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NAT-2026NQualitative Study of Medicinal and Food Resources Inorganic Elements with NAT for Health Management

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Research Article

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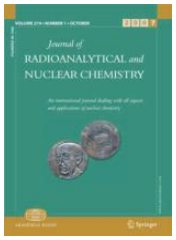
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Abstract

Life style ailments during these years are usually affected by most of the people from middle age in the recent years; these health problems are found to occur even in the lower age too. Nuclear analytical techniques such as PIXE and EDXRF are potential tools to analyze variety of nutritious inorganic elements of different resources namely medicinal and food facilitating to understand about quality of the respective samples/materials. Inorganic elements also play a vital role in managing health problems, particularly to control life style diseases such as diabetic and blood pressure issues besides some related chronic ailments. Specimens of different categories such as diseased patients, food resources, medicinal plants, marine fishes etc belong to life sciences were prepared and performed experimental studies for analysis of their inorganic elemental profiles. These results were compared with healthy and or normal persons /control values and relating materials' inorganic elements to estimate the role of inorganic elements pertaining to nutritions, trace elements besides toxicc elements for managing and controlling life style diseases. The obtained results are discussed to highlight the nutrional food items as natural medicines for management of good health.

Keywords

Nuclear analytical techniques, Inorganic elements, life style diseases, medicinal plants, Health management, Fishes, nutritious, pollution.

Introduction

Till late 20th century people were use to get ill health due to micro-organisms related communicable diseases namely polio, tuberculosis, whooping cough, typhoid, malaria etc. After the discovery of vaccination for them, those were significantly eradicated. However; Corona virus disease; which also a communicable disease that arose six years ago shown high impact on the society, with the discovery of vaccination, it was controlled. Highly modernized and sophisticated intelligent machinery are supporting to enjoy comforts with no much physical activities causing to lead ultra-modern life styles reflecting to reduce healthy life getting exposure to life-style diseases. Through the oxidation; generation of free radicals is taking place largely causing to occur life-style diseases such as diabetes, hyper tension, heart diseases, Parkinson, Alzheimer, cancer etc. These are causing lot of problems in the life; once these affected. In this connection; nutritious food items are playing significant role in managing the health. Besides macro elements; trace elements are showing major impact on health [1]. Their required quantity is small but exhibiting larger affect on health. Macro elements consist of carbohydrates, proteins and lipids forming 90% of the solid matter containing C, H, N, O components having requirements in larger quantities, while trace elements requirements are <100 mg/kg. Basal requirement indicates about intake of nutrients minimum amounts is needed, inadequacy led to impaired function that clinically deficiency symptoms can be detected whereas normative requirement represents little bit higher intakes required to maintain tissue optimal / desirable storage level for good health and function the body properly. Their deficiency causes impair functioning of several enzymes resulting oxidative stress leading to multi organ improper functioning driving to metabolic

problems [2]. In the 21st century; enhanced innovative technologies/industries are resulted to raise urbanizations and industrialization causing discharge of garbage, untreated industrial waste resulting to enhance pollution in the water bodies.

The author going through the books “The vitamin prescription for life (How vitamins can be your Natural medicine)” written by Dr. Richard N Firshein [3] besides the book;” Nutritional medicines” written by Dr. Ray D Strand [4] along with another book *Trace elements in human nutrition and health;* published by the WHO [5] motivated to undertake the present studies to evaluate the role of nutritional emelents role in managing a good health. Thus the author was motivated to carryout investigations to understand impact of inorganic elements as nutritionans, minerals besides toxic elements relating to wide variety of specimens representing healthcare, food resources, beverages, marine fishes etc.

Samples collection and preparation

Specimens were divided into different categories, of which these considered as medicinal diseases, food resources with various types, medicinal plants, cooking impacts, pollution influence on nutrition of marine fishes. These particulars are mentioned as below.

I. Medicinal specimens: The most common forms of mental illness are anxiety disorders, mood disorders, Alcohol dependence psychosis, OCD and schizophrenia disorders etc. Hair samples of the above-mentioned diseased patients analyzed in the present work were collected from the Government Hospital for Mental Care, Visakhapatnam, India. Scalp hairs of the patients volunteered for the present study were cut carefully at the root with a high-quality stainless scissors. The collected hair samples were washed carefully in three stages according to the standard procedure. Initially hair strands relating to a specific person were treated in 20ml of acetone and dried for 20 minutes; then washed with double distilled water, further dried under UV lamp till the water evaporated completely. Second time; again washed with double distilled water and dried fully. Further hair was cut as small pieces with acetone washed scissor; for every specimen the scissor washed with acetone. From this; each and every sample consisting

80mg weighted was taken and packed in a butter paper. Later the specimen was mixed in a 1ml high purity concentrated HNO_3 and further known concentration of 10µl Yttrium oxide added as internal standard. Later from this total solution 10µl was pipette out and put on a nucleo-pore filter paper, kept on a Mylar foil that found on an aluminum frame and dried for irradiation of the same.

The collected blood samples number relating to Schizophrenia and Bipolar disorder of both female and male were 30 and 26 respectively, but for the case of OCD; only female (15) and alcohol-induced psychosis of male (28) specimens were procured. Alzheimer's is a loss of recent memory that linked to have excess A-Beta protein fragments in the brain while Parkinson's disease reflects loss of dopamine-producing cells in the substantia nigra containing association with genes. Blood serum samples were collected concerned to patients afflicted with Alzheimer's disease (30 specimens) and Parkinson's disease (28 specimens).

