# Nutrient Rich Foods and Their Toxicity

# Mumtahin ul Kousar1,Muzzammil Kousar2,Raies A Bhat3 and R.Nissar3

# *1Research Scholar Division of Food Sciences & Technology,SKUAST-Kashmir*

# *2M. Sc .Student Botany A.M.U (U.P)*

# *3Scientist Agronomy,KVK,Kupwara SKUAST-Kashmir*

# *4SMS,Agromet,DAMU Kupwara*

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In twenty first century, the life style has extensively changed with the rapid increase in world

population which has resulted in the increase in leisure and consequently the purchasing power

has also increased. These changes has resulted in the decline in physical activities and had an

explicit impact on food consumption pattern of general public. It is a fact that the shift towards

the utilization of nourishment with tall sugar levels and saturated fats appear hindering impacts

on wellbeing with course of time. This shift has led to sudden rise in chronic diseases such as

coronary heart maladies, hypertension, weight, cancer, diabetes etc. So it has become

necessary to keep up a sound way of life for most individuals. It is well known that great

wellbeing is unequivocally related with eat less and numerous other variables such as heredity

qualities, environment, way of life propensities and physical activity. Now a day’s, people are

profoundly concerned almost selecting solid nourishments with a wide extend of therapeutic

values to diminish their chance of chronic diseases. So nutraceuticals can play an important

role to control the deficiencies caused due to the consumption of tall sugar levels and saturated

fats. It was the Hippocrates who is known as the father of cutting edge pharmaceuticals

nearly 2500 years back, built up the association of nourishment and its centrality for the

treatment of different diseases in an extremely classical way enhancing distinctive benefits.

The word “Nutraceutical” comprises of two words “Nutra derived from Nutrition” and

“Ceutical derived from Pharmaceutical” which was named by Dr. Stephen De-Felice in 1989.

A nutraceutical is characterized as any substance that will be considered nourishment or a

portion of a nourishment and gives restoration or prosperity benefits counting anticipation and

treatment of illness . Nutraceuticals may be utilized to move forward wellbeing, delay the

aging process, and avoid persistent illnesses, increment life hope, or work of the body.

Pharmaceuticals in contrast with nutraceuticals are the drugs utilized for the treatment of

disease and have the legislative endorse but nutraceuticals are the nutrients that may prevent

the disease and have not ordinarily obvious security.

# Classification of Nutrient rich foods

Nutraceutical may be broad and common term utilize to depict any nourishment determined

item that in addition to having fundamental wholesome esteem within the food. There

are different diverse sorts of food items that come beneath the category of nutraceuticals which

## 1. Dietary Supplements

Dietary supplements are the items that contain supplements extracted from food products that

are concentrated in fluid or capsule frame. These incorporate vitamins and minerals like

calcium and iron; herbs such as Echinacea and garlic; and specialty products like glucosamine,

probiotics, and fish oils. There are different criteria on which dietary supplements can be

defined based on the Dietary Supplement Health and Education Act of 1994 which are as:

 Implies an item (other than tobacco) expecting to supplement the calories that bears

diet which contains one or more of the following dietary ingredients:

a) a vitamin b) a mineral c) a herb or other botanical product d) an amino acid e) a

dietary substance for use by man to supplement the diet by increasing the total dietary

intake.

 Means a product which is not represented for use as a conventional food or as a sole

item of a meal or the diet; and

 Does include an article that is approved as a new drug, certified as an antibiotic or

licensed as a biological marketed as a dietary supplement or as a food prior to such

approval, certification, or license (unless the Secretary of Health & Human Services

waives the provision) [4].

## 2. Functional Foods

Functional foods are outlined to permit eating enhanced nourishments near to their

common state, instead of by taking dietary supplements fabricated in fluid or capsule

frame [5]. These include yogurts, omega-3 milk, canola oil, oats, bran, psyllium and

lignins.

## 3. Medical Foods

For nutrition and dietary control of a disease, medicinal foods are specially designed and

formulated. It has distinctive nutritional value than the normal foods. These include health

bars, transgenic cows and lacto-ferrin, Transgenic plants for oral vaccination. The

classification of various nutraceuticals based on various elements is shown in table 1:

