Trace Metals In Locally Grown Vegetables (Brassica Oleracea Var. Botrytis) Collected From Selected Different Agricultural Farms In Darrang And Udalguri Districts Of Assam (India)

Phanindra Deka[1]* Abdul Mannan Sheikh [2]*

Abstract:

A study was carried out with respect to trace metal composition of locally grown cauliflower from dominant agricultural areas of Rangamati, Ramhari, Kowpati, Tangla, Besimari and Balugaon in Darrang and Udalguri districts of Assam. The two districts are situated about 65 km and 115 km away from the city centre, Guwahati, Assam. All the six areas of Assam are well known as agricultural producers. Along with samples of cauliflowers, soil samples were also collected for analysis of trace metals.A comparative relationship was seen between soil trace metalsand that of cauliflowers. It was found that the soil growing cauliflowers had Co: 664.75 mg/kg, Cr: 7.85 mg/kg, Cu: 40.26 mg/kg, Fe: 2563.55 mg/kg, Mn: 445.63 mg/kg, Ni: 43.82 mg/kg, and Zn: 124.40 mg/kg.

Kew words:trace metals, cauliflowers, agricultural soils and human health

DOINumber:10.48047/nq.2022.20.22.NQ10300 **NeuroQuantology2022;20(22):3053-3058**

Introduction:

Vegetables are the extremely important food for people and animals. These vegetables are reported by IARC (2003) and are essential sources of vital micronutrients.People are usually consumed in relatively small amounts as side –dish or relish with the staple foods [4]. Although a few of them are of global importance, many more are still used as condiments locally, in the regions of their natural occurrence while some are traded in small quantities and used in ethnic restaurants.Trace elements play an important role in chemical, biological, metabolic and enzymatic reactions in the living cells of plants, animals and human beings. Man, animals and plants take up these metals from the environment through air, water and food. The role of trace elements in the body metabolism is of prime importance. Their deficiency causes diseases, whereas their presence in excess may result in toxicity to human life. Some trace humans [9]. Trace metals pollution in environment, even at low levels, and their resulting long term cumulative health effects are among the leading health concerns all over the world. For example, bioaccumulation of Pb in human body interferes with the functioning of mitochondria, there by impairing the respiration, and also causes constipation, swelling of the brain, paralysis and eventual death [10]. This situation is even more worrisome in developing countries,under developing countries rather than in advanced countries. Hence, soil is a vital resource for sustaining two human needs of quality food supply and quality environment. Fresh fruits and vegetables are of great importance in the diet as it is considered as "Protective Supplementary Food" as they contain vitamins, micronutrients, proteins, carbohydrates, fats, and minerals, dietary fibers and amino acids in

***Corresponding Author: -** Phanindra Deka
Address: - [1]*Department of chemistry, A.M. Sheikh, department of Mathematics, Assistant professor Tangla College, Tangla-784521, Assam, India.

Relevant conflicts of interest/financial disclosures: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest

hazardous to plants, animals, water and

which are required for normal body functioning of human metabolic processes. The recent population and industrial growth haslead to increasing production of domestic, municipal and industrial wastes.

The demand of soil and water for diverse purposes such as construction, industry, agriculture, etc. is increasing continuously, thereby increasing pollution drastically. Due to increase in population, the demand for vegetables is also increasing hence vegetables become available in advance before season by the use of chemicals, fertilizers, hormones etc. Vegetables are not only important for dietbutalsoformaintenance of health and act as prevention of various diseases. Locally grown cauliflower is a very popular vegetable in north east India. It is generally grown in acidic soil and found in winterseason. The two districts are situated about 65 km and 115 km away from the city centre, Guwahati, Assam. The present aim of this study was to determine the concentration of trace metals in soil as well as in cauliflowers. Also to find out the correlation between trace metals in soil and in vegetables. In the present study, locally grown cauliflower was analyzed for eight (8) trace metals as well as Na, K, Ca and Mg respectively. Soil samples were also analyzed for eight (8) trace metals.

EXPERIMENTAL:

Study area and work plan

The six study areas were taken for analysis of trace metal composition of locally grown vegetables and agricultural soils The six sampling sites were -- Rangamati (L1), Ramhari (L2), Kowpati (L3), Tangla (L4), Besimari (L5) and Balugaon (L6) under Darrangand Udalguri districts of Assam, india.