II. Food Resources: (a) Cereal grains and Vegetables: Barley, Maize, Millet, Sorghum, Wheat and Three different varieties of Teff (Eragrostis tef) were collected from three locations namely Addis Ababa, Gechi and Shewa Robit of Ethiopia. Further leafy vegetables and root vegetables were procured namely *Ethiopian kale (Brassica carinata), Russian kale, Collard, Siberian kale, Lettuce (Lactuca Sativa var.capitata), chard (Beta vulgaris), cauliflower (brassica oleracea.var.botrytis), Cabbage, potato (Solanum tuberosum), carrot (Daucus carota sativus), red beet (Beta vulgaris) and turnip (Brassica rapa)* along with their corresponding soil samples. Five types of packed food items namely Pasta (Rosa pasta, Bona Marconi-Africa PLC-Adama; Ethiopia), Barley (Roasted barley flour, Barley corn – local prod – Debre Tabor), Wheat (Glory biscuit & Cappuccino biscuit by Brothers food complex PLC- Adama; bread – Local: Debre Tabor, cookies-Girum food complex PLC- Adama), Teff Injera (white teff & red teff – homemade- Debre Tabor), Maize (Maize bread - homemade- Debre Tabor) were collected those available in the market of Ethiopia.

Twenty-one varieties of rice (white, parboiled and brown) samples were collected from north coastal districts of AP state, India. These were divided into two categories namely raw and cooked rice. Cooking was performed by using two types of vessels such as Aluminum Utensil and earthen pot. Cooking was carried out in Aluminum utensil for

duration of 25 minutes while in the earthen pots it performed for 40 minutes on a gas stove. These raw rice and cooked rice samples were oven dried at 500C (24 hrs) and 600C (48 hrs) respectively to remove moisture. Seven types of millets like foxtail, kodo, little, barnyard, brown-top, finger and pearl millet besides pulses and lentils were procured from the Visakhapatnam local markets and studied for their nutritional inorganic elements representation.

(b) Coffee Beans: Twenty-eight green coffee-bean subspecies and twelve soil samples were collected across 12 study areas; eight specialist coffee beans of market samples procured. Further compared roasted (180–200°C) with unroasted (oven-dried 60–103°C) beans that were collected in Ethiopia.

(c) Food and Medicinal plant species: Nine samples of medicinal plants were collected from Debre Tabor (altitude 2447–2838 m, mild climate) of Ethiopia. In India; twelve medicinal plants were procured from Paderu division (altitude 904 m) of Visakhapatnam district agency area, AP. Seaweed (algae) species; which contain good nutritious properties were procured from the Visakhapatnam Sea coast while mangrove samples collected from Kakinada Sea coast of AP. Elemental concentrations of coffee beans and plant species were evaluated by using EDXRF experimental technique that standardized with the SRM reference wheat flour (SRM 1567).

III. Marine Fishes: Due to rapid rising of urbanization and industrialization along with increased anthropogenic activities pollution found to grow along the industrialized fishing cities like Visakhapatnam, Kakinada. Thus variety of fishes in all the seasons from the above two cities besides less polluted places namely Bhimunipatnam and Pudimadaka, i.e. totally from four distinct locations were collected to study the bioaccumulation of nutritional and toxic elements; which facilitates to understand the impact of pollution causing to health challenges to the consumers of these fishes. The collected fishes were individually placed in zip locked polythene bag and kept in ice box and onward transferred to the laboratory. Later their physical measurement such as length, weight etc were measured. These fishes were cleaned with de-mineralized water, further dissected to collect tissues. The samples were kept at -20^0C for 14 hours in a deep freezer. Then samples were lyophilized at -50^0C. Further these were pulverized by using

agate mortar and pestle. Then fine powder of every individual fish separately having 150mg weight was pressed into a pellet for experimental studies.

Experimental

For the evaluation of medicinal samples; experimental measurements were performed with the Particle induced X-ray emission (PIXE) technique available at accelerator center belong to the Institute of physics that located in Bhubaneswar, India. To ensure the reliability of experimental system and other parameters; the PIXE spectrum of certified reference material (CRM) namely IAEA supplied animal blood A-13 was recorded. The range of beam current was found to be 3.2 to 5.2 nA and collected charge lied in between 100 to 300 μC.

Food resources specimens were characterized with EDXRF experimental technique available in the UGC-DAE consortium, Kolkata and National center for compositional characterization of Materials (CCCM)-DAE at Hyderabad. Elemental analysis of these samples was performed with the EDXRF experimental facility, which validated with the standard reference materials (SRM) such as apple leaf (SRM 1515) and Oriental Tobacco leaves (CTA-OTL-1) of NIST. In the case of rice, millets, pulses and lentils; the experimental investigations were carried out with EDXRF that validated with the SRM materials such as rice flour (CRM 10a) procured from National institute of environmental science (NIES) and wheat flour (SRM 1567) that belong to NIST. The measured values and certified values were found show good agreement reflecting validation of experimental set up.

Experimental investigations of marine fishes were carried out with the hand held XRF facility available at Bhabha atomic research center in Mumbai. This technique was validated with two reference materials such as ERM-BB422 ‘Fish muscle’ that obtained from European commission – joint research centre, Institute for reference materials and measurements and other CRM namely KRISS CRM 114-01-001 (Tuna fish tissue powder), obtained from Korea Research Institute of Standards and Science, Republic of Korea. The obtained measured experimental values of both the CRM material were

169 compared with their respective certified values and found to have the standard deviation
170 within the ±5 – 10% indicating a good agreement between measured and certified values.

171

172 Results and discussion

173 Inorganic elemental profile/data of diseased samples comparison with normal
174 specimens /standards was performed. It facilitated for understanding these inorganic
175 elements' role in the health management. The obtained results are presented in the
176 Table 1 and typical PIXE spectra of male control subjects and male Schizophrenic
177 patient hair samples are shown in Fig.1.

