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Anti-nutrient profile of different *Chenopodium* genotypes

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Abstract
Bathua (*Chenopodium album* L.) is an important underutilized leafy vegetable belongs to family Chenopodiaceae. Now days it has gained special popularity in India and also in different parts of world mainly due to its high nutritional composition. In the present study present study 24 bathua genotypes were analysed for the anti-nutritional composition *viz.*, Oxalates, nitrates, total phenols using standard methods. The results of the study revealed that the oxalate content ranged from 327.60 mg/100g to 493.50mg/100g. The highest oxalate content present in the genotype NIC-22506 (493.50mg/100g) where has minimum was reported in the genotype HUB – 7(327.60 mg/100g). The nitrate content ranged between 236.17 mg/100g to 337.36 mg/100g. The genotype HUB – 2shows higher nitrate contenti.e.337.36 mg/100g, where has lowest in HUB-7 (236.17 mg/100g). The total phenol content in bathua genotypes ranged between 226.87 mg/100g to 294.96 mg/100g. IC-109249 (294.96 mg/100g) shows maximum phenol content followed by lowest was in HUB-7 (226.87mg/100g).

Keywords: *Chenopodium* genotypes

1. Introduction
Green leafy vegetables are the fresh and edible portions of herbaceous plants. They are an important sources of protective food and a part of healthy diet. They play an important role in human nutrition especially as sources of carbohydrates, proteins, vitamins, minerals and dietary fibre. The varieties of leafy vegetables are diverse, ranging from leaves of annuals and shrubs to tree leaves. Utility of the leaves, pods and edible twigs of shrubs and trees as food is limited due to the presence of major antinutritional factors. Anti nutrional factors are naturally occurring substances or chemical compounds found in leaf, fruit, seeds and food substances in general which are poisonous to humans. They reduce the ability of nutrients such as minerals, vitamins, and even proteins within the plant material (Ugwu and Oranye, 2006) [12]. Oxaltes, nitrates, phenols, saponins, alkaloids, protease inhibitors, cynogens and goitrogen are the commonly found antinutritional factors in leafy vegetables (Pedersen & Wang, 1971; Cheeke & Bronson, 1980; Fenwick & Oakenfull, 1983) [9, 4, 5].
Bathua (*Chenopodium album* L.) is an important underutilized leafy vegetable belongs to family Chenopodiaceae with a diploid chromosome number of 2n=36. It is commonly known with different vernacular names viz., Lamb's quarters, Pig weed, Goose foot, Fat-hen, Bathua sag, Chakota. The genus *Chenopodium* comprises about 250species which include herbaceous, suffrutescent and arborescent perennials, although most species are colonizing annuals. They have been contributed for centuries as leafy vegetables as well as an important grain crop for human and animal foodstuff due to high protein and a balanced amino-acid spectrum (Bhargava *et al*., 2006) [2]. The leaves and seeds of all the members of this genus are edible and are consumed in cooked form mainly in combination with other species. Presence of antinutritional factors may have adverse effects on the health through inhibition of protein digestion, growth, iron and zinc absorption (Larsson *et al*. 1996) [7]. So, this paper reports the anti-nutritional composition of the leaves of various bathua genotypes.

2. Material methods
The experiment was conducted at the Department of Vegetable Science, KRCCH, Arabhavi, University of Horticultural Sciences, Bagalkot and carried out during kharif 2017 using 24 bathua genotypes. Among 24bathua genotypes 15were procured from NBPGR, New Delhi and remaining 9 genotypes collected from different parts of Karnataka. The designed adopted for

study is randomized block design. Each treatment or genotype in a replication was represented by a row of 5.00 meter length with 25 plants. All the cultural practices were carried out to manage the crop. The leaf samples were collected from five plants of each treatment and brought to the laboratory for estimation of antinutrients. In the laboratory the leaves were sorted manually and washed with double distilled water to remove adhering dirt and dust, the leaves were dried at 40±5OC and were grounded in a mixer and stored in airtight containers for further analysis. The various methods followed for the determination of various antinutrients are given below.