The top soils (0-15cm) of six different samples with 1(one) m^2 area were collected.

Soil parameters: Na, K, Ca, Mg and trace elements Fe, Zn, Co, Cd, Cr, Mn, Ni and Cu

The following trace elements are estimated in cauliflower: Na, K, Ca, Mg and trace elements Fe, Zn, Co, Cd, Cr, Mn, Ni and Cu respectively.

Methodology:

Analysis of trace metals in cauliflower samples: The cauliflower samples were weighted and oven dried. It was calcined in the muffle furnace to prepare ash at 450 -550 ^{0}C for twelve hrs. And weighted one gram ash as a sample was taken into 100 ml beaker with adding 10-15 ml perchloric acid $HClO_4$ and digested on an electric hot plate. The digested sample was taken up with conc. HCl (1:1) and filtered through a filter paper (What man 42) with several washing by distilled water. The volume of filtrate was diluted to 100 ml as a final sample for analyzed. The analysis was carried out by Atomic Absorption Spectrophotometer (Perkin Elmer AAS model variant- 220). Each sample was carried out three times.

Analysis of metals in soil samples: Soil samples preparation and estimation were also done by using standard methods.

Analyses for Na, K, of cauliflower and soil samples were carried out by using a flame photometer (Labtronics, Model LT-34, India). Analysis for Ca and Mg of cauliflower and soil samples were carried out through EDTA method. All the reagents used for the analysis were of analytical grade.

Results and Discussions:

Table 1 and 2 represent the physico-chemical properties of soil and vegetable samples. The P^H and electrical conductance (EC) of the soil samples were not significantly different from one sampling site to other. The P^H of soil samples in these sampling locations is almost acidic than control 6.3 and lies between 6.53 and 6.77 respectively. The result showed that the values of Ca, Mg and Na, K were not significantly higher than the normal level of a typical agricultural soil.

Table 3 and 4 represent the trace metals concentrations in the agricultural soils and cauliflowers. The sequence of metal concentrations in the analyzed agricultural soils were – Fe>Co>Mn> Zn>Cu>Ni>Cd>Cr.This shows that the concentration of trace metals in the agricultural soils were varied according to the metal species and season. The Fe had the highest concentration of 2563.55 mg/kg while Cr has observed to be lowest concentration of 1.57 mg/kg in the soil. The mean values of Fe

and Cr were 1066.91 mg/kg and 3.73 mg/kg.
Iron (Fe) is an important element for human body metabolism which acts as a catalyst and is present in greater amount than in any other trace elements. According to an estimate 57.6 % of the body iron in human is contained in hemoglobin and 8.9% in myoglobin, whereas approximately 33% in non-heme iron complexes, including ferritin and hemosiderin. The cytochrome enzymes contain about 0.5% of iron [6]. The concentration of Fe in these vegetables was: 35.26-791.08 mg/kg.

Zinc(Zn) is present in the body as a co-factor for enzymes such as arginase and diaminase. It takes part in the synthesis of DNA, proteins and insulin. It is essential for the normal functioning of the cell including protein synthesis, carbohydrate metabolism, cell growth and cell division.Concentration of Zn in these vegetables was found to be 82.45-138.47 mg/kg. A normal body contains 1.4 to 2.3 gm of zinc and it is present in all the body cells. Recommended daily dietary intake of Zinc is about 15 mg [13].

Excessive intake of zinc may be a long term effect whereas the deficiency syndrome manifests itself by retardation of growth, anorexia, lesions of skin and appendages, impaired development and function of reproductive organs [10]. In view of this, the present estimatedconcentrations of metals in vegetables under investigation don't cause health hazard for consumers.

Cobalt (Co) has little direct activity on its own in the body as it is an integralcomponent of vitamin B_{12} and as such its effects, sources and uses are very similar to that of vitamin B_{12}. It is involved in preventing pernicious anemia and also helps in red blood cell production. Co also supports normal nervous system functions [3]. Very little information has been reported on its concentrations in food materials. The concentrations Co varied from 1.83 to 215.42 mg/kg and mean value of Co was 65.31 mg/kg.