178 **Table 1** Elemental variation of different mental illness patients

S. No	Schizophrenics (30)	Elements obtained among Male patients	Elements obtained among Female patients	Comparison - Remark
1	Observed higher levels of trace elements	Ca, Cu, As	Ca, Cu,	Toxic element detected among male patients
2	Observed lower levels of trace elements	K, Ti, Mn, Fe, Co, Zn, Se	Mn, Fe, Co, Zn, Se	Two additional elements obtained among male patients
	Bipolar disorder (26)	Elements obtained among Male patients	Elements obtained among Female patients	Comparison - Remark
3	Observed higher levels of trace elements	Ca, Cu, As	K, Ca, Cu,	Toxic element found among male
4	Observed lower levels of trace elements	Mn, Fe, Co, Ni, Zn, Se	Mn, Fe, Zn, Se	Toxic element found among male
5	OCD only female (15)	Higher levels of Mn, Fe, Co, Ni, Cu, Zn	No change in the obtained Ti	No male patients
6	Alcohol induced psychosis Male only (28)	Higher levels of Fe, Cu, As	Lower levels Mn, Zn	Higher level of toxic element

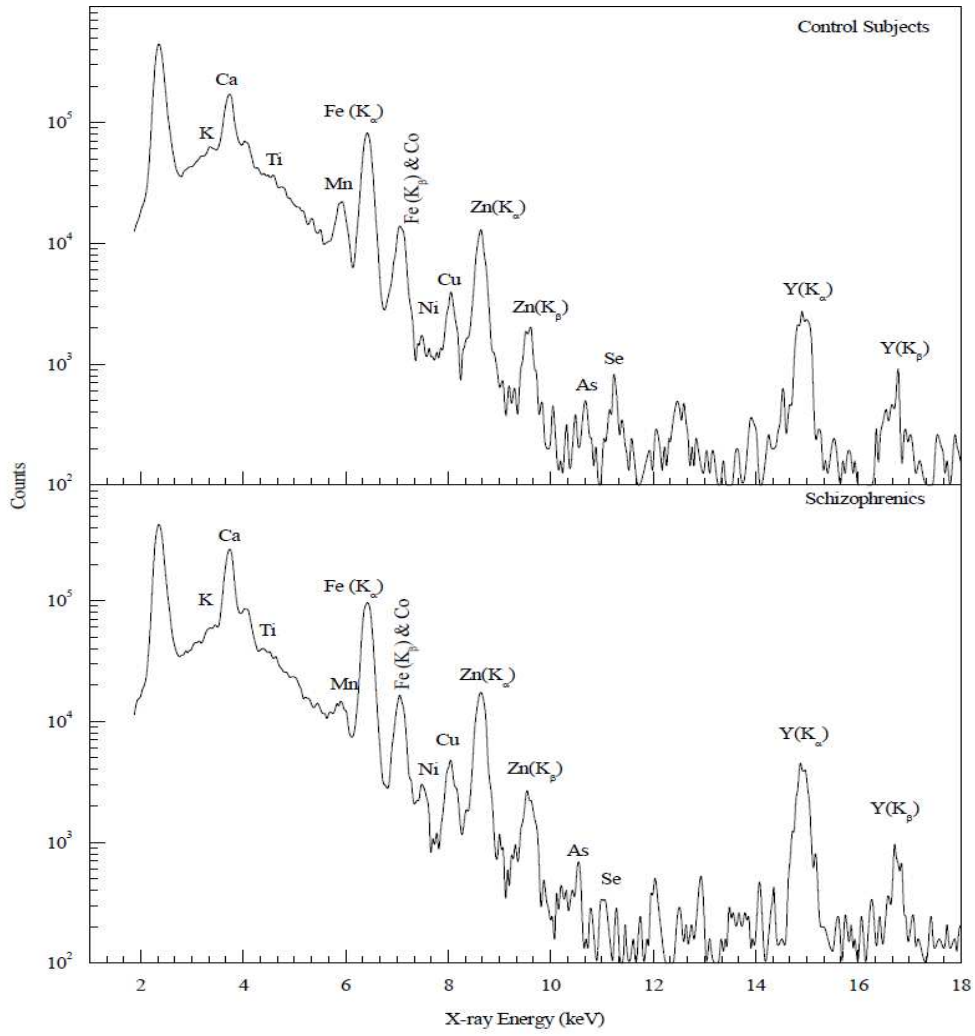


Fig. 1 Typical PIXE spectra of hair samples for male control subjects and Schizophrenic diseased patient

The obtained results indicate that Cu / Zn ratio is higher in the hair samples of male and female patients compared with healthy/normal persons/samples. For all the cases of disorder reflecting patients; Cu and Zn mutual antagonism was observed. Thus; Zn deficiency may cause to rise Cu conc. resulting its toxicity-exhibiting neurological disorders. Higher conc. of Cu causes oxidative damage that produces reactive radical ions called as hydroxyl radicals. Zinc deficiency cannot be viewed as just lack of nutrient deficiency; it creates a biological vacuum that leads to copper toxicity. Excess copper catalyzes the formation of reactive radical ions, which are primary drivers of neuronal damage in Schizophrenic and Bipolar patients. It generates more free radicals reflecting

effects on brain metabolism. Mn deficiency has also been linked with reduced levels of the neurotransmitter, such as dopamine. Oxidative stress with iron deficiency also causes the increase of free radicals. Se deficiency reduces glutathione peroxides that act as defense system to control free radical generation. Free radicals adversely affect the neuronal tissues. Hence brain metabolism led to mitochondrial and neuron dysfunctions due to oxidative stress [6]. Trace elemental imbalances may lead to oxidative damage to bio-molecules. It causes alteration in the neurotransmitter receptors and the concentrations of secondary messenger in the brain.

