). The deficiency of good quality proteins, vitamins and other nutrients in human and animal food is well recognised and therefore there is a need to provide these nutritional supplement to the over increasing population (Sachan *et al.* 2018). Hence, there is a necessity to find alternative cheap resources than the expensive once (Agbede *et al.* 2007). In developing countries deficiency in vitamins, proteins and other nutrients occurs because they are unable to produce cheap nutritional source for their population and also due to the limited and expensive animal sources (Sodamade *et al.* 2014). Therefore, many workers try to search the suitability of green biomass for replacing proteins, vitamins from animal sources which are very expensive and also economically not feasible. There are several unconventional sources of proteins but due to the excessive photosynthesis and abundant availability as green vegetation, the leaf protein concentrates (LPCs) have finds a better potential as a source of protein (Tripathi *et al.* 2014). Green foliages have great ability to synthesize the proteins and other important nutritional elements. The concentrated form of protein obtained from the leaves of plants is known as leaf protein concentrates (LPCs). The leaf protein concentrates (LPCs) prepared from the leaves of various plant species which are underutilised is the cheap source and having the potential to cope out the problem of under nutrition.

The leaf protein concentrate which is obtained by coagulation of leaf extract, depending on the leaf material used for extraction and the method followed, the LPC contains 40-70% protein, 20-25% lipids and 10-15% carbohydrates on DM basis (Lexander *et al.* 1970, Byers, 1971). It also contains appreciable amount of lipids, β-carotene (Provitamin-A), vitamin E and minerals. The LPC when prepared from suitable leaves, it contains 1.4-1.7mg/g β-carotene. Agbed (2005) studied the preparation of LPC and residues from leguminous plants in sub-saharan Africa and clearly suggested that the LPC contains high crude protein and gross energy which serves as alternative feed for humans and non-ruminants, especially where the food supply is limited. Mineral determination and gross energy of many vegetable leaf meals clearly indicate its nutrition potential as the protein supplementation in monogastric feed formulation (Fasuyi, 2005, 2006). Rajlakshmi and Ramakrishnan (1969) showed that, green leafy vegetables on concentration are cheaper and would be a good source of calcium, iron and carotene on fresh weight basis. The less common leafy vegetables contains a fair amount of nutrients like iron, calcium, β carotene and ascorbic acid which helps to overcome the nutritional deficiency and the diseases like anemia, night blindness in pregnant women's, children's and elderly peoples in the tribal areas (Rao and Tuhina, 2002). Leaf protein concentrate derived from olive leaf, berseem and tulsi may be a cheap alternative as these green leaves are rich sources of micronutrients like carotenoids, zinc and vitamin- A, which have been proved to have good immunomodulatory actions (Dewan *et al.* 2009). It also have good source of ascorbic acid, β-carotene and iron (Yadav and Sehgal, 1997, 2002). Similarly, the young leaves of *Brassica napus* also called as rape have good nutritive value, the composition of young leaves have appreciable amount of protein, fat, carbohydrates and fibre. Singh *et al.* (2005) concluded that products developed from dried cauliflower leaves contain sufficient amount of iron and β-carotene and it can help to meet the recommended dietary allowance (RDA) of iron and β-carotene and thus helps in improving health. Khan and Varshney (2015) suggested that the LPC is found to have more nutritive value as compared to pulses. Due to its high nutritional content LPC have been used as feed for children and included in food formulation. It was therefore, the aim of this study to prepare the leaf extracts (LE) and corresponding leaf protein concentrates (LPCs) from the wild and cultivated plant species which are underutilised with respect to their proximate analysis of nutritionally important contents like crude fat, ascorbic acid and niacin were carried out.

MATERIALS AND METHODS:

During the present investigation, ten different plants viz. *Brassica juncea* (L.) Czern. & Coss, *Brassica napus* L., *Brassica oleracea* var. *Botrytis* L. (cultivated plant species) and *Chenopodium album* L, *Goniocaulon indicum,* (Klein ex Willd). C.B. CL, *Celosia argentea* L., *Vigna trilobata* (L.)Verde, *Digera muricata* (L.) Mart, *Tridax procumbens* L. and *Ocimum americanum* L. (wild plant species) were chosen as protein source. The starting material i.e. the leaves of these plants were harvested from the field at its vegetative stage and processed within 2 – 3 hours after being obtained from the field. The leaves were crushed by juicer mixer by adding little quantity of water so as to extract maximum leaf juices (Leaf Extract: LE) and remove the fibrous material. Analysis of oven dried leaf juices of experimental plants was also conducted to compare with that of LPC. The LPC were prepared by following the method suggested by N. W. Pirie (1966b). The LPC thus prepared was oven dried at 50 – 60^{0}C and the dried LE were used for further biochemical studies.

Estimation of Crude fat by soxhlet method: - The crude fat content was estimated by the method given by Sadasivam and Manickam (1996).

Estimation of Ascorbic acid calorimetrically: - The ascorbic acid was estimated calorimetrically by the method given by Harris and Ray (1935).

