

Invited commentary

Role of antinutrient metabolites of plant on production of secondary metabolites and human health

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The secondary metabolites are important constituents of plants for the human beings, for most of the population in the World believe on plant based medicines. These phytoconstituents serve as primary important molecules in modern medicine (Ncube *et al.*, 2008). Many people still depend on the traditional medicine for their preliminary healthcare and treatment (Bannerman *et al.*, 1986). All these treatments mainly depend on the phytoconstituents present in the plants. These concepts force to discover modern medicines in early 19th century where plants were scientifically proved its efficacy due to particular chemical present. Hence, drug discovery from the plant sources gains maximum momentum and importance in the era of modern medicine system. Plants produce huge number of different chemical compounds which are broadly categorized into primary and secondary metabolites. Primary metabolites are essential for the growth of the plants like sugar, proteins, amino acid, *etc.* Secondary metabolites are the products that are considered as waste substances of plants, which are deposited inside the plant bodies in various parts, and provide protection to the plants from attacks of microorganisms, attracting pollinators, *etc.* These secondary metabolites are relatively produced in low quantities in plants but have significant economic and medicinal value to humans. High concentration of secondary metabolites present in plants indicates more resistant to diseases. Various scientific research evidences proved that the therapeutic efficacy and pharmacological actions are mainly by the action of secondary metabolites. Not only that, they are also useful in preparation of various dyes, preparation of agrochemical insecticides, availability of raw materials to industries, for preparation of perfumes, cosmetics, coloring and flavoring agents. The main basic mechanism for plant growth and production of plant metabolites are the uptake of nutrients from the soil and the environment.

Nutrients are the substances that are used by plants to survive, grow, and reproduce. Broadly, nutrients are two categories: macronutrients and micronutrients. Macronutrients (carbohydrates, fats, proteins, water) are required in more quantity and used primarily to generate energy and to incorporate into tissues for

growth and repair. Micronutrients though needed in smaller amounts, they play an important biochemical and physiological roles in cellular processes. All these nutrients are organic and inorganic compounds. Organic compounds contain carbon, whereas inorganic compounds include Fe, Se, Zn, *etc.* Inadequate or excess amounts of essential nutrients, cause diseases that interfere with absorption. A deficiency state of these nutrients caused a compromise in growth, survival and reproduction. The absorption of nutrients by plants in the form of macro or micronutrients are greatly depends on the demographic location and cultural conditions and based on the plant secondary metabolites which are also accumulated in the plant bodies. Many scientific literatures are evident on that (Das *et al.*, 2017; Das and Dang, 2017; Das *et al.*, 2016). Excess amount of nutrients causes the plant to show harmful effects (Ensminger, 1994), such nutrients are called antinutrients.

Antinutrients are the compounds or substances that act to reduce nutrient intake, digestion, absorption and utilization and also produce adverse effects. They are also known as antinutritional factors. Seeds of legumes and other plant sources contain wide varieties of antinutrients (raw state) that are potentially toxic. The major antinutrients are toxic amino acids, saponins, cyanogenic glycosides, tannins, phytic acid, gossypol, oxalates, goitrogens, lectins (phytohaemagglutinins), protease inhibitors, chlorogenic acid and amylase inhibitors. The concentration of these antinutrients in plant sources vary with the species of plant, cultivar as well as processing methods (Akande *et al.*, 2010). The toxic amino acids act antagonistically towards certain nutritionally important amino acids (Liener, 1980). For example, mimosine, a toxic non-protein amino acid structurally similar to tyrosine, is contained in the legume, *Leucaena leucocephala* (D'Mello, 2000). This constituent also shows adverse effect on mammals. The major symptoms of toxicity are poor growth, loss of hair and wool, lameness, mouth and goiter. Djenkolic acid (sulphur containing amino acid, similar to cystine) is present in *Pithecolobium lubatum* beans in free state which is not degraded in the animal body as a result, it crystallizes out in the kidney and excreted through kidney (Enwere, 1998). Saponins are triterpene and steroidal glycoside compounds present in kidney beans, soybeans, ground nuts. Excess saponin content adversely affects animals, causing erythrocyte haemolysis, reduction of blood and liver cholesterol, depression of growth rate, inhibits enzyme activity and cause a reduction in nutrient absorption (Cheeke, 1971). Cyanogenetic glycosides are mainly present in kidney beans, lima beans in large concentrations. The main hydrolytic compound is hydrocyanic acid which is liberated by enzyme action, is very toxic at low concentrations to animals. It causes central nervous system