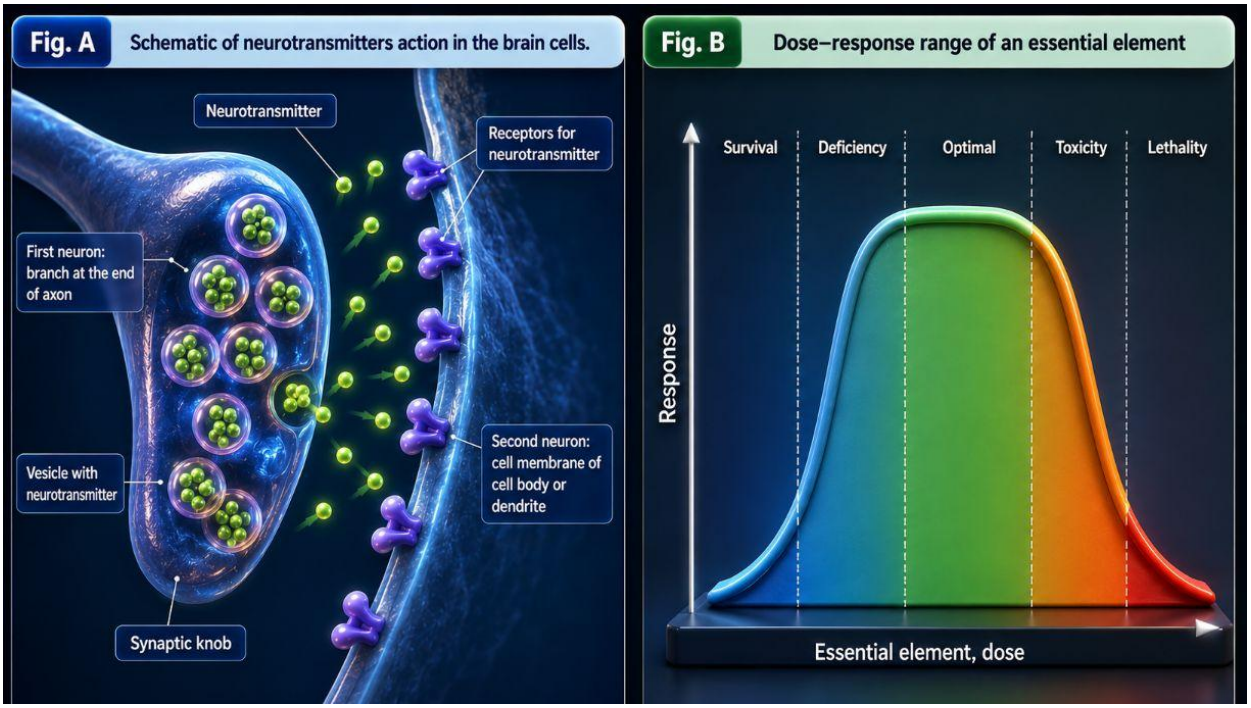


Fig. 1 (A) Scematic of neurotransmitter s action in the brain cells (B) Trace element dose and its response profile

The elements such as Li, Be, Al, V, Cr, Mn, Fe, Co, Ni, Ag, Cd, Cs, Hg and Pb levels were found to show higher conc. in PD disease relative to controls showing statistically ($P<0.05$) significant while though Cu, Zn, As, Se, Rb and Sr levels were observed to be higher compared to controls but statistically insignificant ($P>0.05$). Further Ga and Ba were reflected with lower conc. reflecting statistically insignificant ($P>0.05$). Li, Al, V,

Cr, Mn, Fe, Co, Zn, Ni, As, Se, Ag, Cd, Cs, Hg and Pb were found significantly with higher conc. ($P<0.05$) compared to controls in AD. Further Ga, Rb and Ba were found

