

ADAPTOGENS AND FUNCTIONAL FOOD AND THEIR IMPACT ON HEALTH

Abstract

Adaptogens are plant extract non-toxic chemical substance that increase the ability of body to combat the damaging effects of stress and helps in body homeostasis. It is also used in herbal medicine for claimed stabilization of the physiological process. Adaptogens can activate the protective mechanism of cells, which helps to increase the survival rate of cells both in vitro and in vivo. Adaptogens also play a vital role in overcoming fatigue, depression, anxiety, sexual problems, nervous system problems, and some other chronic diseases. Functional foods are those foods that provide positive health benefits other than providing nutrients and energy and also minimize the risk of chronic disease. Functional foods are actually products formulated or fortified with its naturally occurring chemical constituents/compounds and they are basically present in many grains, spices, herbs fruits, and vegetables which helps in health benefits and reduces the chronic effects of disease. A large number of studies has been done on adaptogens for their pharmacological and clinical effects from 1960 to 1970 in the Union of Soviet Socialist Republic and found that only three plant species as-*Rhodiola rosea*, *Schisandra chinensis*, and *Eleutherococcus senticosus* and later in 1993 *Bryonia alba* were introduced in medical practice. India has recently passed the Food Safety and Standard Act 2006, a food law to serve and regulate food products including functional food. This chapter will elaborately explain the beneficial role of adaptogens and functional foods on health.

Keywords: Adaptogens, Functional Food, Health, Disease.

Authors

Dhananjay Sharma

Department of Dietetics and Applied Nutrition

Amity Medical School

Amity University, Haryana, India.

medhananjaysharma@gmail.com

Kajal Dhama

Department of Dietetics and Applied Nutrition

Amity Medical School

Amity University, Haryana, India.

kajaldhama97@gmail.com

Dr. Luxita Sharma

Ph.D. Associate Professor and Head

Departement of Dietetics and Applied Nutrition

Amity Medical School

Amity University, Gurgaon

Haryana, India.

lshrama@ggn.amity.edu

I. INTRODUCTION

Adaptogens are plant extract non-toxic chemical substance that increase the ability of body to combat the damaging effects of stress and helps in body homeostasis (Panossian, 2003). It is also used in herbal medicine for claimed stabilization of physiological process (Brekhman & Dardymov, 1969). Adaptogens can activate the protective mechanism of cells, which helps to increase the survival rate of cells both in vitro and in vivo (Schriner et al., 2009). Adaptogens also play a vital role in overcoming fatigue, depression, anxiety, sexual problems, nervous system problems, and some other chronic diseases (Lore, 2018).

Functional foods are those foods that provide positive health benefits other than providing nutrients and energy and also minimize the risk of chronic disease (Lee, 2017). According to Devine & Dikeman (2014)- “processed foods have disease-preventing and/or health-promoting benefits in addition to their nutritive value”.

Functional foods are actually products formulated or fortified with naturally occurring chemical constituents/compounds and they are basically present in many grains, spices, herbs fruits, and vegetables which helps in health benefits and reduces the chronic effects of disease.

The term Adaptogen derived from the Latin word *adaptare* means “to fit or adjust”, and was first coined in 1940 by Soviet Scientist, Nikolai V. Lazarev according to him, adaptogens are a substance that increases the body’s stress resistance. Adaptogens by their traditional use, Ayurveda & Siddha (Ashwagandha, sacred basil, shilajit, kulekhara, amla, Guduchi, and shatwari) where Traditional Chinese medicine (Asian ginseng, Eleuthero, and Schisandra) and from western like Russia, Eastern Europe, and United States (American ginseng, Eleuthero and Rhodiola) and from southern America (Maca) (Winston, 2019).

A large number of studies has been done on adaptogens for their pharmacological and clinical effects from 1960 to 1970 in the Union of Soviet Socialist Republic and found that only three plant species as-*Rhodiola rosea*, *Schisandra chinensis*, and *Eleutherococcus senticosus* and later in 1993 *Bryonia alba* were introduced in medical practice (Panossian, 2003).

The term “functional food” was first introduced in the early 1980s in Japan. It also approved the first specific regulatory body for its process and management. Food for Specified Health Use (FOSHU) was first established in 1991. Later, the two countries Europe and America introduced the new concept of an added value of food, the functional food science in Europe (PUFOSE, ILSI Europe, 1999). India has recently passed the Food Safety and Standard Act 2006, a food law to serve and regulate food products including functional food (Keservani et al., 2014).