Estimation of Niacin: - The amount of niacin present in the test sample was calculated from standard curve of niacin followed by Sadasivam and Manickam (1996).

Results and Discussion: - The table no. 1 presents various biochemical compositions i.e. crude fat, ascorbic acid and niacin contents of dried LEs and LPCs of experimental plants. The crude fat content was more in leaf extract as compared to leaf protein concentrates. In the leaf extracts, the highest amount of crude fat was found in *Brassica oleracea* i.e. 30.30%. *Brassica juncea* and *Brassica napus* showed 25.75% and 26.74% crude fat content. The fat content more than 20% was observed in *Chenopodium album* and *Goniocaulon indicum*. The minimum amount was found in *Digera muricata* which was 13.10% whereas remaining species showed the amount in the range of 18% to 16%.

Crampton and Lloyd (1947) showed crude fat i.e. 24.3% in fresh aerial part of lucerne on the basis of fresh wt. whereas in the present investigation the fat content was reported on dry wt. basis. However, Kaur and Bajwa (2003) reported much lower amount of fats in mint and coriander leaves as well as Shingade *et al.* (1995) in twelve plant species including amaranths and vigna species as compared to the present study. Yadav and Sehgal (2002) also reported lower values of fats in the genus *Chenopodium*. Aletor and Adebayo (2012) also showed the crude fat contents in leaf meal (6.4%) and leaf protein concentrates (9.1%) in two vegetables *Amranthus hybridus* and *Manihot esculenta*. These variations in the amount of crude fat were most probably due to fresh leaves samples used by them as against the dried leaf extract used in the present investigation.

In leaf protein concentrate, the crude fat content was higher in *Brassica napus, Goniocaulon indicum* and *Brassica oleracea* which was 23.07%, 22.47%, and 21.77% respectively. More than 15% was observed in *Chenopodium album, Tridax procumbens* and *Ocimum americanum.* More than 10% was found in *Brassica juncea, Celosia argentea* and *Vigna trilobata*. The lower amount was found in *Digera muricata* (9.47%).

The results obtained for crude fat content for leaf protein concentrates is comparable with earlier results. Anelli *et al.* (1977) in alfalfa LPC showed similar results for crude fat content. However, Crampton and Lloyd (1947) reported much lower crude fat content in the LPC of lucerne from USA and Sweden; such type of variation might be due to the place, soil and other environmental conditions or differences in the methods of preparations of LPC. Agbede *et al.* (2012) reported the crude fat content ranging from 8.57% to 17.41% in leaf meal and 9.47% to 20.98% in LPC of eight plant species these are *Amranthus spinosus, Amaranthus viridis, Telfairia occidentalis, Vernonia amygdalina, Bidens pilosa, Cnidoscolus aconitifollus, Manihot* spp. foliage and *Basella alba.* Tripathi *et al.* (2014) also reported the crude fat content 16.69% in the LPC prepared from *Girardinia heterophylla*. They have also suggested on the basis of other nutritional content, the LPC prepared from *Girardinia heterophylla* can be used as a cattle fodder, nutraceutical industries, food industries and fodder industries. Sodamade *et al.* (2014) also showed the crude fat content is 11.05% in the LPC of *Telfaira occidentalis*. Fat in food determines the amount of energy available. The value obtained in the present study is slightly higher. This means that the energy level of these

LE & LPC is higher than the green vegetable. Khan and Varshney (2015) reported the crude fat in the LPC from *Leucaena leucocephala* (7.4%), *Vernonia amygdalina* (9.20%), *Gliricidia sepium* (11.85%), water hyacinth (10.21%), Spinach (0.3%), *Amaranth hybridus* (1.60%) and *Medicago sativa* (8-12%). Sachan *et al.* (2018) showed the crude fat content 11.35% and 11.5% in leaves of *Rumex dentatus* and *Utrica diocia* respectively on fresh wt. basis. Idris *et al.* (2019) reported the level of crude fat content is 2.01% in fresh leaves of *Rumex crispus*.

In general, in the present investigation crude fat content was significantly higher in *Brassica oleracea, Brassica juncea, Brassica napus, Chenopodium album* and in *Goniocaulon indicum* both in leaf extract as well as in leaf protein concentrates.

The results on ascorbic acid and niacin content of leaf extract and leaf protein concentrates is given in Table No.1. The significant differences were observed in the concentration of ascorbic acid and niacin content in leaf extract and leaf protein concentrates among the plant species studied in the present investigation. The data showed that both ascorbic acid and niacin content present in leaf extract is higher as compared to leaf protein concentrates. In leaf extract, the highest amount of ascorbic acid content was observed in *Brassica oleracea* which was 2.55µg/g. *Brassica juncea, Brassica napus* and *Goniocaulon indicum* showed more than 1.0µg/g ascorbic acid content. *Tridax procumbens and Ocimum americanum* showed 0.20µg/g. The minimum content was found in *Digera muricata* (0.10µg/g), whereas remaining species was found in the range of 0.55µg/g to 0.30µg/g.