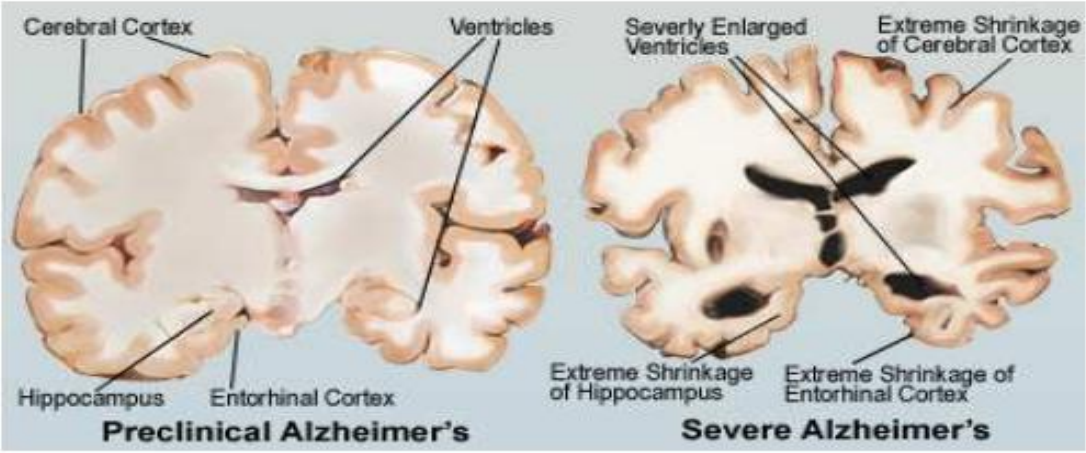


Fig. 2.1: Brain with Alzheimer's disease

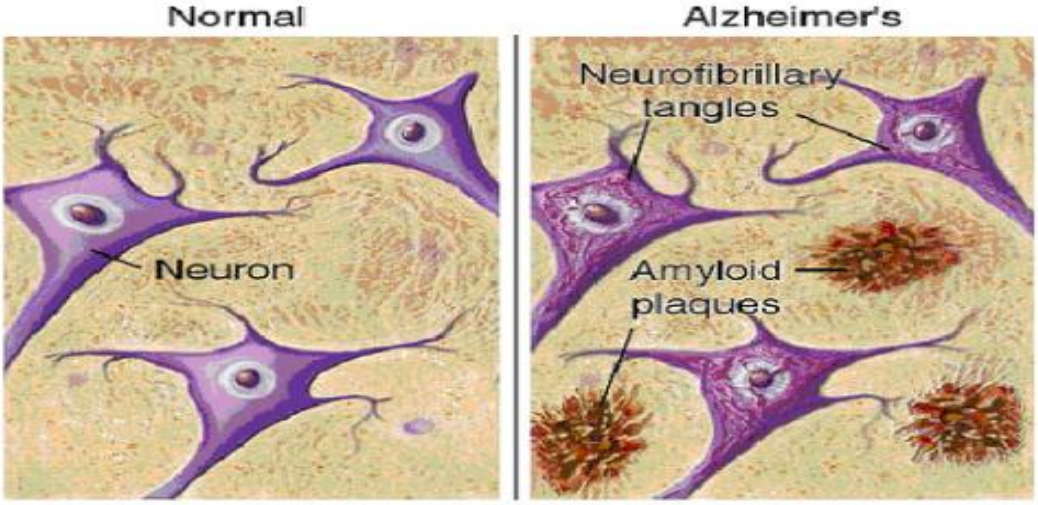


Fig. 2.2: Neurofibrillary Tangles

With lower conc. but statistically significant ($P<0.05$) while Be, Cu and Sr were statistically insignificant ($P>0.05$). Though symptoms and clinical manifestation of both PD and AD are different; features like depletion of dopamine levels, mitochondrial dysfunction, oxidative stress, hyper action of some enzymes, antioxidant enzymes depletion etc found to occur commonly in brain leading to induce neuro-degeneration.

Higher levels trace elements cause neurotoxicity and play pathophysiology role of these diseases. Higher levels may be due to various biochemical and physiological processes. Higher Cd interaction with Zn and Fe causes Nephrotoxicity while Pb interaction with Ca, Zn and Fe exhibit cognitive effects in children. Mercury (Hg) linkage with Se indicates CNS toxicity; Al association with Ca, Mg, Mn and Fe might causes to central nervous system (CNS) toxicity [7]. Cobalt (Co) enhances oxidative stress by inferring with anti-oxidant defence mechanism and cellular damage. Central nervous systems are vulnerable to oxidative damage due to high rate of oxygen utilization. Though studies on PD and AD earlier carried out in US besides Europe; in Asia, very limitedly work was undertaken. These diseases are not cured; only palliative treatment.

Food Resources: (a) Cereal grain and Vegetable

Five types of cereal crops (Barley, Maize, Millet, Sorghum & Wheat) containing 18 varieties were analyzed in which 16 elements (Ca, K, S, P, Zn, Cu, Ni, Co, Fe, Mn, Cr, As, Pb, Sr, Rb, & Br) were detected. These selected cereals were found to have heavy metals namely Fe, As and Pb in each of the samples. However, the conc. of these metals in the cereals analyzed were below the safe limit set by FAO/WHO (2001). Sources of elements observed in the vegetable crop were attained through their growth media, (soil, air, nutrient solutions) that ransmitted via their roots. Four elements were found as major quantities such as Ca, K, S and P among all the studied root vegetables namely potato (Solanum tuberosum), carrot (Daucus carota sativus), red beet (Beta vulgaris) and turnip (Brassica rapa). Twenty one elements (Na, Ca, K, S, P, Mg, Zn, Cu, Ni, Co, Fe, Mn, Cr, V, As, Pb, Ba, Sr, Rb, Br and Se) were observed in the three selected varieties of teff samples. The highest Ca and Mg contents were observed in mixed (sergegna) teff where as K and Fe contents detected high in red teff. Generally, all types of teff found to have higher K, Ca, Mg, Fe and Zinc contents. These facilitate to manage chronic diseases such as diabetes, hyper tension etc.
The order of metal contents found to be Mn > Zn >Fe > Pb> Cu> Ni>Cr>As> Co in leafy vegetables. Agricultural land whose irrigation was performed with waste water caused to accumulate heavy metals in vegetables. Variation in the heavy metals content in the investigated leafy vegetables showed the difference in uptake capabilities and

ability of crops to take up heavy metals through their roots and transport them to the edible portion of the plant. Higher accumulation of heavy metals was noticed in Swiss chard belong to Akaki and Kera farms. The mean concentration of Fe was found to be highest in all the vegetables samples except in red beet collected from Debre Berhan. In general; all root vegetables were found to be a good source of essential trace elements. In the case of leafy vegetables namely Ethiopian kale, lettuce, chard, cauliflower, Cabbage, Collard green (brassica oleracea) procured from the selected location the elements such as Zn, Mn, Cr; Pb and arsenic were obtained and found to be above the permissible limits set by FAO/WHO for human consumption. Long term consumption of heavy metals contaminated leafy vegetables may possibly cause numerous health hazards among human beings [8]. Therefore, regular monitoring of heavy metals present in leafy vegetable is crucial to avoid excessive buildup of these metals in the human food chain.

Consumers usually intended to eat healthy packed foods that labelled with nutritional values. Therefore evaluation of packed foods' nutritions are required [9]. Thus, nutritional values of Packed food materials procured in Ethiopia was carried out. They are five types such as Pasta (Rosa pasta, Bona Marconi-Africa PLC-Adama; Ethiopia), Barley (Roasted barley flour, Barley corn – local prod – Debre Tabor), Wheat (Glory biscuit and Cappuccino biscuit by Brothers food complex PLC- Adama; bread – Local: Debre Tabor, cookies-Girum food complex PLC- Adama), Teff Injera (white teff & red teff – home made- Debre Tabor), Maize (Maize bread - home made- Debre Tabor) were collected. Elements such as P, K, Na, Cl, Mg, were determined as macro nutrients in the studied food items, while Ca, Fe, Al, Zn identified as micro nutrients. Wheat items namely its biscuits and cookies contain higher P, K, Na, Cl, Mg, Al and Zn than pasta and macaroni, but Ca conc. was found to be higher significantly in pasta and macaroni. Higher levels of Na and Cl present in wheat products might cause health problems such as high BP, kidney issues, emphysema (Lungs problems for breathing), potassium deficiency etc. The obtained conc. of elements is below the recommendations of the RDA-FAO/WHO(2005), FDA(2020) indicating the packed food items are safe for consumption by the public.

