

*Full Length Research Paper*

## **Nutritional analysis, micronutrients and chlorophyll contents of *Cichorium intybus* L.**

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**In this study, the nutrient levels and chlorophyll contents of roots, leaves, seeds and seeds (market) of *Cichorium intybus* were determined. The nutritional analysis revealed that *C. intybus* is to be rich in crude proteins, fats and carbohydrates (indicating its suitability as a fodder crop). There was significant difference in the crude protein, fats, crude fiber in all parts and seeds both wild and market. The elemental analysis for Ca, Mg, Na, K, Cu, Zn and Mn were analyzed in roots, leaves and seeds, which showed that substantial amount of these elements, were present with slight variation specific to each plant parts. Amount of chlorophyll although statistically insignificant was sensitive to the altitudinal and chronological variation numerically. Generally, present findings revealed that the seeds contained more nutritional qualities than other parts.**

**Key words:** *Cichorium intybus*, nutritional analysis, micronutrients and chlorophyll contents.

### **INTRODUCTION**

Indigenous vegetables play important roles in human diets. They supply the body with minerals, vitamins and certain hormone precursors in addition to protein and energy (Antia et al., 2006). Despite the consumption of exotic vegetables, some indigenous vegetables have been reported to be more nutritious and less expensive than the exotic ones. Many indigenous vegetables are collected from the wild. The research and development strategies on wild species are the fruitful topics Pakistan encouraging food reservation from the enriched genetic resources (Van Vuuren, 2006).

*Cichorium intybus* L. (Eng. Chicory, Urdu. Kasni, locally called Hun) the wild perennial chicory belongs to family Asteraceae. It is a wild plant and found in the edges of field specially maize (*Zea mays*) in the local area. In Punjab Province it is commonly cultivated and very popular among people of all classes especially in Attock District (Ahmad et al., 2006).

### **Medicinal value**

It is known for its multiple therapeutic efficacy since ancient times. In many countries this small herb is cultivated for salad, vegetable, fodder and often to serve as substitute for coffee in Europe, but in Pakistan it is used for fodder and medicinal purposes. Local people use the roots and leaves. The leaves are used as vegetable locally called "Saag" (Spinach) and are used for the treatment of vomiting, dysentery and typhoid. The roots are used for Jaundice. The reasons of the using this plant include poverty and lack of health facilities.

The high medicinal use of the herb is also described in *Tibb-e-Nabvi* as it has been reported to be a multi-purpose drug (Ibnal-Qayyim Al-Jauzi, 1985). The root is ascribed with the properties such as resolvent, demulcent, anti-inflammatory, diuretic, fever and blood purifier (Hussain et al., 2008). The present study is to set up certain characters which would be helpful in the identification of the correct drug material. Roots of *C. intybus* are the best part of plant which enriches and purifies the blood, lessen the inflammation and pain in the

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**Table 1.** Elemental analysis of different parts of *C. intybus* Linn.

S. No	Plant parts	Ca (%)	Mg (%)	Na (%)	K (%)	Cu (ppm)	Zn (ppm)	Mn (ppm)
1	Roots	0.36	0.30	0.05	1.70	27.00	40.00	75.00
2	Leaves	2.50	0.75	0.06	2.50	25.00	50.00	100.00
3	Seeds (W)	2.00	0.50	0.56	1.17	15.00	65.00	25.00
4	Seeds (M)	3.00	0.65	0.51	1.10	13.00	60.00	65.00

W=Wild, M=Market (sample).

joints (Kirtikar and Basu, 1989).

## MATERIALS AND METHODS

The fresh material of root, leaves and seeds was collected from Miandam Swat (NWFP), Pakistan during June 2010. Leaves for chlorophyll contents were collected from different areas of Swat from different altitude and at different times. The roots, seeds and leaves were separated and cleaned. Each of the samples was oven dried to a constant weight at 60°C for 72 h. After drying, the plant materials were ground into fine powder using an electric grinder (Fritsch, Idar-Oberstein, Germany) with a mesh size of 0.5 mm and stored in well labeled air tight polythene bags at 4°C for various chemical tests.

