e-ISSN 2320 –7876 www.ijfans.org
Vol.11,S Iss.2, 2022
 UGC CARE Listed (Group -I) Journal

Anti-Nutritional Factors of Selected Vegetables Grown In Indo-Gangetic Plains of Prayagraj District

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Abstract:

Vegetables are well known for their nutritional and medicinal properties but vegetables also contain some antinutritional factors which can affect the availability of the nutrients. The present study aims to assess the anti-nutritional factors of some selected vegetables collected from the 2 different Ghats of Prayagraj district namely Phaphamau and Bakshi bandh. The Vegetables selected for this study were *Spinacia oleracea, Coriandrum sativum, Trigonella foenum-graceum, Cucurbita, Lagenaria siceraria, Cucumis sativus, Solanum lycopersicum, and Beta vulgaris*. These vegetables were assessed chemically for the presence of oxalate, Phytates, tannins and alkaloids. The anti-nutritional factors of vegetables were analysed by using standard methods. The results ranged as follows; oxalate (5.4±0.3-664±1.2 mg/100g), Phytates (2.4±0.2-44.2±0.6 mg/100g), Tannins (5.5±0.5-22.3±0.47 mg /100gm), and alkaloids (3.7 ±2.6- 17.2 ±0.23%).Though these anti- nutrients can interfere with nutrients utilisation when in high concentration, the values obtained for the vegetables analysed were not up to the toxic levels of the anti-nutrients. Application of cooking methods in a significant way is accountable for reducing the risk of ANF in the human body.

Keywords: Antinutritional, Oxalate, Phytates, Tannins, Alkaloids

INTRODUCTION

Vegetables are designed as protective foods in the human diet due to richness in essential fatty acids, minerals, vitamins, amino acids, dietary fibre and essential bioactive compounds.

According to "***World Health Organisation (WHO)***" ***400 gms of fruits and non-starchy vegetables*** are accountable to meet daily requirements of nutrients. It has been stated that there

are vast biologically active compounds in plants, which have adverse effects on humans and other animals. Different natural substances of plants, such as ***saponins, alkaloid, oxalic acids, tannins, oxalates, flavonoid trypsin, cyanogenic glycosides haemagglutinin*** and ***gossypol, Saponin, Quercetin, rhamnetin, and epigenin, Sucrose, raffinose and stachyose, Copper, Tomatine, Rutin, epicatechin and caffeic acid*** have that capabilities to elicit biological responses. These molecules are responsible for biological changes, which have negative effects on the body. Tannin has been recognised as one of the common "***Anti Nutritional Factors (ANF)***", which has negative effects on the human body (Natesh *et al.* 2017).

The Indo-Gangetic plain is made of three main rivers like Indus, Ganga and Brahmaputra and this also the biggest alluvial plain in India. This plain is situated parallel with the Himalayas, and it starts from Jammu and Kashmir and continues to the west of Assam (Aryal *et al.* 2018). The major rivers in this plain are Koshi, Sutlej, Yamuna, Chambal, Beas and Gomti. This plain is made of the alluvial that are being deposited by the rivers of this area.The Indo-Gangetic Plains (IGP) in India mainly comprises of five states viz., Punjab, Haryana, Uttar Pradesh, Bihar and West Bengal. The Indo-Gangetic plain can be divided in to various groups like Terai belt, Bhabar belt, Delta plain, Bhangar plain and Khadar plain. This plain is one of the most important plain that is used for agricultural purpose and in the part time, one ninth part of the whole population lived here because this plain has the most suitable agricultural weather and factor that helps the farmers to produce more corps. The aim of this study is to detect the anti-nutritional factors in some selected vegetables and effective processing methods for reducing the rate of anti-nutrients in vegetables.

ANTINUTRITIONAL FACTORS IN VEGETABLES

The undesirable chemical molecules or substances are present in wild plant species and wild plant species. According to IREFIN (2020), these anti nutrients are referred to as "Alco Chemicals". The distribution and quantity of chemical compounds have negative effects on the human body. There are some common ANF, which is found in fresh vegetables, such as oxalates, tannins, cyanogenic glycosides and Phytates, Spinach, Coriander leaves, Fenugreek leaves, bottle gourd, Cucurbits maxima, Tomato, and beetroot. Nitrate is one of the natural and important compounds, which is accountable for characterising the quality of vegetables. The concentration of Nitrate is higher in vegetables than in fruits, roots and other vegetables. It has been stated that Agronomic is accountable for increasing the amount of Nitrate in the green vegetables. Moreover, it has been stated that, nitrate concentration rate increased in lower intensity of lights. The presence of nitrate content is non-toxic but its bi-products and metabolites such as nitric oxide, ***N-nitrous*** compound and nitrite are accountable for health concerns. Presence of excessive amounts of nitrate is causing "***blue baby syndrome"*** or ***methemoglobinemia.*** The WHO has stated that, an acceptable amount of Nitrate is 3.7mg/kg body weight.

