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Effect of blanching on anti-nutritional factors of bathua leaves

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Abstract
Though the inclusion of underutilised bathua (*Chenopodium album*) leaves in diet provides dietary elements and antioxidants, still their nutritional exploitation is hindered due to the presence of anti-nutritional factors like oxalate and saponin.
The bathua leaves were subjected to 1, 2 and 3 min blanching and its methanol and aqueous extracts were analysed for the presence of several anti-nutritional factors such as oxalate and saponin. The oxalate and saponin content were decreased by 27.62% and 68.52% respectively with increase in blanching time from 0 to 3 min.

Keywords: anti-nutritional, bathua leaves

Introduction
The bathua (*Chenopodium album*) leaves were used in traditional medicines (Kumar *et al.*, 2006) [11] and can be consumed cooked like the spinach (Gupta and Wagle, 1988) [6]. Bathua leaves are good source of nutrients like vitamin C, potassium, iron, calcium, and zinc and antioxidants (Afolayan and Jimoh, 2009; Hussain *et al.*, 2009) [1, 9]. Hence it fulfils the nutritional requirements of human beings and thus can be a very healthy addition to the diet. However, the nutritional exploitation of these leaves is hindered due to the presence of antinutritional factors like nitrates, oxalates and saponins (Gupta and Wagle, 1988) [6]. These anti-nutritional factors reduce

Methods
The leaves of bathua were procured from the College Farm of Professor Jayashankar Telangana State Agricultural University, Rajendranagar, Hyderabad. Chemicals used in the analysis were of food grade and purchased from standard companies.
About 800.0 g of tender and fresh bathua leaves were taken, cleaned of foreign materials and stalks and washed thoroughly 6 - 7 times to remove waxy outer coat on the leaves. The leaves were divided into four parts of 200.0 g each, subjected to blanching for 0 min, 1 min, 2 min and 3 min, dried, powdered, sieved and packed in airtight containers till use.
These samples of 1.0 g were subjected to exhaustive extraction by cold maceration in 50.0 ml of methanol and distilled water and stored at 4°C for 72 hours in triplicates. The test tubes were sealed to avoid evaporation. The clear extracts were obtained by centrifugation at 3000 rpm for 10 minutes and filtered through Whatman No. 41 filter paper. The clear filtrates of four samples in various media were subsequently collected and preserved at 4^0C for further use.
The antinutritional factors like oxalates and saponins were assayed. Oxalate content was determined using the titrimetric method described by Day and Underwood (1986) [4] while the spectrophotometric method of Brunner (1984) [3] was used for saponin analysis.

Results and Discussion
Anti-nutritional factors in plants seem to be as a way of storing nutrients or as a mean of defending their structure and reproductive elements (Harborne, 1989) [7]. The anti nutritional factors tend to bind to mineral elements there by forming indigestible complexes (Nkafamiya and Manji, 2006) [13]. Like other green leafy vegetables the main problem in the consumption of the leaves of bathua is the presence of anti-nutritional factors. These factors may have adverse effects on the health through inhibition of protein digestion, growth, iron and zinc

absorption (Larsson *et al.*, 1996) [12].

The most studied anti-nutritional principle in leaves of *C. album* is the oxalic acid otherwise it's a nutritious green leafy vegetable in small servings. Cooking of the plant has been known to reduce the content of oxalic acid (Guil *et al.*, 1996) [5]. Yadav and Sehgal (2003) [18] compared fresh leaves with the processed and cooked leaves for the oxalate content and it was ranged from 0.91-14.92 g for the fresh leaves. They also reported that drying and storage had no significant effect on the anti-nutrient content of these leaves.

Oxalic acid is a dicarboxylic acid commonly found in microorganisms, plants and animals. Besides dietary intake, oxalates in the human body may also be derived from metabolism of ascorbic acid and glyoxylate (Williams and Wandzilak, 1989) [17]. Consumption of a large amount of oxalates can be fatal to humans because of oxalosis that is the formation of calcium oxalate deposits in vital organs of the body (Sanz and Reig, 1992) [16].

The quantitative analysis of the oxalate content revealed gradual decrease from 16.40g to 11.87g per 100g of bathua leaves with the increase in blanching time 0 to 3 min. Hence blanching is an effective way to reduce the oxalate content in the bathua leaves which was similar to the findings of Yadav and Sehgal (2003) [18]. Statistically significant difference at $p < 0.05$ was found in the oxalate content of all samples with increase in blanching time (Table 1).