### Nutritional value

Proximate composition of the various plant samples was determined as described by Antia et al. (2006). Ash determination involved the incineration of each sample in a muffle furnace (Naber Industrieofenbau, Bremen, Germany) at 550°C for 12 h. Crude fat determination was achieved by exhaustively extracting the samples with diethyl ether. Crude fiber was estimated from the loss in weight of the crucible and its contents on ignition after ashing, following the sequential extraction of the samples with 1.25% sulphuric acid and 1.25% sodium hydroxide. Protein was determined using the microkjeldal nitrogen method which involved the digestion of 0.5 g of sample with sulphuric acid and a catalyst followed by calorimetric determination of nitrogen. The value of nitrogen was multiplied by 6.25 to obtain percentage crude protein. The carbohydrate content was obtained by subtracting the values of total ash, crude fiber, lipid and protein from the total dry matter (Antia et al., 2006).

### Elementary analysis

Plants material was collected freshly from the field. All plants material was first cleaned dried and then powdered using an electric blender. Samples in powder form were used for Atomic Absorption Spectrophotometer (AAS). Each plant material (0.25 g) were taken in 50 ml flask and add 6.5 ml of mixed acid solution that is, Nitric acid (HNO<sub>3</sub>), Sulfuric acid (H<sub>2</sub>SO<sub>4</sub>) and Perchloric acid (HClO<sub>4</sub>) (5:1:0.5). The sample boiled in acid solution in fume hood on hot plate (model VWR VELP Scientifica, Germany) till the digestion has been completed which was indicated by white fumes coming out from the flask. Thereafter, few drops of distilled water were added and allowed to cool. Then these digested samples were transferred in 50 ml volumetric flasks and the volume was made up to 50 ml by adding distilled water in them. Then filter the extract with filter paper (Whatmann No. 42) and filtrate were collected in labeled plastic bottles. The solutions were analyzed for

the elements of interest utilizing atomic absorption spectrometer Shimadzu AA-670 with suitable hollow cathode lamps. The percentages of different elements in these samples were determined by the corresponding standard calibration curves obtained by using standard AR grade solutions of the elements that is K<sup>+</sup>, Mg<sup>2+</sup>, Ca<sup>2+</sup>, Na<sup>+</sup>, Fe<sup>2+</sup>, Co<sup>3+</sup>, Mn<sup>2+</sup>, Cu<sup>3+</sup>, Cr<sup>3+</sup>, Zn<sup>2+</sup>, Ni<sup>3+</sup>, Li<sup>1+</sup>, Pb<sup>4+</sup> and Cd<sup>2+</sup>.

### Determination of the chlorophyll content of leaves

The chlorophyll contents of leaves were estimated on the fresh weight basis. 1 g of fresh leaf samples was crushed with 5 ml of 80% acetone. The crushed materials were centrifuged at 1000 rpm for about 5 min in diffused day light. Supernatant was collected in another tube and debris was then crushed 3 times with 2 to 3 ml of 80% acetone each time. The supernatant was then cooled and the volume made up to 20 ml with the extracting medium. Optimal "d" was taken at 645 and 663 nm against reagent blank, for blank 80% acetone was used. Optimal "d" was recorded on Erma (Photic 100) spectrophotometer. Amount of chlorophyll- 'a', chlorophyll- 'b' and total chlorophyll were then calculated by the following formula.

## RESULTS

### Nutritional value

It composes percent content of dry matter, ash, crude protein, crude fiber, ether extract, nitrogen free extract and moisture content. They were analyzed for root, leaf and seed of *C. intybus*, seed purchased from market.

### Root

The root showed 42.0% dry matter as feed, 96.08% dry matter of ground sample, 8.12% ash, 5.54% crude protein, 27.32% crude fiber, 1.04% ether extract and 58.0% moisture while nitrogen free extract value is 57.98 (Table 1).

### Leaves

The leaves showed 77.36% dry matter as feed and 93.00% dry matter of ground sample, 18.65% ash, 14.10% crude protein, 17.61% crude fiber, 0.33% ether extract and 22.64% moisture while nitrogen free extract

**Table 2.** Nutritional value of different parts of *C. intybus* Linn.

S.No	Plant Parts	Dry matter (%) (Ash feed)			Percent on dry matter basis				Moisture (%)
		Air dried	Dry matter (%) of ground sample	Ash	Crude protein	Crude fiber	Ether extract	Nitrogen Free extract	
1	Roots	42.00	96.08	8.12	5.54	27.32	1.04	57.98	58.00
2	Leaves	77.00	93.00	18.65	14.10	17.61	0.33	49.31	22.64
3	Seeds (W)	—	94.74	11.55	18.55	36.63	13.58	19.69	5.26
4	Seeds (M)	—	95.76	17.19	14.45	38.12	10.28	19.69	4.24

W=Wild, M=Market (sample).

value is 49.31% (Table 1).