The higher amount of ascorbic acid was found in *Goniocaulon indicum, Brassica juncea* and *Brassica oleracea* leaf protein concentrate i.e. 0.26µg/g, 0.20µg/g and 0.10µg/g respectively. 0.06µg/g ascorbic acid was found in *Vigna trilobata, Tridax procumbens* and in *Brassica juncea.* 0.04µg/g in *Digera muricata, Ocimum americanum* and in *Chenopodium album* whereas *Celosia argentea* showed 0.08µg/g ascorbic acid content.

The amount of ascorbic acid content in the present investigation for both in leaf extract and leaf protein concentrates was lower as compared to the earlier reports. Prakash *et al.* (1995) reported in different *Celosia* species, Yadav and Sehgal (1997) in *Chenopodium album*, Singh *et al.* (2005) in Cauliflower leaves and Duke (1983) in *Brassica juncea* and *Brassica napus* species. Idris *et al.* (2019) reported ascorbic acid is 152.73 and 26.73 mg/100gm on fresh wt. and dry wt. basis respectively in the leaves of *Rumex crispus*. These workers showed higher values for ascorbic acid content as compared to the present finding. The results on ascorbic acid content were reported by these workers in fresh leaves samples whereas in the present investigation oven dried sample were taken for analysis. The variation also might be due to the location, soil condition and the state of the crop at the time of harvest.

The niacin content was more in leaf extract as compared to leaf protein concentrate except in *Chenopodium album* and *Celosia argentea* where similar amount of niacin content was observed both in LE as well as in LPC. In leaf extract, the highest amount was found in *Brassica juncea* and *Brassica napus* which was 0.66µg/g and 0.22µg/g respectively. In *Goniocaulon indicum, Vigna trilobata* and in *Tridax procumbens* 0.10µg/g while in *Brassica oleracea* and *Ocimum americanum* 0.08µg/g niacin content was observed. The lowest amount was found in *Chenopodium album* and *Celosia argentea.*

The concentration of niacin was low in leaf protein concentrates. The higher amount was found in *Goniocaulon indicum* (0.08µg/g), *Tridax procumbens* (0.08µg/g), *Brassica napus* (0.07µg/g), and in *Vigna trilobata* (0.05µg/g). The species of *Brassica juncea, Brassica oleracea,* *Celosia argentea* and *Digera muricata* showed niacin content about 0.03µg/g each. However, minimum amount was found in *Ocimum americanum* i.e. 0.02µg/g. Like ascorbic acid, the niacin content was also found lower in the present investigation as compared to the earlier reports. The niacin content reported by Duke (1983) in *Brassica juncea* and *Brassica napus* showed variation in concentration which might be due to in the present investigation the dried samples were used as against fresh leaf samples used by these workers for measuring the niacin content.

SUMMARY AND CONCLUSION:

In the present investigation it was found that the vitamins like ascorbic acid and niacin content were observed in higher amount in wild plant species. The maximum amount of ascorbic acid and niacin content was observed in wild plant species *Goniocaulon indicum.* Similarly the higher amount of crude fat content was quantified in cultivated plants, however the satisfactory level of crude fat was also observed in wild plants.

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Table No:-1. Estimation of Crude fat, Ascorbic acid & Niacin content from leaf extract (LE) and leaf protein concentrates (LPC) of various plants (Dry wt. basis)

Plant Name	***Crude Fat (%)***		***Ascorbic Acid (µg/g)***		***Niacin (µg/g)***	
	LE	***LPC***	***LE***	***LPC***	***LE***	***LPC***
Brassica juncea (L.) Czern. & Coss.	25.75	12.37	1.35	0.06	0.66	0.03
Brassica napus L.	26.74	23.07	1.55	0.20	0.22	0.07
Chenopodium album L.	20.12	16.60	0.30	0.04	0.03	0.03
Goniocaulon indicum (Klein ex willd). C.B. C.L.	23.13	22.47	1.35	0.26	0.10	0.08
Brassica oleracea var. Botrytis L.	30.30	21.77	2.55	0.10	0.08	0.03
Celosia argentea L.	17.47	10.77	0.55	0.08	0.03	0.03
Vigna trilobata (L.) Verde.	18.10	11.10	0.50	0.06	0.10	0.05
Digera muricata (L.) Mart.	13.10	9.47	0.10	0.04	0.04	0.03
Tridax procumbens L.	16.90	15.50	0.20	0.06	0.10	0.08
Ocimum americanum L.	17.60	16.23	0.20	0.04	0.08	0.02
Mean	20.92	15.93	0.865	0.094	0.144	0.05
Critical Difference. C.D. (5%)	1.628	0.682	0.055	0.010	0.011	0.003
Critical Difference. C.D. (1%)	2.383	0.997	0.080	0.014	0.016	0.004
Coefficient of Variation. C.V. (%)	7.070	3.894	5.29	9.79	7.28	5.09