International Journal of Agricultural Sciences
Volume **10** | Issue 1| January, 2014 | 474-476

A CASE STUDY

An analytical study of nitrate-nitrogen on vegetables from different markets of Allahabad

L.S. KHARSYNTIEW, R. BHAROSE, SUSHIL KUMAR[1] AND T. THOMAS*
Department of Soil and Environmental Sciences, Sam Higginbottom Institute of Agricultural Technology and Sciences, ALLAHABAD (U.P.) INDIA (Email : thomasaaidu@gmail.com)

Key Words : Nitrate, Nitrogen, Vegetables

View Point Article : Kharsyntiew, L.S., Bharose, R., Kumar, Sushil and Thomas, T. (2014). An analytical study of nitrate-nitrogen on vegetables from different markets of Allahabad. *Internat. J. agric. Sci.*, **10** (1): 474-476.

Article History : Received : 25.10.2013**; Accepted :** 21.12.2013

Nitrogen is an essential plant nutrient that often limits crop production. Consequently nitrogen sources, such as chemical fertilizers and manure, are sometimes applied to meet crops nutrient requirements. It is a plant food most often applied to vegetable crop as fertilizer, and this nutrient is responsible for green leafy growth. Insufficient nitrogen results in poor crop growth and low yields. The nitrate form of nitrogen (NO_3) is especially prone to contamination of ground and surface waters and also responsible for contamination when excessive amounts are applied to crops. Agriculture is considered as the major source of releasing nitrate into the environment. Fertilizers use is rapidly increased, causing excessive loading into the environment.

Nitrogen compounds are also accumulated in some plant tissues. More than three quarter of our average intake comes from the vegetables, which provide about 80% of the average daily dietary intake. Vegetables that may accumulate nitrate in their tissues are leafy vegetables such as spinach, lettuce and cabbage, or root crops like carrot, beetroots, potatoes, radish, and other like cauliflower, beans and peas. The nitrate in vegetables is derived primarily from the nitrate added fertilizers.

Application of chemical fertilizers and farmyard manure affects crop productivity and improve nutrient cycling within soil-plant system, but the magnitude varies with soil-climatic conditions. Nitrate nitrogen leaching is a major problem for soils in which ammonium (NH_4) is quickly nitrified to NO_3. It has become a major concern worldwide, mainly due to increased N fertilizers and farmyard mannure inputs nitrates and nitrites seemed to be among the chemicals that may cause pollution; many studies have expected the effect of these compounds on the environment and on the living health. These studies focused on the nitrate and nitrite content on water and vegetables consumed by humans. In order to control the nitrate and nitrite intake by consumers in general and on babies in particular who are the most vulnerable to the adverse effects of these compounds, a minimum acceptable of these compounds were suggested. The acceptable daily intake (ADI) of nitrate and nitrite set by European Commission's Scientific Committee for Food (ECSCF), is 3.7 mg/kg body weight, and 0.06 mg/kg body weight, respectively (WHO, 1995).

The maximum safe and / or regulatory limits for nitrate in drinking water, vegetables, forage/food stuffs (WHO, 2007) are well within the detection range, 0.5-10 ppm N, of acid reduction method for nitrates. The mean concentrations of 9.1 ppm as nitrate N and 0.7 ppm as nitrite N in the present study would suggest good nitrogen quality of the test soil. vegetables contribute dominantly, 60 to 90% or above, to dietary nitrate intake in humans followed by water (Chiroma *et al.*, 2007). Many workers have determined the nitrate and nitrite contents of the prepared infant cereal foods and

*** Author for correspondence**
[1]Department of Agricultural Chemistry and Soil Sciences, C.C.R. (P.G.) College, MUZAFFARNAGAR (U.P.) INDIA

common vegetables. The leafy vegetables contained large amount of nitrate and nitrite, the most vegetables like beet, turnip and radish were reported to have the highest nitrate contents (1000-2000ppm). The factors responsible for nitrate accumulation in plants are mainly nutritional, environmental and physiological. Nitrogen fertilization and high intensity have been identified as the major factors that influence the nitrate content in vegetables.

Collection of samples:

Fresh vegetables of different types such as cabbage, spinach, radish, cauliflower and fenugreek were collected from different markets of Allahabad namely Alopi Bagh, Gaughat, Naini, Mahewa, near statesman bakery, near High count, Chawk, Muthiganj of Allahabad.