II. CLASSIFICATION

Functional food may be classified into three categories on the basis of

1. Nutrient and non-nutrient
2. Target organ systems and
3. Their origin (source)

1. Nutrient and Non-Nutrient

Nutrient	Non-nutrient
<ul style="list-style-type: none"> • Lipids (n-3 fatty acid, linoleic acid) • Vitamins (Folate, vitamin-Vitamin-E and β-carotene) • Minerals (selenium) 	<ul style="list-style-type: none"> • Fibre (Soluble and insoluble) • Phenolic compounds (Phenolic acids, flavonoids, isoflavones and tannin) • Non-digestible oligosaccharides • Phytosterols

According to Prakash and Van, (2010)

2. Target Organ System

<ul style="list-style-type: none"> • Gastrointestinal Tract: Prebiotic, Probiotic, Insoluble fiber, Polyphenol, Phytate, n-3 fatty acid, Micronutrient • Cardiovascular System: n-3 fatty acids, Polyphenols, Insoluble fiber, Micronutrients • Immune System: Prebiotic, Probiotic, Polyphenol, n-3 fatty acid • Skeletal System (Fructans) • Kidney (Fructans)
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According to Devine & Dikeman, (2014)

3. Origin (Source)

<ul style="list-style-type: none"> • Animal: Linoleic acid, Chitosan, Fish oil • Microbial: Probiotic • Plant: Fibres, Polyphenols, Fructans, n-3 fatty acids, Phytates, Carotenoids
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According to (Udipi, 2018)

III.IMPACT OF FUNCTIONAL FOOD ON HEALTH

1. **Role of Functional Food in Gut:** Lakh of bacteria and other microbes lives in the human gut in association with symbiotic relation. A decrease in their number may lead to problems in the GI tract and may cause autism, bowel disease, and diarrhea. This microflora may also be damaged due to excessive use of antibiotics, but functional food like prebiotics and probiotics helps to improve the macrofloral gut and improve the body's health (Joshi et al., 2018).
2. **Stimulate in Growth of Probiotics:** The human-made dairy products, that can't be digested by humans in their upper GI tract, may help to stimulate the growth of certain microbes but fermented cereal products useful for better growth of probiotic micro-organisms as they contain water-soluble fibers, resistant starch, and arabinoxylan and oligosaccharides others (Charalampopoulos et al., 2002).

- 3. Reduces the Risk of CVD:** Dietary fiber consumption has an inverse relation with CVD, as greater consumption of dietary fiber lowers the risk of CVD. Viscous fibers (found in many fruits, vegetables, oats, and barley) mainly reduce cholesterol and LDL concentration (Soliman, 2019). High intake of flavonoids is linked with a decreased risk of ischemic stroke and CVD mortality in association with vitamin E consumption (Mursu, 2008). Phenols have also been found to consistently decrease the risk of CVD by a reduction in lipid peroxidation (Udipi, 2018).
- 4. Reduces the Risk of Cancer:** Dietary fibers act in two ways –direct and indirect way. In a direct way, the fibers bind to a potential carcinogen. In the colon undegradable fibers form fermentable substrate with microflora, this microflora inhibits the proliferation of tumor cells (Procarcinogen), and the fiber increases stool bulk and reduces the transit time. Indirect way high bile acid may increase the colon cancer risk but fibers absorb bile acid and reduces bile acid concentration after fermentation of dietary fibers to short-chain fatty acids (SCFAs) by reducing pH this acid slows down the proliferation of cancer cell (Harris & Ferguson, 1993). Polyphenol, Curcumin, and ellagic acid act as anti-carcinogenic substance and inhibits the growth of tumor cell (Stoner & Mukhtar, 1995).
- 5. Slowing of the Aging Process:** Fish omega-3 fatty acids, red wine, and dairy products have been found to show a great positive effect on healthy aging, which decreases oxidative aging in the elderly (Da Silva et al., 2016). The combined use of probiotics and prebiotics also reduces aging in the elderly by increasing intestinal microbiota and reducing auto-oxidation in the host (Woodmansey, 2007).
- 6. Functional Food in Immune Function:** Some foods rich in probiotics, selenium, and antioxidant vitamins like vitamin A, vitamin C, and vitamin E play a role in the enhancement of the immune function of the body (López-Varela et al., 2002). Polyphenol curcumin and epigallocatechin gallate activate and regulate the signaling pathway to immune response and stimulate epigenetic changes (Ding et al., 2018).
- 7. Functional Food in Diabetes and Other Complications:** Pomegranate a fruit that contains polyphenolic compounds like punicalagin, punicalins, gallagic acid, and ellagic acid has strong results against CVD, diabetes, and prostate cancer (Johanningsmeier & Harris, 2011). Flaxseed has potential health benefits due to its constituent α -linolenic acid, lignan, and fibers, which help minimize the risk of CVD, diabetes, immune disorder, and atherosclerosis (Goyal et al., 2014). Cereal brans are the end product of grain processing and have functional food properties due to their constituent of arabinoxylan, β -glucan, ferulic acid, anthocyanin, oil (γ -oryzanol), and carotenoid, and others. They are effective in lowering cholesterol, atherogenesis, and diabetes and reduce insulin resistance and obesity (Patel, 2015).
- 8. Spices use as Functional Food:** Coriander (*Coriandrum sativum*) contains linalool a terpene that acts against neurodegenerative disease, cancer, and another metabolic syndrome (Prachayasittikul et al., 2018). Curcumin a most popular polyphenol present in turmeric (*Curcuma longa*) is effectively used as an anti-cancer, anti-inflammatory, and antioxidant and in another disease (Tsuda, 2018). Tomato contains lycopene a carotenoid antioxidant that is effective in prostate cancer (Canene et al., -2005). A major alkaloid present in fenugreek seed (*Trigonella foenum graecum*) is trigonelline. It is used as an