Cadmium (Cd) is a non essential element in foods and natural waters and it accumulates principally in kidneys and liver [1]. Various sources of enviromental contamination have been implicated for its presence in foods [2[. In all sample analyzed, its concentration was varied from 0.11 to 0.92 mg/kg and the mean value was 0.39 mg/kg.

Chromium (Cr) is selectively accumulated in liver and kidney. It has been reported to interfere with enzymatic sulphur uptake of cells affecting the lungs, liver and kidney [5]. Concentration of Cr was found in the range of 0.06 to 0.57 mg/kg. The mean vale of Cr was found 0.30 mg/kg. The safe and adequate Cr intake U.S.A. for adult is 0.05-0.2 milligram [14]. Chromium doesn't apparently pose a health threat in view of its concentration levels in the vegetables investigated.Solooking through this perspective, the vegetables are quite safe for human consumption.

Manganese (Mn) deficiency causes diseases and excess of it causes poisoning of central nervous system and ingestion, inhalation or skin contact may cause manganic pneumonia [8]. Concentration of manganese in the vegetables studied was found to be in the range of 3.52 mg/kg to 60.44 mg/kg. A daily dietary intake of 2.5 to 5 mg of manganese by human contributes to the well being of the cells [7]. The safe and adequate range of Mnintake for adults (U.S.A.) is 2500 to 5000 micrograms per day [15].

Nickel (Ni) also plays an important role in functions of human body including enzyme functions. It occurs naturally more in plants than in animal flesh. It activates some enzyme systems in trace amount but its toxicity at higher levels is more prominent [1]. The concentration of nickel levels varied from 0.36 to 4.42 mg/kg and the mean value of nickel was 2.39 mg/kg.

Copper (Cu) is an essential element, widely distributed and always present in foods, animal livers, which are the major contributor to the dietary exposure to copper e.g. various shellfish and some dry foods offer requirement of copper. It is necessary for normal biological activities of amino-oxides and tyrosinase enzymes. Tyrosinase is required for the catalytic conversion of tyrosine to melanin, the vital pigment located beneath the skin, which protects the skin from dangerous radiation. The concentration of copper in these

vegetables was: 1.42- 14.94 mg/kg. A daily dietary intake of 2 to 3 mg copper is recommended for human adult [7]. But there is no recommended dietary intake for copper in Australia [15]. In the U.S.A., an intake of 2 to 3 milligrams per day for adults is considered to be safe and adequate.

Ingestion of 15-75 mg of copper causes gastrointestinal disorders. Excessive intake of copper may cause heamolysis, hepatotoxic and nephrotoxic effects. Continuous ingestion of copper from food induces chronic copper poisoning in man.

Coclusion:

The higher content of metals such as Fe, Co, Zn, K, Na and Ca were found in the analyzed vegetables. The green vegetables were found to be a good source of macro- and micronutrients. These vegetables should be included in the diet to overcome various nutritional problems like iron, zinc, cobalt, copper, calcium, and magnesium deficiency. The investigated vegetables were quite safe for human consumption.

Table-1 Physico-chemical analysis of soils (mg/kg) used in agricultural fields of Darrang and Udalguri districts.

Locations	PH	EC (mS/cm)	Moisture (%)	Ca	Mg	Na	K
L1	6.72	0.67	8.54	922.54	82.84	512.60	2485.82
L2	6.77	0.71	9.12	978.40	92.33	495.60	2394.75
L3	6.70	0.85	8.34	826.25	92.58	485.83	2103.68
L4	6.53	0.46	10.00	743.81	72.54	425.77	2935.34
L5	6.66	0.66	10.35	769.44	102.50	496.85	2268.47
L6	6.76	0.87	8.66	815.62	120.40	526.38	2761.55

Table-2 Physico-chemical analysis of cauliflower (mg/kg) used in agricultural fields of Darrang and Udalguri districts.

Locations	Moisture (%)	Ca	Mg	Na	K
L1	80.54	820.7	52.60	645.8	2684
L2	80.72	860..3	47.65	618.5	2580
L3	78.46	645.8	40.56	751.5	2463
L4	79.08	565.4	47.62	580.3	3353
L5	79.26	683.2	66.54	836.7	2746
L6	80.44	667.5	61.75	974.6	3178

Table-3 Trace metals (mg/kg) in agricultural soils atDarrang and Udalguri districts.

