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Short Communication

Effect of cooking and processing methods on oxalate content of green leafy vegetables and pulses

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Abstract

Green leafy vegetables (spinach and *bathua*) and pulses (green pea and bengal gram) are widely consumed and hold an important place in the diet of people of India. Vegetarians who consume a greater amount of vegetables will have a higher intake of oxalate, which may reduce calcium availability. The objectives of this present research were to investigate the effect of different domestic cooking and processing methods on anti-nutrient content, oxalate in selected green leafy vegetables and pulses. The effect of cooking methods for green leafy vegetables and pulses via blanching, pressure cooking, open pan cooking, drying, boiling and sprouting on oxalate was determined on raw and cooked samples. Among the treatments given, blanching for 10 minutes (green leafy vegetables) and sprouting for 48 hour (pulses) were found to be the best methods for lowering the phytic acid and oxalate contents. The average reduction ranges on cooking for oxalate were 40.4% (spinach) and 115.9% (*bathua*) for green leafy vegetables and 24.9% (green pea and bengal gram) for pulses. Cooking methods showed considerable reduction in oxalate and phytate, but blanching and sprouting were fairly effective. The reduction of anti-nutrients on cooking is expected to enhance the nutritional value of these green leafy vegetables and pulses. Statistical analysis shows that there was significant influence of various cooking methods on oxalate content of selected samples at ($p \leq 0.05$).

Keywords: vegetarian, phytic acid, anti-nutrients, India.

Introduction

Vegetables form an essential component of the meal by providing vitamins, minerals such as iron, calcium, magnesium, zinc and other important nutrients for human health. The vegetable

contribution of minerals and vitamins to human nutrition is however limited due to the presence of anti nutritional factors that render some of the nutrient unavailable for human beings. Similarly pulses and legume are rich in protein. They are good source of carbohydrate and minerals as well. Due to the presence of several anti-nutritional factors, legumes possess low protein digestibility. The most common anti-nutritional factors in green leafy vegetables and pulses are oxalic acid, phytic acid, tannin and saponin [1]. Oxalic acid, dicarboxylic acid or its salts (oxalates) are widely distributed in plant food. These oxalates are mostly calcium salts. Rich sources of oxalate are green leafy vegetables, green vegetables and some legumes. Oxalates are known to interfere with calcium absorption by forming insoluble salts with calcium. Kidney stone patients are advised to avoid high oxalate containing food. However, diet containing food rich in insoluble calcium oxalate are not likely to be harmful. Green leafy vegetables and pulses are commonly used in daily diet of Indians. They provide a good amount of all essential nutrients like carbohydrate, minerals, vitamins and protein. The objective of this study was to determine the anti-nutrient oxalates and then the effect of cooking methods on oxalate content of selected samples.

Materials and Methods

For the present study green leafy vegetables and pulses were selected. The green leafy vegetables Spinach (*Spinacia oleracea*), *Bathua* (*Chenopodium album*) and pulses Green Pea (*Pisum sativum*) and Bengal gram (*Cicer arietinum*) were purchased from the local market of Allahabad. Six treatments were used, which were replicated three times. Treatments are as follows:

T0- control samples (fresh) of green leafy vegetables and pulses
T1– blanching of green leafy vegetables.
T2 – pressure cooking of green leafy vegetables and pulses.
T3 – Open pan cooking of green leafy vegetables,
T4 – Drying of green leafy vegetables.
T5 – Boiling of pulses.
T6 – Sprouting of pulses

Sample preparation

Samples were prepared by giving various cooking treatment to the selected green leafy vegetables and pulses. For green leafy vegetables and pulses specific treatments were used.

Blanching: This was undertaken using a stainless steel vessel. Water was boiled to 95ºC and vegetables (spinach and *bathua*) were blanched in boiling water for 10 min.

Drying: Drying was undertaken using the tray method, as described by Kumar *et al,* [1]. It was done at 50-60ºC for 5 hr.

Pressure cooking: Pressure cooking was done as per the procedure given by Wanasundera and Ravindran [2]. Vegetables were chopped and cooked in a pressure cooker (Hawkins, India) for exactly 15 min. Pressure cooking was done for both green leafy vegetables and pulses.