antidiabetic and antidyslipidemic (Subramanian & Prasath, 2014). Piperine a main alkaloid found in black pepper (*Piper nigrum*) is effective in brain function (Wattanathorn et al., 2008).

IV. CHEMICAL COMPOSITION OF ADAPTOGEN

1. ***Bryonia***: The extract of *Bryonia* basically consists of two major active components such as cucurbitacin glucosides and tri-hydroxy octadecadienoic acid (THODA) (Panossian & Wikman, 2010). These compounds help in the biosynthesis of eicosanoids and corticosteroids and are the associative mediators for the endocrine, nervous, and immune systems (Panossian et al., 1997).
2. ***Rhodiola***: The roots of *Rhodiola* have biologically active substances such as Flavonoids (rodiolin, rodionin, rodiosin, acetylrodalgin, tricin), Phenylethanol derivatives (salidroside or rhodioloside, tyrosol), Monoterpenes (rosiridol, rosaridin), Triterpenes (daucosterol, beta-sitosterol), Phenylpropanoid (rosavin, rosin, rosarin), Tannins, Phenolic glycosides and, Organic acids (chlorogenic and hydroxycinnamic, gallic acids) (Adaptogen, 2001; Brown et al., 2002).

Salidroside extract from *R. rosea*. was found to have an anti-fatigue effect, stress impairment disorders like neuro-endocrine and immune system, and anti-carcinogenic effect.

- Blocking H₂O₂ apoptosis, salidroside has an antioxidant property it induces antioxidant enzyme like thioredoxin, heme oxygenase-1, and peroxiredoxin-1 and protects neuron cell from H₂O₂ (Zhang et al., 2007).
- Beta-amyloid (A β) peptide is involved in oxidative damage of neuron in Alzheimer's disease, where salidroside play a protective effect for neuroblastoma human cell (SH-SY5Y) against A β (Zhang et al., 2010).

Tyrosol from *Rhodiola* inhibits the JNK signaling pathway and prevents ischemia-induced apoptosis (Sun et al., 2012). It also increases the phosphorylation of Akt, eNOS, and FOXO3a and helps in the longevity of protein SIRT1 and also in myocardial protection against ischemia (Samuel et al., 2008).

3. ***Eleutherococcus***: contains seven or more different glycosides higher in stems and in root than the other part of a plant which is named eleutherosides B & E. Eleutherosides B and E have been obtained in crystal form. Eleutheroside-B is a mono- or bioside whereas Eleutheroside-E is a tri- or a tetraoside (Ovodov et al., 1965).