(b) Cooked Food: Cooking causes lot of changes in physical and chemical properties of food grains resulting variations in nutritious minerals and vitamins [10]. These alterations

that caused by cooking containers and other cooking parameters show impact on health of the consumers. In the present work; cooking was performed as mentioned in the above section; experimental studies. The obtained results showed the detection of S, P, Mg, Ca minerals in the raw and cooked rice. Six essential trace elements were obtained having their conc. values in the decreasing order - Fe > Zn > Mn > Cu > Cr > Ni. As these raw rice specimens were found to contain higher values of S, P, Mg, Fe, Zn, Mn; considered them as useful rice grains to the human beings for proper metabolic reactions. Low Ca and Cu, Cr, Ni were detected in some of the specimens only. In the cooked food grains Mg, Fe, Cu conc. were found to be higher due to earthen pot cookware as it exhibit leaching property contributing Mg and Fe elements that present in clay mineral and Cu in rice, while cooking with Al utensil caused for the presence of Pb at higher levels due to leaching during cooking resulting toxicity to the consumers. Al utensils may be a major contributor to Pb poisoning throughout the developing world.

Four major elements namely P; K; S; Ca along with six essential trace elements such as Fe, Zn, Mn, Cu, Cr, Ni were detected in the millets of the present work. Iron (Fe) was found to be rich in barnyard millets relative to other millets. It can be recommended for the patients with CVD and diabetes mellitus. It is most effective in reducing glucose levels of blood and lipids. Finger millet was observed to have higher quantity of Mn, which considered as store house of nutrients

Table 2 Variation of nutrients with different millets and pulses

S. No	Nutrient (mg/100g)	Millet varieties				Pulses (Dals)			
		Foxtail	Barnyard	Finger	Kondo	Tur Dal	Moong Dal	Urad dal	Chana Dal
1	P	280	290	260	350	337	287	320	310
2	K	195	210	200	190	984	1102	950	875
3	S	110	120	100	105	137	116	147	130
4	Ca	31	34	42	30	77	68	93	80
5	Fe	2.8	4.3	3.6	3.1	3.9	2.7	4.2	4.0
6	Zn	1.2	1.6	1.4	1,5	1.4	1.2	1.6	1.7
7	Mn	1.2	1.8	2.3	1.6	0.9	0.8	1.0	0.9
8	Cu	0.4	0.5	0.5	0.6	0.4	0.3	0.5	0.6
9	Cr	0.08	0.10	0.09	0.11	0.06	0.05	0.07	0.09
10	Ni	0.03	0.04	0.03	0.04	0.02	0.02	0.03	0.03

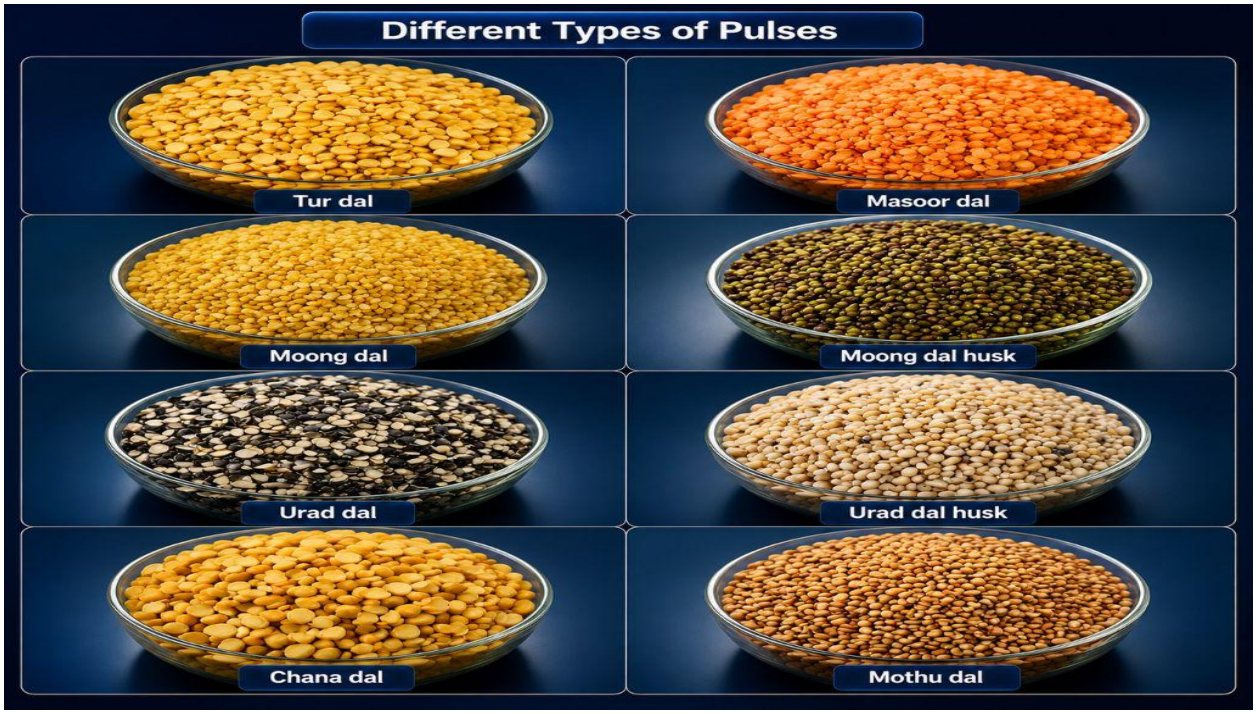


Fig. 3 Various Pulses studied in the present studies

Containing rich contents of proteins, amino acids, minerals and vitamins while kodo millet exhibited to have good amount of Cu and Cr, it found to be good for reducing joints and knee pain. The RDI contributions of Zn, Fe and Cu are higher among millets when compared with white and brown rice. Millets appear to be significant source of Mn for the human beings. P, K, S and Ca were found to be higher in the cooked millets (earth pot). The nutrient elemental order having K > P > S > Ca (major) and Fe > Zn > Mn > Cu > Cr > Ni > Pb (micro) was observed in the raw and cooked pulses. Higher values of Pb element were obtained among the cooked pulses with Al utensil while K conc. found to be rich in the pulses cooked with earthen pot cook ware.