Table 1: Oxalate content of bathua leaves

Time in min	Oxalates (g/100g)
0	$16.40^{a} \pm 0.00$
1	$15.70^{b} \pm 0.00$
2	$15.33^{c} \pm 0.03$
3	$11.87^{d} \pm 0.07$
Mean	14.83
SE of mean	0.53
CD	0.14
CV (%)	0.46

Note: Values are expressed as mean ± standard deviation of three determinations. Means within the same column followed by a common letter do not differ significantly at $p \leq 0.05$

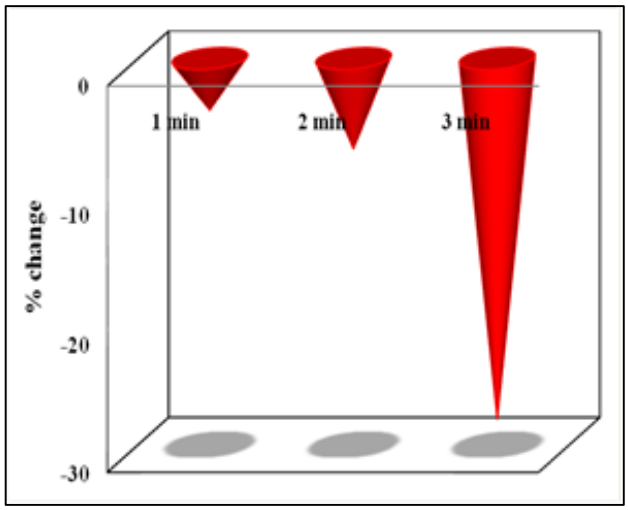

Fig 1: Percentage change in oxalate content of bathua leaves on blanching

The percentage decrease in the oxalate content on blanching of bathua leaves for 1 min, 2 min and 3 min are 4.0, 7.0 and 28.0% respectively when compared with the sample 0 (Figure 1).

Saponins are glycosidic triterpenoids or sterols that are widely distributed throughout the plant (Koziol *et al.*, 1993) [10]. They showed anti-nutritional or toxic effects (Ahmad, 1990) [2] and their toxicity depends upon the type of saponin and the method of absorption (Pachauri *et al.*, 2017) [14].

Although toxic, saponins are poorly absorbed by the body and most pass straight through without any problem. They are also broken down to a large extent in the cooking process (Poonia and Upadhayay, 2015) [15]. The quantitative analysis of the saponin content revealed gradual decrease from 16.33µg to 5.14µg per 1.0g in these leaves with the increase in blanching time 0 to 3 min. Hence blanching is an effective approach to reduce the saponin content in the leaves. Statistically significant difference at $p < 0.05$ was found in the saponins of all samples with increase in blanching time (Table 2).

Table 2: Saponin content of bathua leaves

Time in min	Saponins (µg/g)
0	$16.33^{a} \pm 0.00$
1	$13.35^{b} \pm 0.01$
2	$9.97^{c} \pm 0.02$
3	$5.14^{d} \pm 0.03$
Mean	11.1958
SE of mean	0.017
CD	0.060
CV (%)	0.261

Note: Values are expressed as mean ± standard deviation of three determinations. Means within the same column followed by a common letter do not differ significantly at $p \leq 0.05$

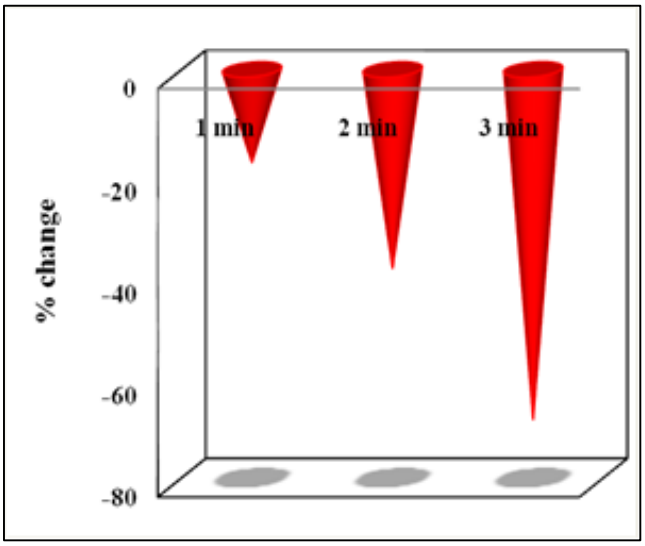

Fig 2: Percentage change in saponin content of bathua leaves on blanching

The percentage decrease in the saponin content on blanching of bathua leaves for 1, 2 and 3 min were 18.25, 38.95 and 68.52% respectively when compared with the non blanched sample (Figure 2).

Conclusion

Though bathua leaves have an undeserved reputation, given to its wondrous nutritional profile but the presence of anti-nutritional factors like oxalates and saponins which may have adverse effects on health was hindering its consumption like the other green leafy vegetables. Hence blanching of the leaves was done which resulted in significant decline of these anti-nutritional factors with the increase in blanching time to 3 min when compared to the control.

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