From the seed of *Schisandra chinensis*, two substances were isolated – deoxyschizandrin and pseudo-gama-schizandrin and they belong to a new group of natural substances derived from 5,6,7,8-tetrahydrodibenzo [a, c] cyclooctate (Kochetkov et al., 1964).

From the berry of *Panax ginseng* the ginsenosides and triterpenes were isolated. According to Zhao et al. (1991), it is point out as 20(R)-ginsenoside-Rh2 (anti-carcinogenic) and later, the other four were beta-sitosterol, 20(R)-protopanaxatriol,

daucosterine, and 20(R) ginsenoside-Rg3 by Zhao et al. (1993). Where triterpene monoglucoside were name as isoginsenoside-Rh(3) by Wang et al(2004) (Lee, et al., 2010). The extract of saponin from Indian ginseng was found more effective than Korean ginseng (Dua et al., 1989).

Indian ginseng *Withania somnifera* is known as Ashwagandha and is classified as rasayana in Ayurveda (Kulkarni & Dhir, 2008). The chemical constituents of *Withania somnifera* are alkaloids (isopellertierine, anferine), steroidal lactones (withanolides, withaferin), saponin containing an acyl group (sitoindoside vii and viii) withanolides with glucose (sitonidoside xi and x) (Singh et al., 2010).

Emblica officinalis (Amla) has various nutraceutical properties due to the presence of adaptogenic compounds like hydrolyzable tannin (emblicanin A & B, punigluconin, pedunculagin, ellagitannin), an alkaloid (Phyllantine, phyllembin, phyllantidine), phenolic compound (gallic acid, methyl gallate, ellagic acid, trigallayl glucose) (Dasaroju & Gottumukkala, 2014).

Ocimum basilicum (Basil) shows an adaptogenic effect due to its constituent of triterpenoid (ursolic acid, rosmarinic acid), alkaloid, saponin, flavonoids (apigenin, luteolin, and glycosides) and tannin (Wohlmuth, 2004).

Great cardamom (*Amomum subulatum Roxb.*) is used in Ayurved and unani since age. The seeds contain α and β pinene, gamma terpinene, sebinene, cardamonin, alpinetin, tannin, flavonoid and saponin, glycosides, and subulin. Due to its composition great cardamom possesses cardio-adaptogenic properties (Verma et al., 2010).

Salidroside, Eleutheroside-E, and Schisandrin-B resemble the same structure as catecholamines and act as mediators between the sympathetic nervous system and adrenal medulla which helps to stimulate the stress system in early response to stress (Panossian et al., 1999). Cucurbitacin -R-diglucoside, Phytosterol-glycoside (Eleutheroside-A, Sitoindosides), and ginsenosides, they structurally similar to corticosteroids a stress hormone associated with the inactivation of stress system (Munck et al., 1984). And rosiridin from *Rhodiola rosea*, inhibits the monoamine oxidase A and B in in-vitro and which play an effective role in depression and in mental illness (Van Diermen et al., 2009).

V. CLINICAL TRIALS

Bryonia Extract is very effective in treating workers of the Chernobyl nuclear reactor suffering from vegetovascular dystonia and other associated illnesses. It helps to prevent radiation-induced disorders like pericarditis and cytostatic side effects in cancer treatment. It is also used in athletes to increase their endurance, efficiency, and heart rate restoration (Panossian et al., 1997).

Studies found that **Rhodiola** helps to generate resistance against physical, chemical, and biological stressors in rats and other animal. Some results also show cardioprotective and anticancer benefits in animals and it also increases the swimming time (Adaptogen, 2001). According to Linnaeus, R rosea acts as a constringent and is used in the treatment of hernia,

leucorrhea, and hysteria [9]. The histopathological and clinical score evaluation of *R. rosea*. An animal model shows an adaptogenic effect on autoimmune encephalomyelitis, by decreasing IL-6, IL-6R, IFN- γ , and IL-17 and increasing IL-14 in splenocyte supernatants, and also inhibiting Th-1 and TH-17 cells, and regulating JAK1, JAK2, STAT3, and ROR γ t in mice spinal cord (Lin et al., 2020).