Apart from nitrate, the presence of oxalate is accountable for increasing the risk factors. According to Boshe and Ukorebi(2020), ***Oxalic acids*** **[(COOH)2]** in combination with minerals or salts create oxalates, which has a negative impact on the human body. The enzymatic analytic method has stated that Beta ***vulgaris*** and ***Spinacia oleracea*** have more oxalates than other stems of vegetables. Tannin is identified as another ANF, which has high molecular weight (more than 20,000 Da). Plant tannin is present in fruits, wood, leaves, roots and plant galls. According to Satheesh and Workneh Fanta (2020), Freudenberg has classified tannins into two different sections, such as ***hydrolysed tannins*** and ***non-hydrolysed tannins***. ***UV spectroscopy, HPLC coupled with MS*** and ***Vanillin assay*** is the significant analytical method for detecting the number of tannins. Excessive amounts of dietary intake cause oesophagus cancer.

Phytic acid acts as the major storage of phosphates in green vegetables. This acid is found in the plants' tissues in the forms of cations, such as magnesium, calcium and potassium. Excessive intake of ANF is accountable for the poor digestive system in the human body. According to Ayeni and Oyeyemi (2021), alkaloid is another ANF, excessive consumption of alkaloid causes neurological disorders and gastrointestinal issues. Some plant alkaloids are accountable for infertility issues among people.

PROCESSING METHODS FOR REDUCING ANTI-NUTRIENTS

Recognition of the effective method for reducing antinutritional factors are essential for reducing the risk of several diseases. According to Diouf *et al.*(2019), heat treatment is one of the effective methods for reducing the risk of ANF in plant vegetables. Evaluating blanching and cooking methods is significant for reducing the amount of oxalic and phytic acids from the plant vegetables. The study has revealed that 10 to 15 minutes of blanching is accountable for reducing the amount of ANF from ***Spinacia oleracea (***spinach), ***Chenopodium album*** (bathua), ***Trigonella foenumgrecum*** (fenugreek). Blanching and cooking are essential for reducing the risk of ANF, whereas storage and drying does not make any significant effects on ANF.

METHOD AND MATERIALS

Study area

The site has been selected for detecting the ANF of vegetables at 2 different Ghats of Prayagraj district namely Phaphamau and Bakshi bandh. Some significant vegetables, such as*Spinacia oleracea(Spinach), Coriandrum sativum(Coriander leaves), Trigonella foenum-graceum(Fenugreek leaves), Cucurbita maxima(Pumpkin), Lagenaria siceraria(Bottle gourd), Cucumis sativus(Cucumber), Solanum lycopersicum(Tomato),and Beta vulgaris(beetroot*)have been taken for detection of the antinutritional factors.