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# 90 Table 1: Classification of various nutraceuticals

|  |  |  |
| --- | --- | --- |
| **Chemical constituent** | **Source** | **References** |
| **Carotenoids (Isoprenoids)** |  |  |
| Lycopene | Tomatoes, pink grapefruit,  guava papaya and watermelon | Mourvaki et al., 2005 |
| Lutin | Corn, avocado, egg York and  spinach | Abdel-Aa et al., 2013 |
| β-Carotene α-Carotene  α-Cryptoxanthin Zeaxanthin | Carrots, various fruits and vegetables  Oranges and tangerines  Corn and avocado | Abdel-Aa et al., 2013 |
| **Dietary fibres** |  |  |
| Solube fibre | Legumes, oats, barley and  some fruits | Dhingra et al., 2012 |
| Insoluble fibre | Whole grain foods wheat, nuts  and corn bran | Dhingra et al., 2012 |
| **Polyphenolic compounds** |  |  |
| Flavonones | Anti-cancer, citrus fruits and  antioxidants | Ronis et al., 2018 |
| Flavones | Soybean, fruits and  vegetables, | Ronis et al., 2018 |
| Flavonols | Broccoli, tea, onions and  apples | Ronis et al., 2018 |
| Anthocyanins | Black raspberries,  blackberries and blueberries, | Ronis et al., 2018 |
| Phenolic acids | Berries andlegumes | Ronis et al., 2018 |
| Resveratrol | Berries, catechins and red  grapes | Ronis et al., 2018 |
| Curcumin | Turmeric root | Ronis et al., 2018 |
| **Fatty Acids** |  |  |

|  |  |  |
| --- | --- | --- |
| Omega-3 fatty acids (poly  unsaturated fatty acids) | Salmon and Flax seed | Rodriguez-Leyva et  al., 2010 |
| Mono-saturated fatty acids | Tree nuts | King et al., 2008 |
| **Isothiocyanates** |  |  |
| Sulporaphane | Broccoli, cauliflower, cabbage  and horse-radish | Yagishita et al., 2019 |
| **Plant Stanols/Sterols** |  |  |
| Stanol/sterol esters | Stanol ester dietary supplements and fortified  table spreads | Ojansivu et al., 2015 |
| **Tocotrienol** |  |  |
| Isoprenoids | Grains and palm Oil | Ahsan et al., 2005 |
| Saponins | Chickpeas and soybeans | Ahsan et al., 2005 |
| **Probiotics/Prebiotics** |  |  |
| Lactobacilli/bifidobacteria | Yogurt, other dairy and non-  dairy applications | Pandey et al., 2015 |
| **Minerals** |  |  |
| Calcium, selenium, potassium,  zinc and copper | Food |  |
| **Gulcosinolates** |  |  |
| Gulcosinolates | Cruciferous vegetables and  cauliflowers | Kassie et al., 2004 |
| **Phytoestrogens** |  |  |
| Isoflavanes (genistein,  daidzein) | Soybeans and legumes | Desmawati et al., 2019 |
| Liganans | Flaxseed, rye, vegetables | Desmawati et al., 2019 |
| **Alkaloids** |  |  |
| Quinine | Cinchona | Egamberdieva et al.,  2019 |
| Tropane alkaloids | Solanaceous members: deadly | Egamberdieva et al., |

|  |  |  |
| --- | --- | --- |
|  | night shade and datura | 2019 |
| Morphine | Opium poppy | Egamberdieva et al.,  2019 |
| Ergot alkaloids | Fungus: (Claviceps purpurea) | Egamberdieva et al.,  2019 |
| Vincristine | Periwinkle | Egamberdieva et al.,  2019 |
| Vinblastine | Periwinkle | Egamberdieva et al.,  2019 |
| Fenugreekine | Fenugreek | Egamberdieva et al.,  2019 |
| **Non-carotenoid terpenoids** |  |  |
| Saponins | Legumes | Hock et al., 2016 |
| Perillyl alcohol | Cherries and mints | Hock et al., 2016 |
| Terpene limonoids | Peels and citrus fruits  membranes | Hock et al., 2016 |
| Terpenol | Carrots | Hock et al., 2016 |
| **Anthraquinones** |  |  |
| Senna | Legumes and pulses | Nida, 2019 |
| Barbaloin | Aloe | Nida, 2019 |
| Capsaicin | Capsicum | Nida, 2019 |
| Piperine | Black peppers and jalapeno  peppers | Nida, 2019 |
| **Terpenes** |  |  |
| Menthol | Mint family plants | Cox-Georgian et al., 2019 |
| Borneol | Pine oil | Cox-Georgian et al.,  2019 |
| Santonin | Wormwood | Cox-Georgian et al., 2019 |
| Gossypol | Cotton | Cox-Georgian et al., 2019 |

# Relationship of nutraceuticals with different diseases and their mode of action

***Prevention of cardio-vascular diseases (CVD):*** The term cardio vascular malady is utilized to

allude heart and blood vessels and incorporate coronary supply, route illness, fringe vascular

illness and stroke. It is recognized that low consumption of vegetables and natural products is

associated with high CVD mortality and that this majority of CVD is avoidable [6]. Numerous

examinations have shown a defensive part for eating healthy diet rich in vegetables and fruits

against cardiovascular diseases. [7,8,9]. For the prevention and treatment of CVD,

nutraceuticals as nutrients, minerals, antioxidants, dietary fibers and omega-3 polyunsaturated

fatty acids along with active work are proposed. Components for example polyphenols alters

the digestion and motioning of cells to diminish blood vessel sickness [10].