Eleutherosides E of *Eleutherococcus* is effective on hyperglycemia and insulin resistance in db/db mice and also increases the insulin provoke glucose uptake in C2C12 myotube. And it also improves TNF-alpha-induced suppression of glucose spikes in 3T3-L1 adipocytes. A study has also shown that Eleutherosides E increases the metabolism of hepatic glucose by regulating glycolysis and gluconeogenesis in type-2 diabetic obese mice (Ahn et al., 2013).

Schisandra chinensis is very effective in CNS, immune, respiratory, cardiovascular system, and gastrointestinal systems, and on atherosclerosis, blood glucose, and neuromuscular conditions (Panossian & Wikman, 2008). The methanolic extract of *S. chinensis* fruit reduces the toxicity of cortical cells induced by L-glutamate in rats due to its adaptogenic agent dibenzo cyclooctadiene lignin. This lignin consists of deoxyschisandrin, gomisins-N, gomisins-A, schisandrin and wuweizisu-C. Out of these five lignins, only three of them deoxyschisandrin, gomisins, and wuweizisu-C may help to overcome the neurotoxicity effect produced by L-glutamate. It is due to the increase of calcium ion intracellularly, and by reducing glutathione peroxidase, and also inhibits the unwanted cellular oxidation by H₂O₂. This effect shows that *S. chinensis* plays an effective role in minimizing neurotoxicity in the cortical cell (Kim et al., 2014).

The berry of *Panax ginseng* is used as an anti-diabetic agent (Lee et al., 2010). It also plays a role in brain function, pain relieving effect, anti-tumor activity, and also enhances liver function and anti-stress and anti-fatigue (CHOI, 2008). Ginseng plays an important role in liver protection from cadmium chloride poisoning, it decreases LPO (lipid peroxidation), GOT (glutamic oxaloacetate transaminase), and GPT (glutamine pyruvic transaminase) (Shukla & Kumar, 2009).

Indian ginseng *Witania somnifera* has a lot of pharmacological profile and helps in anti-cancer activity, anti-inflammatory effect, anti-oxidant effect, anti-microbial activity, and have also anti-arthritis properties (Mir et al., 2012).

Emblica officinalis is very effective against free radical scavenging. It elevates the hepatic antioxidant system and promotes procollagen production and inhibits MMP-1 in human skin fibroblasts, it is also effective in preventing ischemic reperfusion oxidative stress. It has a cytoprotective and immune modulatory effect (Chen et al., 2008).

The aqueous extract of amla reduces cytophospane (a cancer drug) which is involved in the suppression of humoral immunity. The extract reduces the level of cytochrome (cyt) P450 and increases glutathione and glutathione peroxidase, glutathione reductase, and increases the enzyme associated with detoxification. The study shows that the amla extract suppresses the proliferation of lung (A549) and hepatic (HepG2) carcinoma (Baliga & Dsouza, 2011).

The powder of peruvia maca (*Lepidium meyenii*) is effective in the treatment of a wide range of diseases and clinical conditions sexual dysfunction regulation, neuroprotection and memory enhancement, skin protection, and as an anti-depressant (Peres et al., 2020).

The adaptogens of Basil (*Ocimum basilicum*) leaf extract shows effective action against oxidative damage by free radical in cataract, and also helps in immune modulatory activity, chemo-preventive activity, reduces chromosome aberration, antioxidant activity, radioprotective and also as anti-stress agent.

Great cardamom (*Amomum subulatum Roxb.*) seed powder has been found to have a great effect as an anti-stress agent and also effective in myocardial stress damage by stress and is also known to increase the swimming time in guinea pigs (used as sample). And also studied that, great cardamom is also effective against 1,1-diphenylpicrylhydrazyl (DPPH) to prevent radical scavenging. According to Sarkar Limited (1 teaspoon), regular consumption of cardamom powder may help to improve the problem of ischemic heart disease (IHD) (Verma et al., 2010).

VI. ACTIONS OF ADAPTOGEN

- 1. Antioxidant Evaluation of Adaptogens:** The extract of three adaptogens has antioxidant action. The extract of *Rhodiola rosea* (golden root), *E. senticosus*, and *Emblca officinalis* (Amla). The studies show that *R. rosea* has a high potential for single oxygen scavenging, H₂O₂ scavenging, ferric reduction, ferrous chelate, and protein thiol protection in comparison to the other two. A high level of polyphenols may decrease the complications produced by oxidative stress (Chen et al., 2008).
- 2. Anti-Stress Effect of Adaptogen:** Adaptogens are interconnected with the neuroendocrine and immune systems of the body, and the stress system regulated by the hypothalamic pituitary adrenal (HPA) axis. Adaptogens have an amphoteric effect which can reduce the activity of the CNS (Central Nervous System), immune system, HPA, and SAS (Sympathoadrenal system). They decrease the incidence of harmful side effects of stress on the body (Winston, 2019). The *Fig.1* illustrates the actions of the Adaptogens.