Open pan cooking: This method was done following the procedure given by Srilakshmi [3]. In this method cooking was done with enough water just to cover the base of the pan.

Boiling: Boiling was undertaken following the procedure given by Wanasundera and Ravindran [2]. Water was added to cut pieces at the ratio of 1:1 (w/w) and cooked in a closed stainless steel vessel for exactly 30 min. Water was discarded after boiling.

Sprouting: Sprouting was done by soaking pulses, namely green pea and Bengal gram, overnight. The water was drained and the pulses kept in muslin cloth for 48 hr.

Analysis

Selected vegetables (namely Spinach, *Bhatua*, Green Pea and Bengal Gram) were analyzed for anti-nutrient oxalate before and after various cooking treatments. For the analysis of oxalate, prepared samples were chemically analyzed by the standardized procedures given by Baker [4] and later modified by Wilson *et al* [5]. The data obtained from the experiment was statistically analyzed using analysis of variance technique Two-Way classification and critical difference.

Results and Discussion

The total oxalic acid contents of vegetables and pulses are shown in Table I.

Table I. Effect of cooking methods on oxalate contents of green leafy vegetables and pulses.

Cooking methods	Green leafy vegetables		Pulses	
	Mean ±S.E	Mean± S.E.	Mean± S.E	Mean± S.E.
Fresh	88.8 ±7.36	174.5± 33.61	38.1± 7.29	133.4±45.74
Blanched	48.4± 2.07	58.6± 10.65	-	-
Pressure cooked	57.2± 5.49	66± 4.15	-	-
Open pan cooked	60.13±3.17	69.73±26.20	-	-
Dried vegetables	186± 19.53	347.53±18.13	-	-
Boiled	-	-	20.5± 3.17	20.5± 3.172
Sprouted	-	-	13.2± 2.07	13.2± 4.15

S *($p \leq 0.05$)

It can be concluded from the results in Table I that the oxalic acid content of fresh samples were 88.8mg, 174.5mg, 38.1mg and 133.4mg per 100 gm, respectively. Green leafy vegetables blanched for 10 minutes shows the highest reduction for oxalate. This is because the concentrations of anti-nutritional factors are highest in the superficial layer of vegetables and blanching ruptures this layer [6], whereas green pea sprouted for 48 hr (T3) shows the highest reduction and Bengal gram pressure cooked for 15 minutes (T2) shows the highest reduction in comparison to other cooking methods. The loss of anti-nutrients during germination may be due to hydrolytic activity of phytase reported to be present in various plant food [7]. Conversely, it was noticed that after drying treatment, the oxalic acid content increased from 174.5 mg /100 gm to 347.53 mg /100 gm. This is due to considerable loss in moisture content, other components such as anti-nutritional factors oxalate and phytate of the dehydrated vegetables became concentrated and hence their values were much greater than those of the fresh vegetables. If high oxalate food were to be consumed in conjunction with a low calcium diet, then the consumer may be at risk of hyperoxaluria and stone formation. Radek and Savage [8], reported on the soluble and total oxalate content of 11 leafy vegetables grown in India as follows; spinach, purple and green amaranth and colocasia contained high levels of total oxalate, which ranged from 5,138.0 ± 37.6mg/ 100g dry matter up to 12,576.1±107.9mg/100g dry matter. Seven other leafy vegetables (curry, drumstick, shepu, fenugreek, coriander, radish and onion stalks) contained only insoluble oxalate, which ranged from 209.0±5.0 mg/ 100g dry matter to 2,774.9±18.4mg/100g dry matter.

Conclusion

Chemical analysis shows that the anti-nutritional factors oxalate and phytate were present in selected green leafy vegetables and pulses. Different cooking methods (blanching, pressure cooking, open pan cooking, drying, boiling and sprouting) have varied effects in reducing the levels of oxalate and phytate. However, changes during cooking were mostly similar in cases of green leafy vegetables and pulses for both oxalate and phytate. However, blanching and sprouting were found to be the best methods in order to reduce the contents of anti-nutritional factors. The reduction of anti-nutritional factors by cooking is expected to enhance the nutritional value of these green leafy vegetables and pulses.

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