Standard solution which was used to calibrate the spectrophotometer:

Potassium nitrate KNO_3 standard solution:

Stock solution contains 100 mg L^{-1} NO_3-N or 100 ppm was prepared by dissolving 0.7215g of (AR) KNO_3 and the volume was made up to 1 litre by distilled water. Working solution of 200, 300, 400 up to 1000 ppm was prepared from the stock solution after taking different amount of solution in 100 ml beaker.

10 ml of the working solutions was taken individually and pinch of Ca $(OH)_2$ was added. 0.5 g of $MgCO_3$ was also added and swirled the flask. The solutions were allowed to stand for sometime and filtered, after that the solution were dried in a water bath and cooled at room temperature and 3ml of phenoldisulphonic acid was added and mixed, 15 ml of distilled water was added after 10 minutes the solutions were cooled and transferred to a 100 ml volumetric flask. Diluted ammonia (1:1) was added slowly and mixed until the solution became alkaline yellow, 2ml extra diluted ammonia solution was also added. The volume of each concentration was then made upto 100 ml with distilled water.

Washing, air drying and preparation of samples:

All the vegetables collected from different markets of Allahabad were washed thoroughly with water several times. The samples were then washed with about 0.2% detergent solution thoroughly to remove the waxy/greasy coating on the upper surface, which is often present. The vegetables were then washed with 0.1N HCl followed with thoroughly washing with plenty of water and distilled water. Then the final rinse was given with double distilled water. They were then soaked to dryness with good quality of tissue paper (Singh *et al.*, 1999). They were then spread on clean paper for air drying them in a dust free atmosphere away from any kind of contamination. The dried vegetables were chopped into smaller pieces and ground in a porcelain mortar till homogenous slurry was formed. The sample was then used for analysis of NO_3-N content in different vegetables with the help of UV spectrophotometer.

Procedure for analysis of NO_3-N content in vegetables is given in Table A.

10 gms of the slurry was washed in a 250 ml beaker with 70 ml distilled waters and 2.5 ml of 4% NaOH was added

↓

The content was warmed in a beaker on hot plate at 80°C for 25 minutes with occasional shaking

↓

The solution was filtered through Whatman No. 1 filter paper into 100ml volumetric flask

↓

Then 4 ml of the aliquot was taken into a test tube and kept in cold water for cooling the solution

↓

1 ml of 5% Ag_2SO_4 solution was added, followed by subsequent addition of 7ml of 98% H_2SO_4 and 1 ml of 5% phenol solution was also added

↓

The solution was allowed to stand for 20 minutes with occasional shaking

↓

After 20 minutes the mixture was then extracted in a beaker and then transferred into 50 ml separating tunnel by adding toluene and the solution was then shaken for 10 minutes and the aqueous layer was discarded.

↓

The organic phase was then washed twice with 10 ml of distilled water and shaked for two minutes and each time the aqueous phase was discarded

↓

The organic phase was then extracted again in a test tube and shaked for 1 minute with 10 ml of 10% Na_2CO_3 solution and collected in a test tube to measure the NO_3-N concentration.

↓

Absorbance was read at 407nm on the digital screen of spectrophotometer

Source: (Spectrophotometric determination of nitrate, Gaya, and Alimi, 2006)

Fig. A: Flow chart

Table 1 and Fig 1 present the summary of NO_3-N concentration in different vegetables collected from different markets of Allahabad. The maximum NO_3-N in cauliflower (0.530 µg/g) and radish (0.679µg/g) was found in Muthi ganj market and minimum value of NO_3-N in cauliflower (0.270µg/g) and radish (0.358µg/g) was found in Chowk market. The NO_3-N in spinach (0.629µg/g) and fenugreek (0.537µg/g) was maximum in Allahpur market and a minimum value of NO_3-N in spinach (0.379µg/g) was found in Muthiganj and fenugreek (0.319µg/g) in Chowk market. The concentration of NO_3-N in cabbage (0.669µg/g) was maximum in Mahewa and minimum (0.358µg/g) in Chowk market. Since all the values of NO_3-N concentration in different markets of Allahabad were below the permissible limit and safe for human consumption without any effect on the health of children to elders.