Flavonoids are commonly present in vegetables, onion, endives, cruciferous, grapefruits,

apples, cherries etc. play a major role in cardiovascular disease prevention and curing.

Flavonoids piece the chemical such as angiotensin protein, cyclo-oxygenase that break down

prostaglandins and check the conglomeration of platelets. The vascular system that transports

oxygen and nutrients to cells is also covered [11].

***Treatment of Cancer:*** According to the Global Cancer Report, cancer rates are increasing and

there are 15 million new cases by 2020. In order to prevent cancer, it is important to have a

healthy lifestyle and a good diet. Plants with a high content of daidzein, biochanine,

isoflavones and genistein inhibit the development of prostate cancer cells [12]. Lycopene in

tomatoes, guava, pink grapefruit, water melon and papaya has a cancer-protective effect

through a reduction in oxidative stress and also protects DNA damage 13]. Saponins are

reported to have anti-mutagenic as well as anti-tumour activities and can reduce the risk of

human cancers by inhibiting the growth of cancer cells [14].

***Treatment of Diabetes:*** The most foremost frame of diabetes is type 2 diabetes with a

prevalence of 95% and is linked to obesity. While various medications have been developed

for the prevention and treatment of diabetes, the overall number of people with diabetes with

different causes is growing globally [15]. A wide variety of herbal dietary supplements has

clinically demonstrated their assistance in preclinical trials to benefit type-2-diabetes mellitus

[16] but, few has proven itself in well-developed randomized clinical trials [17]. The patients

susceptible to diabetes, omega-3 fatty acids have been suggested to decrease glucose tolerance.

Insulin is needed for the synthesis of long-chain n-3 fatty acids; the heart may therefore be

vulnerable to diabetes depletion [18]. Diabetic neuropathy can be treated by using an

antioxidant such as lipoic acid which also tends to be useful as a long term food supplement to

protect diabetics from complications [19].

***Enhancement of Immune system:*** A wide extend of nutraceuticals have revealed to inflict

decisive parts in resistant status and exposure to few illness conditions. Extricates from the

coneflowers, or some herbs of the genus *Echinacea*, such as *Echinacea angustfolia*, *Echinacea*

*pillida*, *Echinacea purpurea* are group of resistant boosters which are valuable to make strides

in immune function. Supplementation with probiotics like the strains belonging to

*Lactobacillus*, *Bifidobacterium* sp. and sometimes *Streptococcus* give maturational signals for

the lymphoid tissue and provide the equilibrium between master and anti-inflammatory

cytokines [21, 22].

# Toxic effects of nutraceuticals

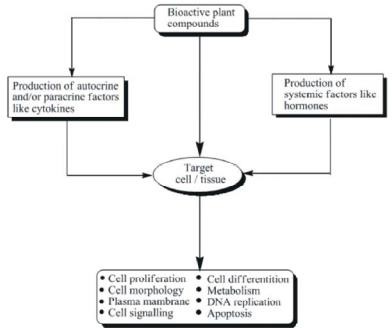
1. Table 2 represents some of the nutraceuticles are their toxic effects

# Table 2: Toxic effects of nutraceutical

|  |  |  |
| --- | --- | --- |
| **Nutraceutical** | **Toxic effect** | **References** |
| Vitamins and Mineral Supplements | * Higher dosages (> of vitamin B6 leads to photosensitivity and neurotoxicity in elderly patients * Higher dosages of vitamin E supplements leads to bleeding correlated with antiplatelet action, and causes diarrhea, fatigue and blurred vision. * unfavourable impacts on bone wellbeing, counting low bone mineral thickness and expanded fracture risk, are associated with excess vitamin A supplementation. | * Ziegler et al. 1996 * Melhus et al. 1998 |
| Fish oils and omega 3 fatty | * They can intensify | Gross et al. 2017 |