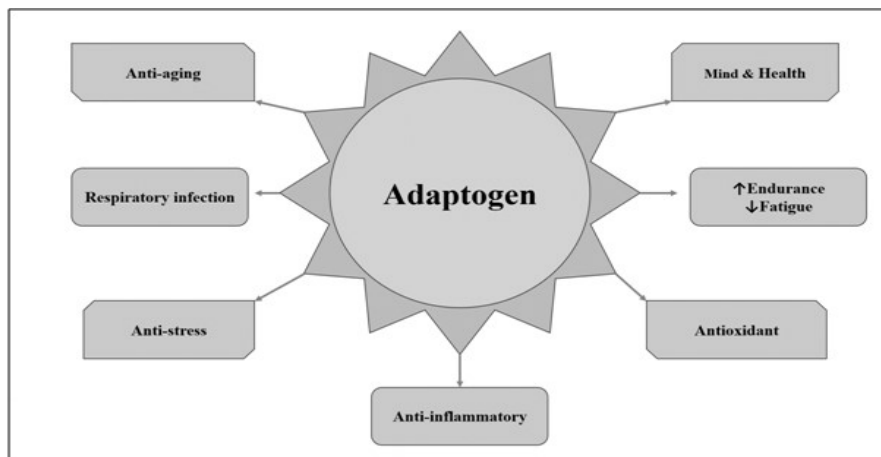


Figure 1: The Actions of the Adaptogens

3. **Health and Well-Being and Anti-Aging:** Some adaptogens like ginseng, and ashwagandha have anabolic effects by increasing adaptive energy. This quality of adaptogens is very important in athletic training and bodybuilding. They induce the ATP in mitochondria for energy production. They also obstruct cortisol-induced mitochondrial dysfunction. They enhance energy from the liver by using hepatoprotective adaptogen and also help to excrete metabolic waste. They inhibit the aging process by reducing wear and tear on the body and they are also effective in cellular inflammation (Winston, 2019).
4. **The Action of Adaptogen on Respiratory Infection:** The adaptogen of *Andrographis paniculata* (kulekhara), *E.senticosus*, *Panax spp*, *R rosea*, and *S chinensis* is effective in the treatment of viral infection prophylaxis and also very effective in respiratory infection (Panossian & Brendler, 2020).
5. **Interaction between Mind and Health:** Adaptogens found to have a significant role in the homeostasis of the body and mind to regulate and maintain the interaction between the brain and peripheral nervous system, by affecting HPA, SAS, and HPG (Hypothalamic pituitary gonadal) axis and control both physical and psychological health (Winston, 2019).
6. **Adaptogen in Fatigue and Increases Endurance:** SHR-5 extract boosts cognitive and mental function in chronic fatigue syndrome, where *S chinensis* and *E Senticosus* increases endurance as well as mental performance in mild fatigue weak patient. An adaptogen helps to maintain the homeostasis of the body through various mechanisms in association with the HPA-axis and JNK1, Hsp70, Forkhead Fox O transcription factor DAF-16, cortisol, and Nitric oxide (NO). Phyto adaptogen regulates stress sensor protein HSP70 which helps in cell activity and apoptosis. HSP-70 suppresses NO synthase-II gene which connects glucocorticoid receptors with the help of the JNK pathway and actively affects the level of cortisol and NO. When NO increases, ATP production goes down in stress and results in increased endurance. Adaptogens act as resistant to stress as they induce HSP70, JNK-1, and DAF-16 and help to increase longevity and work performance (Panossian & Wikman, 2009). It is shown that ADAPT reduces the accumulation of Hsp70 protein by shifting it into the liver from the heart muscle (Prodius et al., 1997).
7. **Adaptogen in Inflammatory Reduction:** *Panax ginseng* is traditionally used in Asian and Western countries. The most biologically active constituent of ginseng is ginsenoside. The derivatives of ginsenoside include (g)-Rb1, G-Rb2, G-Rd, G-Re, G-Rg1, GRg3, GRg5, G-Rh1, GRh2, and G-Rp1 is effective in inflammation and it inhibits the production of pro-inflammatory cytokines and regulates the pathway. Such as factor-kB and activator-protein-1. This study shows that ginsenoside has an effective role in inflammation (Kim et al., 2017). **Fig. 2** illustrates the health benefits of Adaptogen and Functional foods