The Table 2 depicts that the value of NO_3-N in cauliflower (0.0053mg/g) was less than the recommended

Table 1 : Concentration of NO_3-N (µg/g) in different vegetables collected from different markets of Allahabad

Markets	Cauliflower	Cabbage	Radish	Spinach	Fenugreek
Mahewa	0.402	0.669	0.663	0.609	0.527
Naini	0.284	0.533	0.344	0.505	0.389
Muthi ganj	0.530	0.551	0.679	0.379	0.478
Gaughat	0.393	0.643	0.634	0.626	0.522
Near Statesman Bakery	0.384	0.403	0.488	0.494	0.505
Near High Court	0.434	0.680	0.672	0.585	0.371
Chowk	0.270	0.358	0.314	0.470	0.319
Alopi bagh	0.419	0.658	0.619	0.610	0.497
Allahpur	0.434	0.612	0,555	0.629	0.537
F. test	NS	NS	NS	S	NS
S.E.±	0.001279	0.00 2967	0.002510	0.002267	0.002374
C.D. (P=0.05)	0.006290	0.006481	0.005322	0.004806	0.005033

NS=Non-significant

Table 2 : Comparison of NO_3-N in different vegetables with the recommended values of NO_3-N for vegetable (Singh, 2001)

Names of the vegetables	IIVR value of nitrate content (mg/kg)	Absorbed values (mg/kg)
Cabbage	390.00	0.0680
Spinach	2100.00	0.0629
Radish	1100.00	0.0679
Cauliflower	37.00	0.0053
Fenugreek	280.00	0.0537

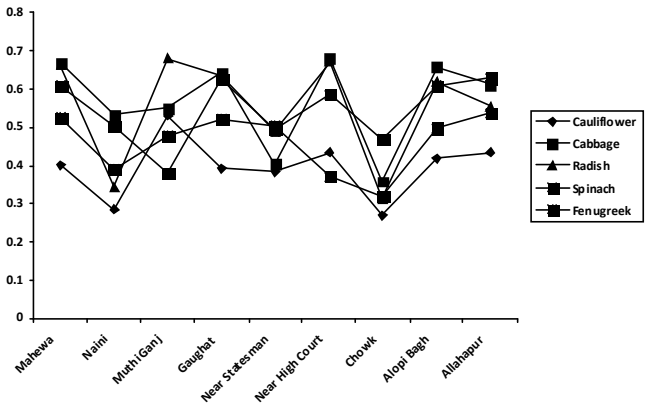

Fig. 1 : Concentration of nitrate nitrogen in different vegetables from different markets of Allahabad

value (37.00 mg/kg). Similarly the values of NO_3-N in cabbage (0.0680mg/g), spinach (0.0629mg/g), radish (0.0679 mg/g) and fenugreek (0.0537mg/g) were also found to be less than the recommended values 390mg/kg, 2100mg/kg, 1100mg/kg and, 280.0 mg/kg, respectively. Since these values are below the permissible limit as given by IIVR hence, the vegetables are safe for human consumption, without any effect on the health of children to elders.

Conclusion:

On the basis of experimental result it is concluded that the vegetables from different markets of Allahabad are not much polluted because the values of NO_3-N content was coming under permissible limit as recommended by IIVR. According to the acceptable daily intake (ADI) given by the European Commission's (EC) Scientific committee on food (SCF), nitrate content are needed in human body according to body weight to be consumed in a diet.

REFERENCES

Anjana, Umar, S., Iqbal, M. and Abrol, Y.P. (2007). Are nitrate concentrations in leafy vegetables within safe limits? Proceedings of the Workshop on Nitrogen in Environment, Industry and Agriculture, New Delhi, India, PP: 81-84.

Bednar, C.M., Kies, C. and Carlson, M. (1991) Nitrate-Nitrite levels in commercially processes and home processed Beets and Spinach. *Plant Foods for Human Nutrition*, **41** (3): 261-268.

Chiroma, H.D., Ayinla, G.T., Orish, O.E., Emmanuel, O.O., Jigam, A.A., Makun, H.A., Sani, G.M., Johnson, A.O. and Humphrey, P. (2007). Seasonal nitrate content of stream water, soil and some foodstuffs samples in Abuja Municipal area of Federal capital territory, Nigeria. *J. Health Sci.*, **53**(4): 359-364.

Gathungu, G.K., Shibairo, S.I., Gethiri, S.M., Mburu,, M.W.K., Ljiambo P.S. and Kidanemarian, H.M. (2000). Effect of Source, time, and Method of Nitrogen Application on Growth and yield Components of potato in Kenya. *African Crop Sci. J.*, **8**(4): 387-402.

Janez, S., Veronika, K. and Ana, G. (2002) A survey of nitrate and nitrite content of fruits and vegetables grown in Slovenia. Agriculture Institute of Slovenia, Ljubljana, Slovenia. *Food Additives & Contaminants: Part A*, **23** (4) : 385-390.

Singh, Jagdish (2001). State level collaborating training programme and vegetables production technology, Indian Institute of Vegetable Research (IIVR), vegetable crops & Nutritional Security p 1-11.