|  |  |  |
| --- | --- | --- |
| Acids | anticoagulation and advance bleeding in patients. |  |
| Green tea | Active catechol in green tea extract is alleged to increase oxidative stress and have been related to liver injury. | Mazzanti et al. 2009 |
| Isoflavone supplements | Intake of Isofalvone supplements have resulted endometriosis in women and increased risk of estrogen sensitive cancers in consumers of these products | Mahady et al. 2003 |
| Soy products | Increment the chance of kidney stones since they contain huge sums of a bunch of chemicals called oxalates. | Ferraro et al. 2020 |
| Saponins | Effects metabolism in a various ways like erythrocyte haemolysis, lessening of blood and liver cholesterol, discourgement of growth rate. | Chauhan et al. 1999 |
| Probiotics | * People with compromised immune systems or treating from cancer chemotherapy taking probiotics may actually increase one's chances of getting sick. * Temporary increase in gas and bloating. * Constipation and increased thirst * Probiotic supplements can produce histamine inside the digestive tract of humans. * Probiotics can enter the | * Salminen et al. 2004 * Williams, 2010 * Karpa et al. 2007 * Pugin et al. 2017 * Boyle et al. 2006 |

|  |  |  |
| --- | --- | --- |
|  | bloodstream and cause infections in people with suppressed immune systems, prolonged hospitalizations. |  |

1. 
2. **Figure 1.** Toxicity due to nutraceuticals (Saad et al., 2006)

# Normal dosages for nutracuticals

1. The normal dosages/day of some nutraceutical was given by National Institute of Nutrition in
2. association with ICMR (Indian Council of Medical Research) in 2020 and is given in Table 3:

# Table 3: Normal dosages of Nutrient rich foods

|  |  |
| --- | --- |
| **Nutraceutical** | **Daily Intake** |
| Vitamin B6 | 2-4 mg |
| Vitamin E | 10-12 mg |
| Vitamin A | 600 µg |
| Calcium | < 2000 mg/day |

|  |  |
| --- | --- |
| Magnesium | < 420 mg/day |
| Potassium | < 3400 mg/day |
| Dietary Fibers | 20–35 g/day |
| Polyunsaturated Fatty Acids | 2- 3 g/day |
| Phytosterols | ~ 150-450 mg/day |
| Isoflavones | 25 to 50 mg/day |
| Probiotics | 1-10 Billion CFUs |

**Regulatory Aspects of Nutrient rich foods**

Direction presents imperative challenge to the globalization of nutraceuticals, with bleak and

somewhat different definition of these items in several nations [36]. In the USA, the Food and

Drug Administration (FDA) directs nutraceuticals beneath a diverse set of laws when

compared with those covering “conventional” foods and drug products. According to the

Dietary Supplement Health and Education Act from 1994 (DSHEA), it is the manufacturer's

duty to guarantee that a nutraceutical is secure before it is promoted. In the European Union,

food legislation, nutraceutical is to a great extent beneath the body of European Food and

Safety Authority (EFSA). This enactment focuses on “food supplements”, which are

characterized as concentrated sources of supplements and other substances with a valuable

nutritional effect. In India, the administrative body which legalizes nutraceutical products is

the Food safety and standards authority of India (FSSAI), which has created for playing down

science, based guidelines for articles of food and regulates their manufacture, storage and

dissemination .

# Global Nutrient Rich Foods Market

In coming decade or so, nutraceuticals market is proceeding to encounter colossal

development internationally. Key developed and health-conscious countries are fundamentally

driving this. However, developing market consumers are too getting to be progressively

mindful of the benefits of such items. Alongside, expandable wages of common populace is

additionally expanding exponentially in numerous developing countries including India [37].

In few years, world will have more the 1 billion population 70% of this populace live in

developed countries and remaining 30% in developing countries. The demand for nutraceutical

will expand at a relentless rate in developed countries. The US has been the leading

nutraceutical market till date and nearly completely mature. Between 2010 and 2015, it

developed from $ 50 Bn to $ 65 Bn, a compounded development of 10% every year. The US

market comprises of functional food and Refreshments (65%) and Dietary Supplements

(35%). The European market has developed from $ 35 Bn in 2010 to $ 40 Bn in 2016. It is

anticipated to develop to $ 51 Bn by 2021. This demonstrates a yearly development of 5%

[37]. The Indian nutraceuticals market is anticipated to develop from $ 4 Bn in 2015 to $ 10

Bn in 2022, this speaks to a gigantic development of 21% development yearly [37] because the

normal urban and semi-urban Indian is getting to be more cognizant around wellbeing and

wellness. This can be giving an enormous development opportunity for nutraceuticals in India.

# Conclusion

In later a long time, there's a developing intrigued in nutraceuticals that give wellbeing benefits

and are elective to present day medication. Nutraceuticals hold great potential for the long run

since they are helpful for today's life fashion. Buyer intrigued in relationship diet and

wellbeing has expanded the request for data on nutraceuticals. In spite of the fact that

nutraceuticals have critical guarantee within the advancement of human wellbeing and disease

prevention, long term clinical ponders are obligatory to experimentally endorse the

nutraceuticals in different therapeutic conditions. It will not be distant when nutraceuticals will

be our favored medicine in coming a long time.

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