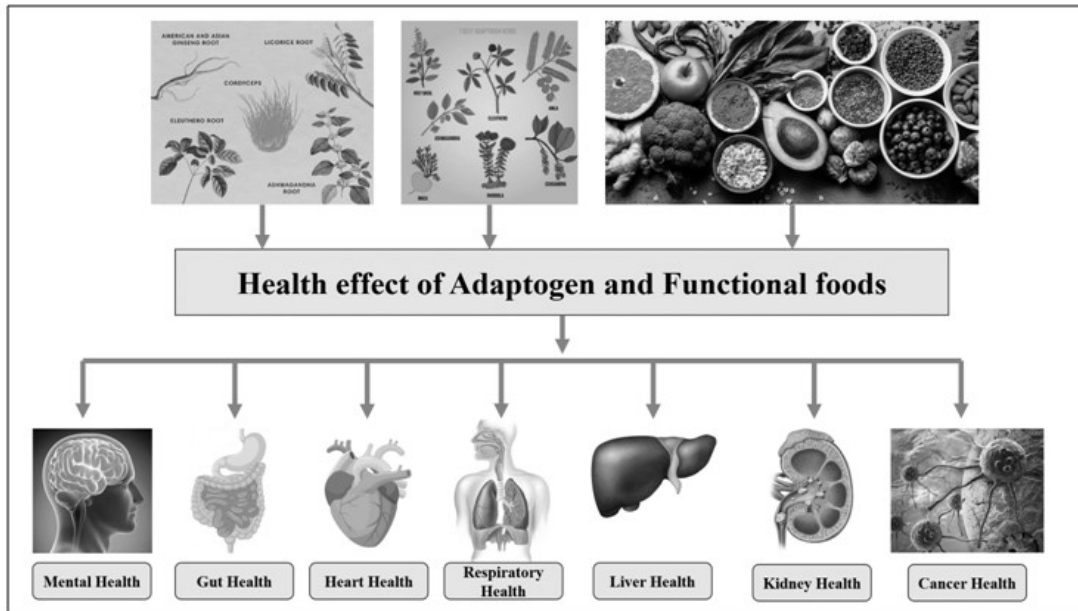


Figure 2: The Health Benefits of Adaptogen and Functional Foods

VII. CONCLUSION

Microflora may also be damaged due to excessive use of antibiotics, but functional food like prebiotics and probiotics helps to improve the macrofloral gut and improve the body's health. Some foods rich in probiotics, selenium, and antioxidant vitamins like vitamin A, vitamin C, and vitamin E play a role in the enhancement of the immune function of the body. Polyphenol curcumin and epigallocatechin gallate activate and regulate the signaling pathway to immune response and stimulate epigenetic changes.

Pomegranate a fruit that contains polyphenolic compounds like punicalagin, penicillins, gallagic acid, and ellagic acid has strong results against CVD, diabetes, and prostate cancer. Flaxseed has potential health benefits due to its constituent α -linolenic acid, lignan, and fibers, which help minimize the risk of CVD, diabetes, immune disorder, and atherosclerosis. Cereal brands are the end product of grain processing and have functional food properties due to their constituent of arabinoxylan, β -glucan, ferulic acid, anthocyanin, oil (γ -oryzanol), and carotenoid, and others. They are effective in lowering cholesterol, atherogenesis, and diabetes and reduce insulin resistance and obesity.

Adaptogens are plant extract non-toxic chemical substance that increases the ability of the body to combat the damaging effects of stress and helps in body homeostasis. It is also used in herbal medicine for claimed stabilization of the physiological process. Adaptogens can activate the protective mechanism of cells, which helps to increase the survival rate of cells both in vitro and in vivo. Adaptogens also play a vital role in overcoming fatigue, depression, anxiety, sexual problems, nervous system problems, and some other chronic diseases. The chapter has concluded the potential health benefits of both adaptogens and functional foods.

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