Plant analysis

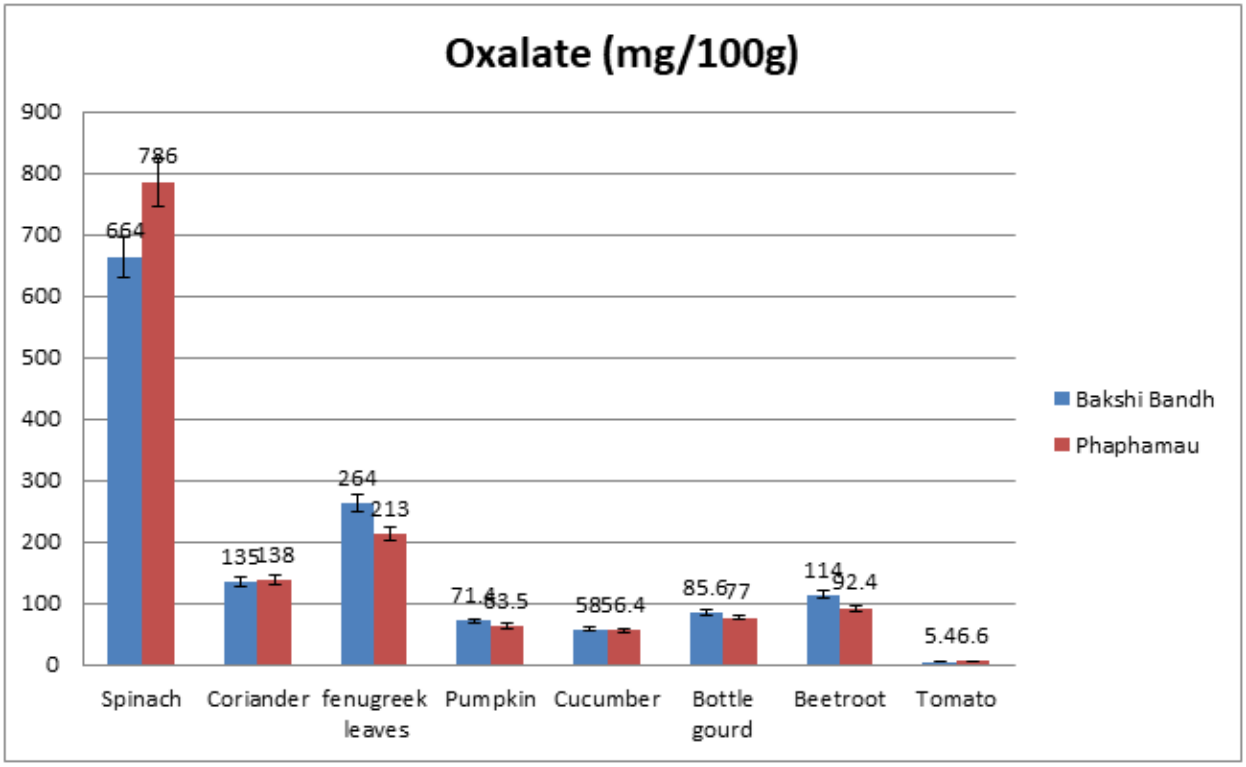
The selected plants have been washed with acidified water, tap water and distilled water. After that, the samples were dried at room temperature and then the plant samples were dried with hot air for 48 hours. Dried plants have been crushed and stored separately in the labelled jar. Identification of the heavy metals present in selected plants helped to detect the amount of ANF, which is accountable for making negative effects on the human body.

Estimation of Anti nutritional factors

Throughout the research method, different analytic processes, such as the tannin determination are done by "***Folin-Denis Method*** (Ranganna, 2005)."***Sadasivam and Manickam,2008***" method is used for determining the amount of phytate in plants. "***Adenyl SA et al. 2009*** " quantitative analysis method is used for detecting the amount of oxalate and alkaloid in plant materials.

RESULTS AND FINDINGS

The findings and analysis section give the opportunity to detect the amount of anti-nutritional factors in the selected vegetable from the Indo Gangetic Plains of Prayagraj district. Presentation of the phytochemical analytic process gave the opportunity for detecting the presented anti - nutritive factors and its values.