### Seed (wild)

The seed (wild) showed 0.00% dry matter as feed and 94.74% dry matter of ground sample, 11.55% ash, 18.55% crude protein, 36.63% crude fiber, 13.58% ether extract and 5.26% moisture while nitrogen free extract value is 19.69% (Table 1).

### Elementary analysis

Elementary analysis for Ca, Mg, Na, K, Cu, Zn and Mn was carried out for roots, leaves, seeds, seed (wild seed) and seeds obtained from market, in terms of percentage and ppm.

### Root

The amount of Ca is 0.36%, Mg 0.30%, Na 0.05% and K 1.70%, while Cu is 27 ppm, Zn 40 ppm and Mn 75 ppm (Table 2).

### Leaves

The amount of Ca is 2.50%, Mg 0.75%, Na 0.06% and K 2.50%, while Cu is 25 ppm, Zn 50 ppm and Mn 100 ppm (Table 2).

### Seeds (wild)

The amount of Ca is 2.00%, Mg 0.50%, Na 0.56% and K 1.17%, while Cu is 15 ppm, Zn 65 ppm and Mn 25 ppm (Table 2).

### Chlorophyll analysis

The leaves are collected from different areas of Swat

from different altitude ranging from (1100 to 1750 m) at different times of the day.

### Comparative statistical analysis of chlorophyll content

The leaves are collected from different areas of Swat from different altitude ranging from 1100 to 1750 m at different times of the day that is, 7.00 a.m., 10.00 a.m., 1.00 p.m., 4.00 p.m. and 7.00 p.m. Comparative statistical analysis that is, t-test was carried out to compare the chlorophyll content of leaves from Matta (1100 m), with Chail (1600 m), Matta with Ashari (1650 m), Matta with Kolakarin (1700 m) and Matta with Shtoot (1750 m) both on the basis of altitude and time. The result of comparative statistical analysis showed that there was no significant difference (Table 3).

### DISCUSSION

The population of the world is increasing rapidly and creates many serious problems such as resources deficiency other factors, food and feed shortage, energy crisis and environmental pollution. At present among other factors, food and feed shortage is a prime challenge for nutritionist to provide more and more protein rich food for growing population. Plants food such as fruits and vegetables are playing a vital role in the diet of human being since centuries, providing enough quantity and quality of fat, protein, carbohydrates, vitamins and minerals (Noomrio, 19956).

Biochemical analysis composes present content of dry matter, ash, crude protein, crude fiber, ether extract, nitrogen free extract and moisture percent in roots, leaves and seeds of *C. intybus*. Ash found to be the highest (18.65%) in leaves and lowest (8.12%) in the roots. The crude protein found to be the highest (18.55%) in the seeds and the lowest (5.54%) in roots. Ether extract found to be the highest (13.58%) in seeds and the

**Table 3.** Comparative statistical analysis of chlorophyll content of *C. intybus* Linn. All observations are means of five readings.

S. No	Locality (Altitude, meter)	t-test		Result
		t-Cal	t-Tab	
1	Miandam (1700) Chail (1600)	0.68	2.35	IS
2	Miandam (1700) Ashari (1650)	-1.66	2.35	IS
3	Miandam (1700) Kolakarín (1500)	1.11	2.35	IS
4	Miandam (1700) Matta (1100)	00s	2.35	IS

Cal = Calculated, Tab = Tabulated, IS = Insignificant.

lowest (0.33%) in leaves. The highest percentage of nitrogen free extract is found (57.98%) in roots and the lowest percentage (19.69%) in seeds. The highest percentage of moisture content (58%) is found in roots and the lowest (4.24%) in seeds. The remaining value shows slight differences (Table 1).

Jerez et al. (1991) compared chicory (*C. intybus*) with *Trifolium repens* for nutritional value forage and showed that chicory contains 3.74% crude protein, 29.83% crude fibre, 2.01% fats and 60.0% sugar while *T. repens* contains 3.35% crude protein, 27.5% crude fibre, 1.98% fats and 59.3% sugar and concluded that the chicory is of high nutritive value as compared to *T. repens*. Lioveras (1990) reported the dry matter yield and nutritive value of chicory, *C. intybus* from Spain showed that the air dried yield was 41%, the oven dried yield 95.7%, 5% crude protein, 27% crude fibre, 1.5% fats, 60.80% sugar and 7.5% ash. Falkowski et al. (1990) reported the fodder value of *Taraxacum officinale* including 22.2% crude protein, 16.63% crude fibre and 42.4% sugar and it also showed that 37 to 57% cattle and 25% horses consumed *T. officinale*.