(C) Coffee Beans: Four major elements such as P,K, Ca, S and eight minor elements like Mn, Fe, Cu, Zn, Se, Sr, Rb, Br were observed in the Ethiopia coffee beans while twenty two elements (Na, Ca,K, Si, Al, Mg, Ti, Zn, Cu, Ni, Fe, Mn, Cr, V, As, B.a, Cd, Pb, Mo, Sr, Rb, Se) observed in the soil samples related to coffee crop. In the case of non-roasted coffee beans the order of elemental conc. in descending order was found to be K>Ca > P >S>Fe>Rb >Mn>Cu > Zn, Sr >Br > Se while for roasted beans it found to be K > Ca > S

316 >P > Fe > Rb> Mn > Cu > Zn, Sr > Br >Se. Green (unroasted) coffee beans are
317 containing rich antioxidants that reduces damaging effects of free radicals in human body
318 and preserve the overall health. Protect the heart and lower the risk of neurological
319 diseases, boosts metabolic activity, helps to burn extra fat, treatment of diabetes, helps for
320 improving blood circulation, used for natural detoxification, anti-aging effects etc. The
321 obtained minor elements such as Cu, Mn, Se Zn act as cofactors of antioxidant enzymes
322 to protect the body from Oxygen Free Radicals (OFR) that produce during oxidative
323 stress.

324 Roasted Roasted and non-roasted coffee beans have no change of elemental contents for
325 the elements S, Mn, Fe, Cu, Zn, Se, Sr, Rb and Br but conc of P, K and Ca elements
326 were increased due to roasting process. It indicating that roasting process did not
327 eliminate any of the elements studied. Among major elements; K contained more than



328

329 Fig. 3 Forest coffee, Geisha coffee varities and local coffee bean drying method in
330 Godere woreda
331

332 75%; followed by Ca(10-12%), P (6-7%), and S(6-7%). Among micro nutrients Fe(58–74
333 %) followed by Rb(10–15%), Mn(8–13%), Cu (4-8%). Except potassium conc, other

elemental conc present in soil samples was higher than the coffee samples. Highest conc. of major elements found in the samples those collected at higher altitude having proper rainfall while the highest conc. of micro elements like Mn, Fe, Cu, Rb, Sr were found in the samples belongs to low altitude area. In the present study it is observed that optimum climatic condition of coffee growth in Ethiopia requires altitude values in the range 1500 – 2200 m, temperature values lying in between 18 – 22 °C and the average annual rain fall ranges in between 1500-1850 mm per year. The conc of minor elements such as Fe, Mn, Cu and Zn in the coffee samples analyzed are below the maximum permissible concentration set by FAO/WHO (2001). Therefore, these coffee bean samples can be considered as safe for consumption

Medicinal plants of Ethiopia and India:

Ten major elements namely K, Ca, Si, Mg, Fe, Cl, Al, P, Na, S and ten minor elements like Cr, Sr, Co, Cu, Mn, Zn, I, Ni, Se, V were detected in the Ethopian medicnal plants. Their Conc. was found to vary from BDL to 22825 ± 2184.2 ppm. Among all of these; African soapberry has the highest conc. of potassium (22825 ± 2184.2 ppm) and silicon as the 2nd highest element found in Lepidium Sativum (22750 ± 453.7). Potasium (K) has a high conc. among the major elements; more than 25% ; followed by Ca (19 - 20%), Si (12-14%), and Sulfur has the lowest conc containing (2 - 3%). The av. Conc. of (Cr) was found to show highest compared to other minor elements with an av. % of 27.74%, while V has lowest av. Conc. 3.71%.

The obtained present elemental concentration of Croton macrostachyus (except Ca & Mn); in the current study show higher values than earlier studies [11]of similar plant, as the current study area belongs to higher altitude and climate conditions are different than the earlier studied area.The conc of Zn in the current study shows good agreement with the earlier similar studies performed by Zemenay Zewdu Aberie et al. [12]



Fig. 4 Various medicinal plants procured from Debre area for the present studies

Seaweeds collected from Visakhapatnam coastal line were found to contain calcium (Ca) with highest concentration relative to other elements namely K and P. Nine essential trace elements such as I; Zn; Se; Cu; Mo; Cr; Mn; Fe and Co were obtained in the present algae species. These algae are useful to prepare some food items that useful to old and women. In India, 65% of the population belong to rural and tribal areas, for their health issues that follow Ayurveda medicinal systems for primary needs. In the present medicinal plants six macro elements found to be in the order K > Ca > P > Si > Cl > S, while ten micro or trace elements reflecting the order Fe > Mn > Zn > V >Cu > Ni>I > Cr > Mo > Se were detected. Potasium (K) content was found to be very rich in the species *Arisaema tortuosum, Alstonia Venenata, Aristolochia indica, Curculigo orchioides, and Rhaphidophora decursiva*. It is a macro element, highly useful for electrolyte and fluid balance maintenance, muscle contraction, metabolic activities of lipid. Dietary K is helpful for regulation of BP besides attenuation of platelet reactivity. The ratio of Na/K works as a bio-indicator for obstruction of hypertension when the ratio

values less than unity. This raises bioavailability of Ca in human beings facilitating enhancement of bone strength. Hence all the five plant species those indicated above with higher quantities of K seem to be useful for hypertension and cancer curative purposes. Pearson's correlation was performed for the elements detected from soil samples of four different locations of Paderu agency area in association with the corresponding same element of plant species collected at same locations taking as pair. These values showed positive association for S; Cl; K; Ca; Zn; Cu; Mn; Si; V while negative association for the elements P; I; Ni; Co; Fe and Pb. Thus, a linkage between soil elements and elements of plant species collected at same site has been established. The highest positive correlation was observed for Cu (0.452) followed by Mn (0.396) and Cl (0.394). These values reflect medium level of relationship between those elements present in the soil and the respective plant species. For the remaining elements such as S; K; Ca; Zn; Si & V having Pearson's coefficient values < 0.3 indicate small level of linkage for those elements. Correlation pertaining to the elements of plant and soil is useful to select nutrient rich plant for conserving medicinal biodiversity.