Graph -1 Oxalate (mg/100) values of selected vegetables

e-ISSN 2320 –7876 www.ijfans.org
Vol.11,S Iss.2, 2022

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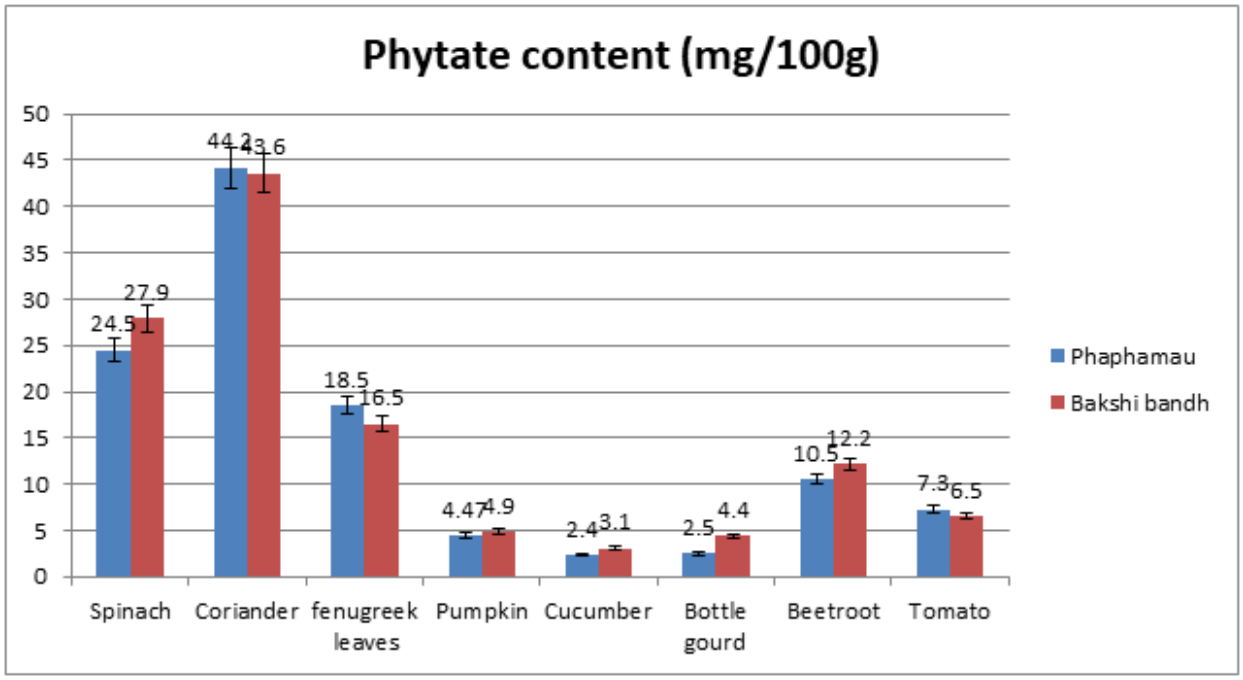
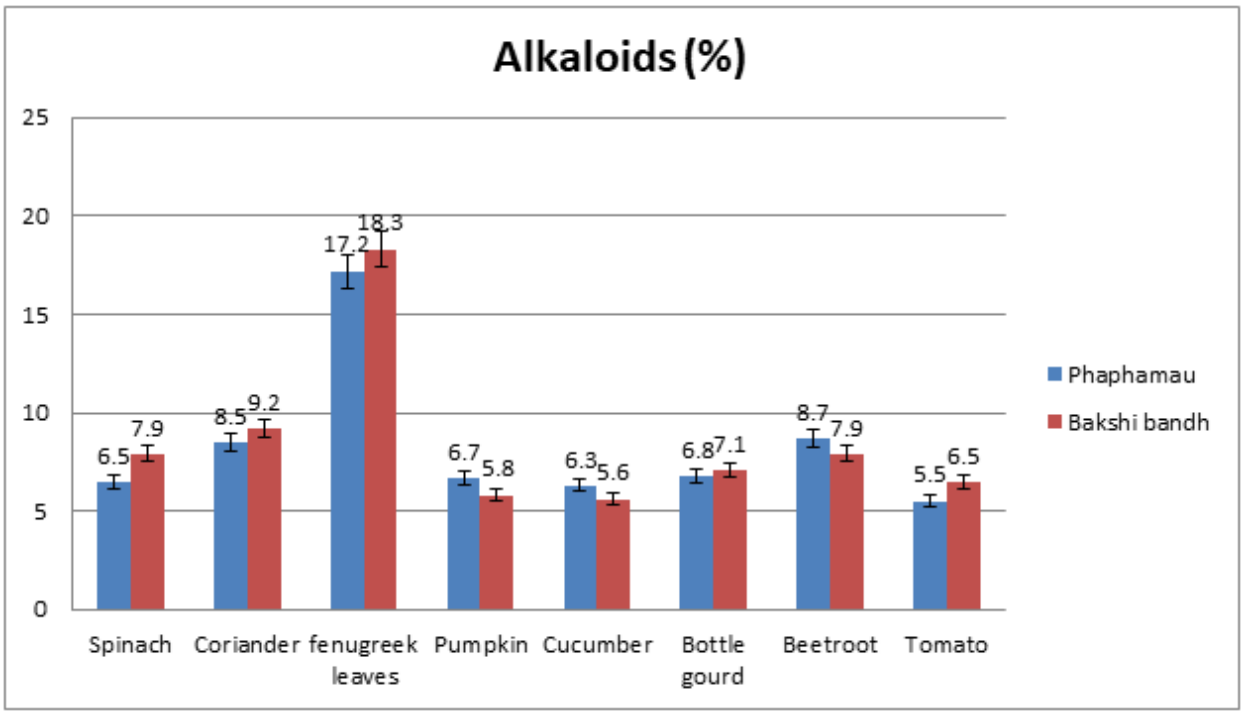
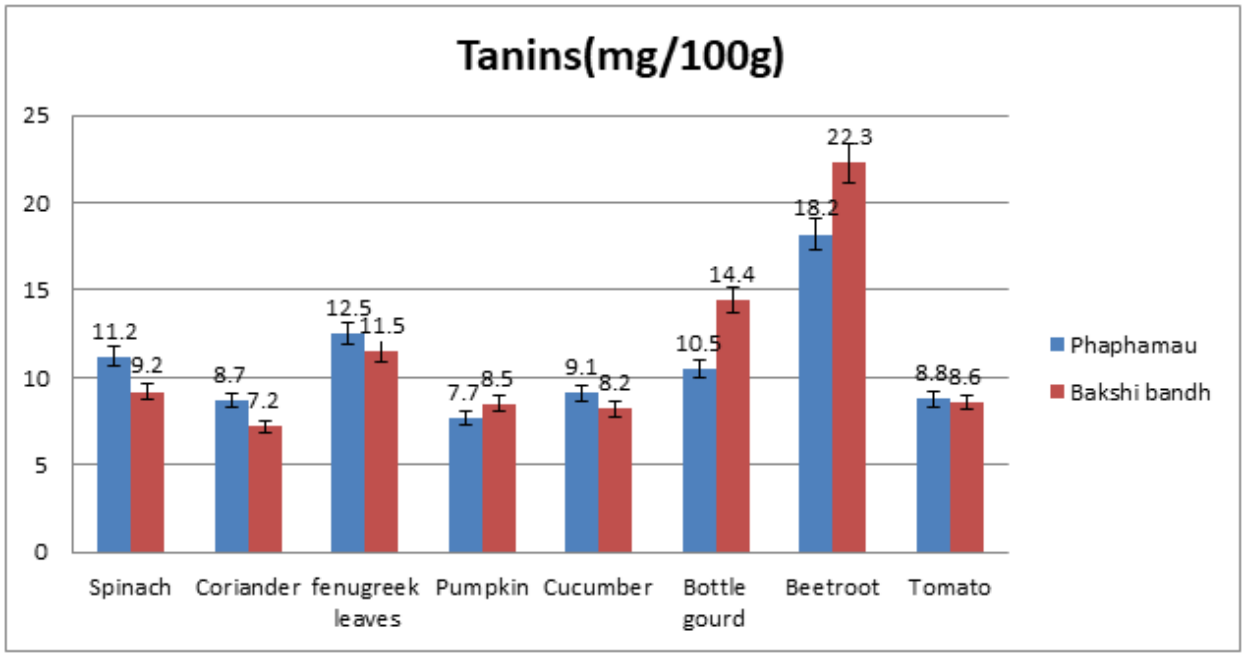