2.1 Estimation of Nitrates (mg /100 g)

Nitrate content was estimated by the method suggested by Marderosian *et al*. (1979) [8]. One gram of the dried and powdered sample was extracted in 100 ml of distilled water for 30 minutes by shaking and then filtered. To that filtrate (5ml) 0.1 g of 3, 4 dimethylphenol was added, followed by 10 ml of concentrated sulphuric acid and allowed to stand for 10 minutes. To this, 30 ml of distilled water was added and kept the flask under running water for 30 minutes. Later, the contents were steam distilled and 25 ml of distillate was collected in a volumetric flask containing 3 ml of 5 per cent NaOH.

The colour intensity was measured in a spectrophotometer at 430 nm. A standard graph was prepared using a serial dilution of standard sodium nitrate solution and the content of nitrate in the sample was estimated and expressed in mg per 100 g of dry sample.

2.2 Estimation of Oxalates (mg /100 g)

Oxalate content in the sample was analysed colorimetrically as suggested by Marderosian *et al.* (1979) [8]. To 0.5 g of dried and powdered sample, 10 ml of distilled water and 10 ml of citric acid reagent were added. The sample was extracted by shaking for 10 minutes at room temperature and filtered. The precipitate was dissolved in 50 ml of 0.4 N HCL by shaking for 10 minutes and was filtered again. Two ml of filtrate was taken and two ml of diluted iron ferron reagent was added and the absorbance was read at 540 nm in a spectrophotometer. The oxalate content of the sample was calculated from the standard graph and converted to dry weight basis and expressed in mg per 100 g.

2.3 Estimation of Total phenols (mg /100 g)

The phenol content was estimated colorimetrically using the method suggested by Sadasivam and Manickam (1992) [10]. One gram of fresh sample was extracted with 80 per cent ethanol twice and the supernatant was pooled. Evaporated the supernatant to dryness.

The residue was dissolved in a known volume of distilled water from which one ml was pipette and made up the volume to three ml with distilled water to which 0.5 ml of Folin-Ciocalteau reagent was added. After three minutes, 2 ml of 20 per cent sodium carbonate was added and mixed thoroughly and heated for exactly one minute, cooled and measured the absorbance in spectrophotometer at 650 nm against a reagent blank. A standard graph was prepared using serial dilutions of standard catechol solution. From the standard graph, the phenol content of the sample was estimated.

3. Result and Discussion

3.1 Oxalates

Oxalates is a dicarboxylic acid and it found in the form of soluble salts. Soluble oxalates forms strong chelates with dietary calcium, rendering it unavailable for absorption and assimilation. Table 1 revealed that higher oxalate content was present in NIC-22506 (493.50mg) followed by EC-359444 (474.06 mg/100g), HUB-3 (423.51 mg/100g) and IC-415477 (415.21 mg/100g). The lowest oxalate content was reported in HUB-7(327.60 mg/100g). According to Guil *et al*. (1996) [11] the leaves of goosefoot (bathua) contained oxalic acid with a range value of 360-2000mg/100g. The results are at par with other worker however the slight differences in degree of accumulation of oxalates might be related to species, the plant part, age of plant and the agro-climatic conditions. However, high dietary intake of soluble oxalate can lead to the formation of kidney stones. A diet high in oxalates may require supplementation of divalent minerals to prevent deficiencies. Addition of a source of calcium to vegetables containing high levels of soluble oxalate has been shown to reduce the intestinal available oxalate content in such food (Radek and Savage, 2008).

