

Nutritional and Anti-Nutritional Chemical Composition of Green Leafy Vegetables

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Abstract: Green leafy vegetables are an excellent source of vitamins, minerals, and phenolic compounds. This study looks at the nutritional and antinutritional properties of certain common green leafy vegetables. The kind and mix of nutritional and antinutritive elements differ between genera and species of edible plants. Anti-nutritional factors are chemical substances found in plant tissues that prevent humans from absorbing nutrients. Their consequences can be direct or indirect, ranging from mild repercussions to death. Antinutrients such as nitrates, phytates, tannins, oxalates, and cyanogenic glycosides have been linked to a variety of health problems. Anti-nutritional elements can be reduced using different processing methods such as cooking and blanching.

Keywords: leafy vegetable, human nutrition, quality, chemical, nutritional factors, anti-nutritional factors

1. Introduction

Vegetables are vital in rational nutrition because of their high nutritional and energy content, as well as their beneficial effect on the functioning of the physiologic human organism. It is widely known that the World Health Organization (WHO) recommendation of at least 400g of fruit and non-starchy vegetables is utilized to achieve the required daily supply of nutrients. People should diversify their meals, according to nutritionists and dieticians, because no single vegetable provides all the nutritional requirements for optimal health and wellness. Vegetables come in a wide variety of species, kinds, and variants, making them ideal for cooking a wide range of dishes. Thus improving range enriching food. Vegetable composition reveals a high-water content, sugars, protein, starch, fat, energy value and so on. It is worth noting that, while many chemical compounds have health benefits, others can be extremely toxic and fatal to humans when consumed. This paper aims at reviewing the common health-promoting chemical constituents known as nutritional factors as well as the health-inhibiting or toxic chemicals known as anti-nutritional factors.

1.1 Understanding Anti-Nutrients

Antinutritional factors are primarily associated with natural or synthetic compounds or substances that interfere with nutrient absorption, reduce nutrient intake, digestion, and utilization, and may have other negative effects. Antinutrients, which are naturally synthesized in plants, are frequently associated with plant-based, raw, or vegan diets [3]. Many antinutrients in the body can cause nausea, bloating, headaches, rashes, nutritional deficiencies, and other symptoms. On the other hand, when used wisely, such chemical compounds can be clearly beneficial to humanity. Plants, in fact, primarily use antinutrients for defense. Antinutrients are found in their highest concentrations in grains, beans, legumes, and nuts, but can also be found in leaves, roots and fruits of certain varieties of plants. The major antinutrients found in plant-based foods are phytates, tannins, lectins, oxalates, etc.

1.2 Anti-Nutrients in Green Leafy vegetables

Lectins

Lectins are proteins or glycoproteins of nonimmune origin. They have the potential to bind, without modifying, to both carbohydrates and glycoconjugates (glycoproteins, glycolipids, polysaccharides). They can correctly apprehend animal mobileular carbohydrates, which corresponds to the Latin derivation of the phrase legere which means to select [4]. Lectins have plenty of roles. They can skip human protection gadget and journey all around the frame inflicting diseases (i.e. Crohn's disease, Coeliac Sprue, colitis, etc.) with the aid of using breaking down the floor of the small intestine [5]. When big portions of lectins are brought withinside the frame, the intestine wall develops holes, and intestinal permeability, inflicting the leaky intestine syndrome.

Glucosinolates and Goitrogens

Goitrogens can prevent the absorption of iodine, which may then interfere with thyroid function and cause goiter. Those already with an iodine deficiency or a condition called hypothyroidism are most susceptible. Vegetables from the genus Brassica i.e. broccoli, cabbage, cauliflower, Brussels sprouts, and kale are some of the goitrogen rich foods [6]. The consumption of cruciferous vegetables affects triiodothyronine (T3) and thyroxine (T4) levels by causing hypothyroidism. Concomitant factors can be insufficient water consumption and protein malnutrition [7].

Oxalate

Oxalates are insoluble (calcium, magnesium, iron) salts or esters or oxalic acid that are commonly found in plants i.e. leafy vegetables or synthesized in the body. Insoluble salts cannot be processed out of the urinary tract once processed through the digestive system. Calcium oxalate may have a deleterious impact on human nutrients and fitness through amassing kidney stones [8]. Cruciferous veggies (kale, radishes, cauliflower, broccoli), in addition to chard, spinach, parsley, beets, rhubarb, black pepper, chocolate, nuts, berries (blueberries, black berries) and beans are a number of the meals with excessive quantities of oxalates [9].

Tannins

Tannins are flavan-3-ol oligomers and flavan-3, 4-diol oligomers found in the bran fraction of legumes. This water-soluble polyphenol is abundant in grapes and green tea. Tannins have antinutritional properties because they impair nutrient digestion and prevent the body from absorbing beneficial bioavailable substances. Tannins can also bind to proteins and shrink them. Tannin-protein complexes may inactivate digestive enzymes and reduce protein digestibility due to protein substrate and ionisable iron interaction [10].

Phytates

Phytates inhibit the activity of digestive enzymes by chelating mineral cofactors or interfering with protein interactions. For example, phytate disrupts zinc homeostasis. Protein binding by phytate can be direct (phytate: protein) or indirect (phytate: protein) (through a cation bridge)[11]. Because phytate is relatively heat stable, processing techniques such as boiling and cooking have no effect on reducing the level of phytic acid [12]. Wade and Morgan⁹⁶ developed the main method for phytic acid determination in food samples, after which several methods were developed. Complexometric titration, enzymatic reaction, potentiometric and ionic chromatography are current methods found in the literature.