Graph -2 Phytates (mg/100) values of selected vegetables



Graph -3 Alkaloids (%) values of selected vegetables



Graph -4 Tannins (mg/100) content of selected vegetables

The above graph represents the amount of antinutritional content of selected vegetables.Oxalate, Phytates, alkaloids and tannin content were analyzed from two different ghats of vegetables.The oxalate content was found to be maximum in*Spinacia oleracea* followed by *Trigonella foenum-graceum*, *Beta vulgaris* and*Solanum lycopersicum* in the Phaphamau area; it ranged between 664-5.4mg/100g where as in bakshi bandh area the oxalate content was found high in *Spinacia oleracea* and low in *Solanum lycopersicum*, ranging between 786- 6.6mg/100g**(Graph 1).** Also Oxalate has been identified in this study as it produces and accumulates in vegetable plants, when the plants are being consumed by a body, oxalates does not only mix them with calcium but it mixes with magnesium to have a form of insoluble salts that are available in the body. The below table shows that spinach contains calcium oxalate. According to Abbas and Ahmad (2018), oxalate is the anti-nutritive factor; it has made a composition with calcium. The insoluble calcium oxalate is accountable for making precipitation in the soft tissues, such as the ***kidney***. Excessive precipitation of calcium oxalate is accountable for ***kidney stones.***

The phytate content was found to be high in*Coriandrum sativum* followed by*Spinacia oleracea*,*Trigonella foenum-graceum*and*Cucumis sativus* it ranged between 44.2-2.4mg/100g in Phaphamau area where as in bakshi bandh area the phytate content was found to be high in*Coriandrum sativum* (43.6mg/100g) and lower in*Cucumis sativus* (3.1mg/100g) **(Graph 2).**Phytates lowers the uses of the components such as magnesium, calcium, iron and zinc due the capacity for forming an insoluble salt along with ions. The content of phytic acid indicates 20% to 60% of the Phytates in plants excreted from the body.The phytic acid works as an effective chelator forming the protein. It has been stated that long terms of phytate diet are

accountable for decreasing the ***bioavailability of significant mineral***s. The findings and analysis section help to detect the statistical value of several antinutritional factors.