Saeed (1972) reported the nutritive composition of fresh dried chicory, which include 75.69% water, 10% nitrogenous matter, 0.49% fat, 3.44% sugar, 17.62% nitrogenous free extract, 0.97% cellulose and 0.78% ash in case of fresh chicory while dry chicory showed 12.16% water, 6.09% nitrogenous matter, 2.055 fat, 15.87% sugar, 46.71% nitrogen free extract, 11.0% cellulose and 6.12% ash. These findings support the present studies and shows that *C. intybus* has a high nutritive value in Pakistan and in the other countries. In all the study areas except Matta the basal leaves and roots are edible while in Pakistan and other parts of the world the seeds and roots are edible. The stem and leaves are grazed in summer season by goat and sheep in the study area.

The plant grows wildy and is not cultivated by the people in the study area. As it is not a cash crop that is why it is not cultivated by the farmers of the area.

Trace element plays a vital role in the medicinal and nutritive value of a plant, in health and to cure disease. The trace elements play nutritive, catalytic and balancing function in plants (Joyo et al., 1997). Plants take them from the ground and incorporate them into organic compounds that we consume them by eating either the plants or the animals that ate the plants (Khaliq, 2000). In the present study Ca, Mg, Na and K are in large quantity while Cu, Zn and Mn are relatively low in different parts of *C. intybus*. The Ca is found in large percentage that is (2.5%) in leaves and in low quantity (0.3%) in roots. Similarly, Na is found in large quantity (0.56%) in the seeds and low quantity (0.05%) in roots. The remaining elements are found with a slight difference in their quantity which are too small to be noted (Table 2). Haag and Minami (1998) reported the macro and micro nutrients of leaf and roots of *C. intybus* from Brazil which include 4.39% N, 0.47% P, 2.93% K, 1.0% C, 0.35% Mg, 0.2% S, 59 ppm B, 15 ppm Cu, 2926 ppm Fe, 117 ppm Mn and 80.0 ppm Zn while roots contain 3.56% N, 0.43% P, 1.95% K, 0.87% Ca, 1.42% Mg, 0.18% S, 49 ppm B, 21 ppm Cu, 2870 ppm Fe, 93 ppm Mn and 73.0 ppm Zn. The main difference which is observed between the two studies is that Ca, Mg and Cu are present in large amount in leaves of *C. intybus* (Swat) while K, Zn and Mn are present in lesser amount. Similarly, Cu is found in greater amount in roots of *C. intybus* (Swat). Schuhmacher et al. (1993) reported the composition of minerals in roots and seeds in wild chicory (*C. intybus*) from Spain. The roots contain 1.15% N, 2.30% P, 1.63% K, 0.65% Mg, 0.53% Ca, 0.95% Fe, 75 ppm Mn, 38 ppm Cu and 59 ppm Zn while seeds contain 1.06% N, 2.95% P, 2.25% K, 1.00% Mg, 0.62% Ca, 0.82% Fe, 72 ppm

Mn, 41.0 ppm Cu and 50 ppm Zn. The main difference, which is observed between the two studies, is that Ca, Mg, Cu and Zn are present in low quantity in roots and K is present in greater amount in leaves of *C. intybus* and Mg, K, Cu and Mn are present in greater amount in seeds of *C. intybus*. Similarly, Kaneez et al. (2000) detected similar elements that is Co, Cr, Cu, Fe, Mg, Mn, Ni and Zn in stem, roots, leaves, seeds and flower of *C. intybus* collected from Karachi, which showed that Fe and Mg are in abundance in all parts except in leaves in which the concentration of Mg is low. All these findings supported the present results except with slight differences in values.

Chlorophyll analysis of leaves of *C. intybus* is carried out on the basis of varying time of collection of leaves and altitude. The highest value (0.299) of total chlorophyll content is recorded at 1.00 p.m. at 1650 m (Ashari). The minimum value (0.197) of total chlorophyll content is recorded at 7.00 a.m. at 1600 m (Chail). The over all values showed that the total chlorophyll contents decreased with increasing altitude. Statistical analysis for chlorophyll content is insignificant (Table 3). Fluke et al. (1955) reviewed that chlorophyll is present in different concentration in plants at different altitudes. According to Henrici (1955) that in all plants a lower percentage of chlorophyll was found with increasing height.

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