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dysfunction, respiratory failure and cardiac arrest (D'Mello, 2000). Tannins are high molecular weight water soluble phenolic compounds. Tannins may form a less digestive complex with dietary proteins and may bind and inhibit the endogenous protein, such as digestive enzymes (Kumar and Singh, 1984). They are of mainly two types, *i.e.*, hydrolysable and condensed tannins. Condensed tannins are responsible for the testa bound trypsin inhibitor activity of fababeans (Helsper *et al.*, 1993). Hence, tannins interfere with digestion by displaying antitrypsin and anti-amylase activity. Phytic acid is one more major antinutrient that occurs naturally throughout the plant kingdom. It is present in major legumes and oilseeds. They accumulate in the storage side in seeds and forms chelates (complex phytate) (Erdman, 1979) with several metal ions and form insoluble complexes that are not absorbed by the gastro intestinal tract (GIT). Gossypol, a naturally occurring polyphenolic occurs in cotton seeds. Gossypol binds with the reactive epsilon amino group of lysine during heat processing and reduces lysine availability (Robinson, 1991). It causes a depressed appetite, loss of weight, laboured breathing and cardiac irregularity. Lectins are glycoprotein containing antinutrient, widely distributed in legumes and some certain oil seeds. It can directly bind to the intestinal mucosa and interferes with the absorption and transportation of nutrients (Santiago *et al.*, 1993). Chlorogenic acid, a tannin like compound present in sunflower meal and inhibits activity of digestive enzymes including trypsin, chymotrypsin, amylase and lipase (Cheeke and Shull, 1985). All the above antinutrients inhibit or resist the nutrient uptake by the plants and this results in improper growth, eventually affecting the production of plant secondary metabolites. Titration methods are used to determine the oxalates and phytates, whereas alkaloids, saponins and tannins are determined by other specific methods. With these estimation methods, the activities of antinutrients are reduced and improve both the content of plant secondary metabolites as well human health.

Most of these antinutritional factors are present in foods of plant origin. Thus, their presence in foods may induce undesirable effects in human population above a limit. The harmful effects may also be due to the products of metabolism of these compounds. These antinutritional factors as well as their metabolites may have beneficial health properties, if present in smaller quantities (Gemed and Ratta, 2014). Further, antinutritional factors such as nitrates, oxalates, phytates, cyanogenic glycosides and tannins in vegetables may disturb absorption of micronutrients and, makes them unavailable. Thermal processing of leafy vegetables through boiling, cooking and blanching before consumption is very helpful in reducing the level of antinutrients (Natesh *et al.*, 2017).

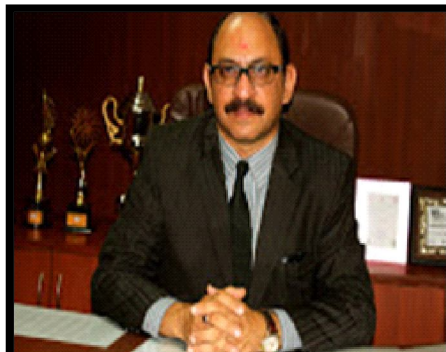
In the journey from traditional era to the modern scientific era, scientific journals have played a vital role by publishing systematic scrutinized and double blind reviewed good quality papers. Currently lots of online journals are available but very few are maintaining standard quality. Getting good quality research works with innovative scientific concepts confined in the form of standard manuscripts are not easy. Not only that, selection of manuscripts by the editorial board as well as the services of efficient, experienced

and unbiased reviewers is also a team works required for the success of a journal. The journals should provide a solid platform for inspiration to the scientists, students and young researchers in particular. Of late "Annals of Phytomedicine" is a prestigious multidisciplinary journal where plant science linked with all the disciplines such as chemistry, pharmacology, modern medicine, biochemistry, biotechnology, molecular biology, plant tissue culture and statistics work harmonically. This broad multidisciplinary concept is the key success to this journal for running smoothly in this difficult and challenging world. Quality of papers that are publishing in this journal, keeps high within a small span of years with prestigious abstracting and indexing. Further, the journal is ahead of Thomson Reuters indexing and wishing for successful long journey. I am very happy to acknowledge and share my article in this journal and appeal to all the researchers that "Annals of Phytomedicine: An International Journal" is the right forum for publication of their research papers.

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Professor Raman Dang (M.Pharm, Ph.D., MBA, FAELS), Registrar, DPSRU, New Delhi, India is a dynamic, hardworking, enthusiastic professional and responsible person in the field of Pharmaceutical Sciences. He has proven leadership abilities in working as a team, handling multiple tasks, great adaptability to any enterprise's environment.

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Special credentials: With his active efforts, the college accredited with quality certification by "The National Assessment and Accreditation Council (NAAC)" for maintaining sustained and uplifted quality education and actively involved in the finalizing of the MOS's between Teleradiology, Wipro and Green Chem. He serves as an expert committee and scrutiny member for various research projects under Rajiv Gandhi University of Health Sciences, Bangalore, Inida.