Pollution impact on nutrients: Marine fishes contain rich protein and amino acid contents (15-24%), Lipids and fatty acid content (0.1-22%), minerals (1-2%), vitamins etc. Thus, these are useful to control Cardio Vascular Disease, CHD, Heart stroke, BP, variety of cancers etc and related issued can also be reduced. Rapid urbanization, industrialization caused for numerous untreated industrial wastage discharges; improper disposal of sewage and pesticides were found to cause toxicity pertaining to marine life through the food chain that lead to serious threat for the safety of fish [13].Hence assessed the impact of pollution on the nutrients of marine fishes that causes health risk of consumers. Bioaccumulation of metals in fish is dependent up on the phase of sexual reproduction (the season when the fishes are collected) (Nejatkhah et al.[14]. Nutrients accumulation depends on seasonal fluctuation of toxic and trace elements present in muscle (As, Cd, Cu, Fe, Mn, Se and Zn) of various fish species (*Epinephelus coioides, Pampus argentius, Lates calcarifer, Scoliodon sorrakowah, & Mugil cephalus*) captured from Visakhapatnam coast performed. The non-carcinogenic and carcinogenic risks through consumption of fish was estimated.

The average conc of Cd and Zn were found to be higher in the fishes collected during

Summer; As, Cu and Fe were observed to be higher in the fishes procured in the Monsoon season while Mn and Se seemed to be higher in the fishes related to Winter season. The estimated daily intake (EDI) values of all the heavy metals of the present studies are higher than the reference dose (RfD). Thus, pollution monitoring in the coastal environment of Visakhapatnam needs to be performed periodically with regard to heavy metals accumulation.

Table 3 varying levels of nutrients present among

S. No	Element	Visakhapatnam	Kakinada	Pudimadaka	Bheemili
1	As	↑↑	↗	\	↓
2	Cd	↑↑	↗	\ →	↓
3	Cu	↗	↑↑	↑	\
4	Fe	↗	↑↑	↑	\
5	Mn	↗	↑	↑↑	↗
6	Zn	↑↑	↑	↗	\
7	Se	↑↑	↑	↗	\
8	Ca	↑↑	↑	↗	\
9	K	↗	↑	↑↑	↗
10	Mg	↗	↑	↑↑	↗

↑↑ Very high ↑ High ↗ Moderate → Similar \ low ↓ Very low

The hazard quotient (HQ) due to consumption of *Scomberomorus lineolatus, Lutjanus johni and Arius jella* was found to be less than 'one' (1) for Cu, Fe, Mn Se, and Zn while the obtained HQ values of Cd and Arsenic were reflected as greater than unity; these indicate that the consumption of these fishes may cause consumers' health problems. The estimated daily intake (EDI) values of all the heavy metals were showed as higher than the reference dose (RfD) value. Some nutritional elements such as Fe, Se, Mn etc are found to show a positive correlation with arsenic in one fish species while those elements exhibit negative correlation or exhibit antagonist behavior in the other fish species. This type of behavior may be understood on the lines of physiology and metabolic systems of respective fish species. The lowest and the highest values of "Target Cancer Risk" (TCR) for Arsenic heavy metal were obtained in *Epinephelus coioides* and *Lates calcarifer* fishes respectively. In the case of Cd; lowest TCR value was observed for the fishes *Epinephelus coioides* and *Pampus argentis* while highest value showed in the *Lates*

calcarifer species. Thus it is recommended that all types of wastewaters, sewage, industrial effluents and agricultural waste be treated before being released into the aquatic systems.

Conclusions:

It is observed that for all the cases of disorder; Cu / Zn ratio was found to be higher in the hair samples of male and female patients compared with normal(s) reflecting their mutual antagonism. Obtained reduced levels of dopamine among Parkinson's affected persons and brain shrinkage were observed in the case of Alzheimer's patients. In the case of vegetables; all root vegetables were found to be a good source of essential trace elements. Wheat items namely its biscuits and cookies contain higher P, K, Na, Cl, Mg, Al and Zn than pasta and macaroni, but Ca concentration was found to be significantly higher in pasta and macaroni. Higher value of Pb was present in the rice cooked with Al utensil while its lower value observed in the rice cooked with earthen pot. Al utensils may be a major contributor to Pb leading to poisoning of food throughout the developing world. Barnyard millet was found be good in reducing glucose levels of blood and lipids, kondo millet observed to be good for controlling joint and knee pains. Potassium (K) conc. was found to be higher in the pulses cooked with earthen pot cook ware. Green (unroasted) coffee beans were observed to be rich in antioxidant that reduces damaging effects of free radicals in human body and preserve the overall health. Potassium (K) was found to be highest among the major elements consisting more than 25% while chromium observed to be highest among minor elements pertaining to Ethiopia medicinal plants. The ratio of Na/K works as a bio-indicator for obstruction of hypertension when the ratio values less than unity. This raises bioavailability of Ca in human beings that causes enhancement of bone strength. The estimated daily intake (EDI) values of all the heavy metals of the present studies are higher than the reference dose (RfD). Thus, pollution monitoring in the coastal environment of Visakhapatnam needs to be performed periodically with regard to heavy metals accumulation.

Heavy metals' toxicological impact not only shows directly but also affect indirectly through the nutritional elements on consumers. Finally; it concluded that though the trace/minor elements quantity is small, they play a significant role in managing good

health/wellness. Therefore, the concerned agencies are advised to make rigorous activities for creating awareness among public about importance of nutritional elements for controlling life style diseases.

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Conflict of Interest (COI)

I declare that there is no conflict of interest linked with this study. No one in this study have any financial or personal affiliations that could potentially bias or impact the findings or interpretations reported in the publication. The supporting data can be obtained from the corresponding author upon request.

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