Table 2: The statistical data (Source: Diouf *et al.*2019)

Plant	**Anti-nutritional factors**	**Amount**
Spinacia oleracea	Calcium oxalate	592 ±2.6 mg/100g
Coriandrum sativum	Quercetin, rhamnetin, and epigenin	0.8 mg/100 g
Trigonella foenum-graceum	Nitrate	15.90 ± 0.14%
Cucurbita maxima	Phytates	4.9 ±0.9 mg/100g
Lagenaria siceraria	Alkaloids	5.27 ±0.8 - 15.20±2.5%
Cucumis sativus	Tannins	4.6 ±3.8 - 8.20± 3.08 mg /100gm
Solanum lycopersicum	Phytates	7.39+0.66 mg/100g
Beta vulgaris	Oxalate	92 ±2.8 - 114 ±0.2 mg/100g

The Alkaloid percentage was found to be maximum*Trigonella foenum-graceum* in followed by *Beta vulgaris*, *Coriandrum sativum* and *Solanum lycopersicum*in Phaphamau area, it ranges between 17.2- 2.6%. Whereas in the bakshi bandh area, alkaloid content ranged between 18.3%-3.7% **(Graph-3).**Alkaloids are non- volatile, crystalline solids and colourless that tends to have a bitter taste. Most often it can be present in the fenugreek leaves due its bitterness. Alkaloids show a strong biological effect on human and animal organism with very small amount of doses. Moreover, increasing the amount of toxic alkaloids is accountable for having negative effects on the digestive system, gastrointestinal tract, kidney and heart (Abu *et a*l. 2020).

Tannin content was found to be highest in *Beta vulgaris*followed by *Trigonella foenum-graceum*, *Lagenaria siceraria*and *Cucurbita maxima* in Phaphamau area, it ranged between 18.2-7.7mg/100g where as in bakshi bandh area the tannin content was found to be high in *Beta vulgaris*(22.3mg/100g) and low in *Coriandrum sativum* (7.2mg/100g) **(Graph 4).**Moreover, tannins are the phenolic compounds that are water soluble with molecular weight higher than 500and with the capacity for protein precipitation through aqueous solution.According to the above represented table, the amount of tannin is *22.3 ±2.8 – 7.2± 1.6 mg /100gm*, which has

greater molecular weight. Tannin is accountable for making binds of protein and it is responsible for bioavailability in the human body. Identification of these ANF are significant for reducing the risk of several health issues. The physicochemical process is accountable to identify all ANF for increasing the nutritive value of green vegetables. Green leafy vegetables blanched for 10 mins shows the reduction in antinutritional factors. This is because the concentrations of antinutritional factors are highest in the superficial layer of vegetables and blanching ruptures this layer (Albinhn et al., 2004).

RECOMMENDATION AND CONCLUSION

Consumption of ANF through vegetables has negative effects on the human body. Vegetables are accountable for providing vital nutrients for the fulfilment of nutritional demand. Identification of the micro and macro nutrients are essential for identification of the harsh materials in vegetables, which has negative effects on the human body. The inclusion of the blanching and thermal processing method is essential for reducing the negative effects in the human body. The present research study has recognised the potential ANF in the vegetables. Detection of the concentration of ANF in a scientific way is essential for adopting effective strategies for enhancing nutritional benefits. Application of cooking methods in a significant way is accountable for reducing the risk of ANF in the human body. Inclusion of the heating via a scientific method is essential for removing the antinutritional properties from green vegetables.

Acknowledgement- Arshi acknowledges the Junior Research Fellowship (JRF) from University Grant Commission (UGC), New Delhi for financial assistance.

Conflict of interest –The authors declare that there are no conflicts of interest in the course of conducting the research. All the authors had final decision regarding the manuscript and decision to submit the findings for publication.

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