3.2 Nitrates

As is evident from the Table 1 the Nitrate content of leaves in bathua genotypes ranged from 236.17mg/100g to 337.36 mg/100g with a grand mean of 295.99 mg/100g. The genotype HUB-2 (337.36 mg) having higher concentration of nitrate followed by HUB-3 (323.53mg/100g), HUB-1 (321.73 mg/100g) genotypes. The lowest concentration of nitrates reported in HUB-7 (236.17 mg/100g) followed by HUB-8 (251.68mg/100g) and HUB-6 (267.79 mg/100g). Nitrate accumulation can have serious deleterious effect. Within the gastrointestinal tract nitrate is reduced to nitrite which is absorbed into blood stream where it binds with haemoglobin oxidizing ferrous iron to ferric iron to form met haemoglobin. This form of haemoglobin complex is incapable of oxygen transport. The result is Anoxia, specially referred to as methaemoglobinaemia (Greenwood and Hunt, 1986)

3.3 Phenols

Table 1 shows the total phenol contents present in leaves of different bathua cultivars. Total phenols content of leaves in bathua genotypes ranged from 226.87 to 294.96 mg/100g with a grand mean of 257.48 mg/100g. It is clear that the genotype IC-109249 (294.96 mg/100g) shows higher concentration of total phenols followed by IC-415477 (287.55 mg/100g), EC-359445 (282.72 mg/100g) and NIC-22506 (272.72 mg/100g). However lowest concentration of total phenols reported in HUB-7 (226.87mg/100g) followed by HUB-6 (238.34 mg/100g) and HUB-8 (239.63mg/100g). Kaur and Kapoor (2002) [6] reported 253.5 mg GAE/100g total phenol content in the leaves of *Chenopodium album*. Phenols exhibit antioxidant potential (Awika *et al.* 2003) [1] due to their redox properties which allow them to act as reducing agents, hydrogen donators and single oxygen quenchers (Chang *et al.* 2001) [3]. The result of present investigation are in accordance with other workers however slight variation in result might be due to differences in varieties or species, agro-climatic conditions and extraction or analytical procedure applied to determine the content.

Table 1: Anti-nutritional factors of bathua genotypes leaves (Each value is average of three replications)

S.No	Genotype	Oxalates (mg/100 g)	Nitrates (mg/100 g)	Phenol (mg/100 g)	Sl. No	Genotype	Oxalates (mg/100 g)	Nitrates (mg/100 g)	Phenol (mg/100 g)
1	EC-359444	474.06	298.43	268.94	15	IC-109235	374.71	312.43	253.99
2	NC-50229	390.83	300.73	266.95	16	HUB-6	354.53	267.79	238.34
3	HUB – 1	368.26	321.73	261.60	17	HUB – 8	345.57	251.68	239.63
4	HUB – 2	357.25	337.36	247.28	18	IC-415477	415.21	300.71	287.55
5	EC-359445	388.15	302.90	282.72	19	IC-540831	356.83	273.63	242.17
6	IC-243192	377.54	313.30	265.35	20	NIC-22517	406.01	314.37	257.64
7	HUB – 3	423.51	323.53	252.92	21	HUB – 7	327.60	236.17	226.87
8	IC-341703	390.12	282.79	245.60	22	IC-540842	356.75	270.51	241.61
9	HUB – 4	356.85	275.54	242.38	23	IC-4152393	364.64	324.90	255.83
10	IC-109249	358.37	303.94	294.96	24	HUB – 9	377.03	306.80	262.88
11	NIC-22506	493.50	289.42	272.72		Mean	380.79	295.99	257.48
12	HUB – 5	368.37	300.45	255.16		S.Em±	12.84	6.19	8.67
13	NC-58616	364.07	297.80	256.16		CD (0.05)	36.55	17.63	24.69
14	NIC-22492	349.15	296.85	260.22		CD (0.01)	48.79	23.53	32.96
						CV	5.84	3.62	5.83

4. Conclusion

From the preceding discussion it appears that all the genotypes of bathua contained sustainable quantities of ant nutritional factors like oxalates, nitrates, total phenols. However, after inactivation or removal of such antinutrients by adopting economically viable and indigenous processing techniques, the bathua can serve as more nutritive leafy vegetable. Further studies are required in this context to study the effect of various processing techniques on these detected anti-nutrients.

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