Locations	Fe	Zn	Co	Cd	Cr	Mn	Ni	Cu
S1	135.66	52.12	3.54	2.54	4.14	328.57	37.04	40.28
S2	128.75	83.81	53.65	5.65	4.65	445.63	41.91	22.57
S3	121.54	65.08	3.74	2.83	1.65	342.55	43.82	32.88
S4	1770.00	124.40	664.75	6.57	1.57	214.54	11.63	6.57
S5	1802.00	48.58	417.40	10.06	2.53	8.52	3.34	11.03
S6	2563.55	41.09	471.50	5.66	7.85	9.63	3.94	5.66
Mean	1066.91	69.18	269.09	5.55	3.73	224.90	23.61	19.85
Max.	2563.55	124.40	664.75	10.06	7.85	445.63	43.82	40.28

Table-4 Trace metals (mg/kg) incauliflowersatDarrang and Udalguri districts.

Locations	Fe	Zn	Co	Cd	Cr	Mn	Ni	Cu
L1	41.46	103.54	5.67	0.11	0.43	25.61	3.77	14.94
L2	37.65	120.85	15.67	0.33	0.45	60.44	4.28	6.66
L3	35.26	112.46	1.83	0.30	0.08	26.53	4.42	9.55
L4	520.05	138.47	215.42	0.37	0.06	21.28	1.20	1.75
L5	596.84	90.55	70.62	0.92	0.24	3.57	0.36	3.02
L6	791.08	82.45	82.66	0.31	0.57	3.52	0.36	1.42
Mean	337.05	108.05	65.31	0.39	0.30	23.49	2.39	6.22
Max.	791.08	138.47	215.42	0.92	0.57	60.44	4.42	14.86

Fig. 1. Presentation of trace metals (mg/kg) in agricultural soils at Darrangand Udalguridistricts.

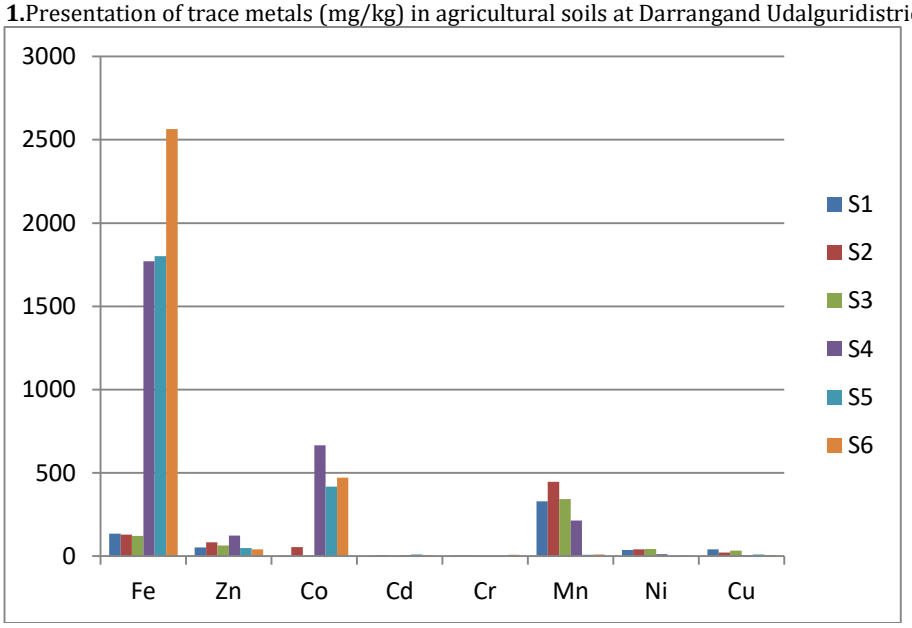
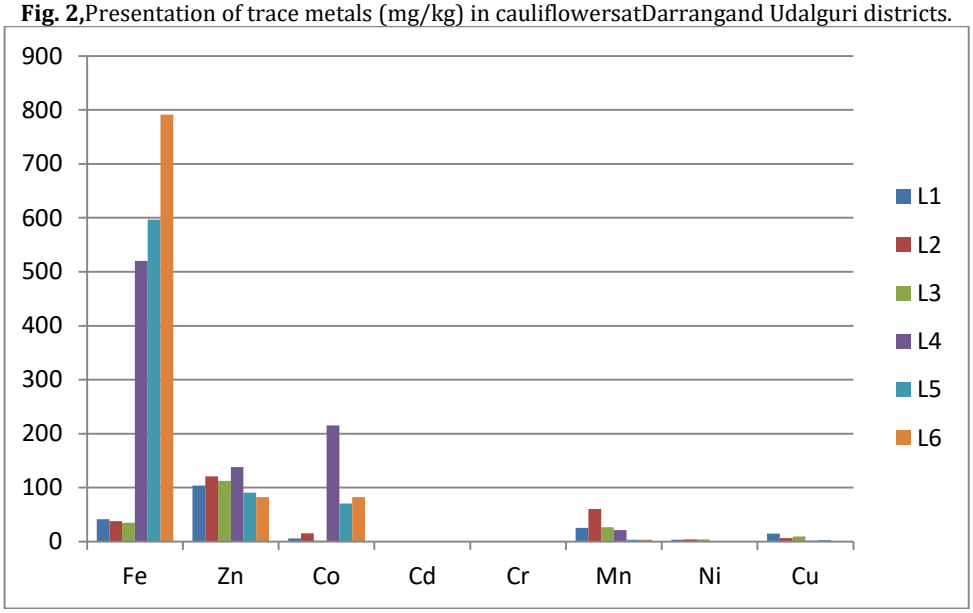