Saponins

Some saponins (steroid or triterpene glycoside compounds) are edible, while others are poisonous. Saponins with a bitter taste are toxic in high concentrations and can interfere with nutrient absorption by inhibiting enzymes (both metabolic and digestive) and binding with nutrients such as zinc. Saponins are naturally occurring substances that have a wide range of biological effects. Saponins have a strong hypocholesterolemia effect in the presence of cholesterol [13]. They can also cause hypoglycemia, impair protein digestion, vitamin and mineral absorption in the gut, and lead to the development of a leaky gut.

1.3 Nutritional Factors in Green Leafy vegetables

Minerals

Minerals are important for body to stay healthy. There are two kinds of minerals: macrominerals and trace minerals. Minerals are necessary for 3 main reasons: (i) building strong bones and teeth (ii) controlling body fluids inside and outside cells (iii) turning the food you eat into energy. Mineral nutrients are abundant in green leafy vegetables. For example, spinach contains the most calcium (1036mg/100g), magnesium (827mg/100g), iron (28.4mg/100g), and sodium (827mg/100g), whereas duck weed contains the most zinc (15mg/100g). However, when compared to all seeds, soy seed has a significant amount of calcium (195mg/100g), iron (6mg/100g), magnesium (407mg/100g), phosphorus (469mg/100g), and potassium (2387mg/100g), sodium (12.3mg/100g), and zinc (3.7mg/100g). Minerals in leafy vegetables can be determined by atomic absorption spectrophotometry (AAS) method, inductively coupled plasma optical emission spectroscopy (ICP-OES) [14].

Proteins

Protein is found throughout the body—in muscle, bone, skin, hair, and virtually every other body part or tissue. It

makes up the enzymes that power many chemical reactions and the hemoglobin that carries oxygen in your blood. At least 10,000 different proteins make you what you are and keep you that way. Protein is made from twenty-plus basic building blocks called amino acids. Because we don't store amino acids, our bodies make them in two different ways: either from scratch, or by modifying others. Nine amino acids—histidine, isoleucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophan, and valine—known as the essential amino acids, must come from food. The National Academy of Medicine recommends that adults get a minimum of 0.8 grams of protein for every kilogram of body weight per day, or just over 7 grams for every 20 pounds of body weight [15]. For a 140-pound person, that means about 50 grams of protein each day. Green leafy vegetables such as spinach (*Spinacia oleracea*), broccoli (*Brassica oleracea*) and duckweed (*Lemna perpusilla*) provide all the essential amino acids that meet the FAO nutrition standards.¹⁵ Evidence showed that apart from lower methionine content, cassava (*Manihot esculenta*) leaves consumed as green leafy vegetable has amino acids profile comparable with pulse and dairy products.

Vitamins

Green leafy vegetables are abundant sources for β -carotene. In leaves, vitamin A is present in the form of provitamin A carotenoids such as β -carotene (ca. 25-30%), α -carotene, γ -carotene, β -cryptoxanthin and non-provitamin A carotenoids lutein (ca. 45%), violaxanthin (ca. 15%) and neoxanthin (ca. 15%), the content of vitamin A is expressed in retinol equivalents (RE) with one (1) RE being equivalent to 6 μ g of β -carotene and 12 μ g of the other pro vitamin carotenoids. Salad greens, kale and spinach are rich in vitamins A, C, E and K. These vegetables also contain an abundance of carotenoids-antioxidants that protect cells and play roles in blocking the early stages of cancer [16]. The dark greens supply a significant amount of folate, a B vitamin that promotes heart health and helps prevent certain birth defects. Folate is also necessary for DNA duplication and repair which protects against the development of cancer. Several large studies have shown that high intakes of folate may lower the risk of colon polyps by 30 to 40 percent compared to low intakes of this vitamin. Other research suggests that diets low in folate may increase the risk of cancers of the breast, cervix, and lung. The vitamin K contents of dark green leafy vegetables provide several health benefits including protecting bones from osteoporosis and helping to prevent against inflammatory diseases.

Dietary Fibres

Dietary fiber, also known as roughage or bulk, includes the parts of plant foods body can't digest or absorb. Unlike other food components, such as fats, proteins, or carbohydrates — which your body breaks down and absorbs — fiber isn't digested by body. Instead, it passes relatively intact through stomach, small intestine, and colon and out of body. Fiber is commonly classified as soluble, which dissolves in water, or insoluble, which doesn't dissolve. Soluble fibers dissolve in water to form a gel-like material. It can help lower blood cholesterol and glucose levels. Insoluble fibers promote the movement of material through digestive system and increases stool bulk, so it can be of benefit to those who

struggle with constipation or irregular stools. Green leafy vegetables have been traditionally recognized as good sources of dietary fiber. Literature information showed that Indian Green leafy vegetables such as basella (*Basella rubra*), fenugreek (*Trigonella foenum graecum*), hibiscus (*Hibiscus cannabinus*), coriander (*Coriandrum sativum*), cabbage (*Brassica oleracea*) and spinach (*Spinacia oleracea*) are good sources of soluble dietary fiber content. The amount of total dietary fiber in green leafy vegetables can vary with different plant variety of the same species, agro-climatic conditions, stages of maturity and type and rate of fertilizer applications. [17-18]

2. Conclusion

Green leafy vegetables contain essential nutrients for human health and well-being. Amino acids, vitamins, essential fatty acids, minerals, and dietary fiber are examples of these. They are commonly regarded as the least expensive source of food for supplementing vitamins and micronutrients to combat nutrient deficiencies. It is also used as a herbal and medicinal plant in a variety of cultural and traditional settings to treat a variety of ailments. The presence of antinutritional factors in green leafy vegetables such as nitrates, oxalates, phytates, cyanogenic glycosides, and tannins can affect micronutrient absorption and thus make the latter unavailable. Before consumption, leafy vegetables should be thermally processed by boiling, cooking, or blanching to reduce the level of antinutrients.

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