Fig. 2,Presentation of trace metals (mg/kg) in cauliflowersatDarrangand Udalguri districts.



References:

1.Divrikli U, Horzum N, Soylak M, Elci L 'Trace heavy metal contents of some species and herbal plants from western Anatolia'. Int. J. Food Sci. Technol. 41: 712-716, 2006.

2.Adriano DC. 'Trace metals in the Terrestrial Environment'. New York: Verlag Spiegler. 1984.

3.Sobukola OP, Awonorin SO, Idowu MA, Bamiro FO. ' Chemical and physical Hazard profile of 'robo' processing—a street vender melon snack.' Inter. J. Food Sci. Technol. 43 (2): 237—242, 2008.

4.IARC (2003) Fruit and vegetables. International Agency for Research on Cancer, Lyon. Pp.22-23.

5.Lawrence, K.A., A. J. Pesce and S.C. Kazmierczak. Clinical Chemistry, 4th ed., Theory, Analysis, Correlation, ISBN 0-323-01716-9, Published by Mosby Inc. USA, p. 707-721, 1993.

6.Jaccob, A. and M. Worwoods. "Blood and Disorders." (Eds): R.M. Hardesty and D.J. Weatheral.

7.Dara, S.S. "Environmental Chemistry and Pollution Control." First edition, published by S. Chand and Company Ltd., New Delhi, India, pp.184-205, 1993.

8.Underwood, E.J. 1977, Trace elements in human and animal nutriti. 4th ed. Academic Press Inc., New York, pp. 1977.

9.E.A. Oluyemi,G.Feuyit, J.A.O. Oyekunle and A.O. Ogunfowokam. 'Seasonal variations in heavy metal concentrations in soil and some selected Crops at a land fill in Nigeria.' A. J. of Environmental Science and Technology vol.2 (5), pp. 089-096, May, 2008.

10. Chang LW. 'The concept of Toxic Metal/ Essential Element interactions as a common bio-mechanism underlying metal toxicity.' In: Toxins in Food Plenum Press, New York, p.61, 1992.

11.http:// www. thefoodchart.com/calcium.php
12.http:// www. thefoodchart.com/magnesium.php
13.http:// www. thefoodchart.com/zinc.php
14. Food data chart-Chromium http: //www.healthyeatingclub.org/info/books-phds/books/foodfacts/html/d….
15. Food data chart-http://www. healthyeatingclub.org/info/books-phds /books/food facts/html/d…..
16. Food data chart- Copper-http://www. Healthyeatingclub.org/info/books-phds /books/food facts/html/d…..