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REVIEW

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Bioactive Components and Chemical Constituents of Some Important Legumes in Traditional Medicine

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Legumes in traditional medicine play a key role in the world. In majority of countries, especially in Iran and China, western and traditional medicine has been practiced side by side of each other. The aim of this study is to review bioactive components and chemical constituents of some important legumes in East of Asia. All relevant papers in English language of researchers and scholars from various countries gathered. The soybean itself is composed of approximately 40% protein, 20% oil, 35% carbohydrates, and 5% trace minerals and other compounds. The most important functional components of soy are α-Linolenic acid, isoflavones, lecithins, lectins, linoleic acid, peptides, phytosterols, protein and saponin. Peanuts are considered an important source of oil, folate, antioxidants, protein, and essential fatty acids (linoleic), and it ranked fourth in oilseed crops in the world after soybeans, rapeseed, and cotton. Peanuts are considered an important source of oil, folate, antioxidants, protein, and essential fatty acids (linoleic), and it ranked fourth in oilseed crops in the world after soybeans, rapeseed, and cotton. It has been revealed the presence of flavonoids, tannins, terpenoids, saponins, steroids, alkaloids by positive reaction with the respective test reagent. Cow peas are valuable source of protein, carbohydrate, mineral and vitamins, and it also contain biologically active components including phenols, phytic acid, saponin, oligosaccharides, fiber and etc. Nutrition therapy according to traditional Asian medicine by considering tremendous benefits of legumes is quite effective at not only treating common diseases, but also its prevention.

Key words: Soybean; Peanuts; Cowpea; Bioactive Components; Legume; Traditional Medicine

Legumes are indispensable for human diet in respect to their valuable and nutritive bioactive molecules (Soleymani *et al.*, 2011a,b,c; Soleymani and Shahrajabian, 2012; Soleymani *et al.*, 2012a,b; Yong *et al.*, 2018). Among the species of medicinal plants, some are mainly confined to folk medicine and some are used as occasional or local substitutes for the main species listed in the Materia Medica (Soleymani and Shahajabian, 2018; Sun *et al.*, 2019a,b; Shahrajabian *et al.*, 2019a,b,c; Shahrajabian *et al.*, 2021a,b,c,d). Traditional Chinese medicine (TCM) has a history of thousands of years it is formed by summarizing the precious experience of understanding life, maintaining health, and fighting diseases accumulated in daily life, production and medical practice (Ogbaji *et al.*, 2013; Ogbaji *et al.*, 2018; Shahrajabian *et al.*, 2019d,e,f,g,h,I; Sun *et al.*, 2021a,b,c). Soybean has been one of the most important sources of vegetable-sourced proteins (Ziegler *et al.*, 2016). The soybean (*Glycine Max*. (L.) *Merrill*) is a leguminous which has been originated from China and has been cultivated for more than five thousand years and it has been considered as a stable food in many countries of East of Asia. Soybean are suggested to have many health benefits such as the healthy functioning of bowels, heart, kidney, liver, lowering of serum cholesterol levels and reduction in the risk for coronary heart disease (CHD), reduction in the risk for breast cancer, and osteoporosis in women, and alleviation of the disturbances caused by menopause (Oyvind *et al.*, 2006) [23]. Peanuts or groundnuts as they are known in some parts of the world are the edible seeds of a legume. Commercially, it is used mainly for oil production but apart from oil, the by-products of peanut contains many other functional compounds like proteins, fibers, polyphenols, antioxidants, vitamins and minerals which can be added as a functional ingredient into many processed foods (Arya *et al.*, 2016; Chukwumah *et al.*, 2007; Wu *et al.*, 2015; Zahran and Tawfeuk, 2019). Cow pea is commonly cultivated as a nutritious and highly palatable food source in Asia, the Middle East, the USA and throughout the tropics and subtropics. It can be used as forage, hay, and silage (Wu *et al.*, 2015).

SOYBEAN

Sitohy and Osman (2018) reported glycinin, basic subunit, and β-conglycinin isolated from soybean protein. Their results suggest that a soy protein fraction containing mainly β-conglycinin can be used as an effective environmentally friendly fungicidal agent against postharvest fungal infections. Isanga and Zhang (2008) in their research has implicated soybean phytochemicals as functioning in cholesterol reduction, cardiovascular disease prevention, diabetic symptoms prevention, bone loss prevention, and cancer prevention. However, some bioactive compounds in soybean are reported to have some adverse effects to health. Soybeans have various bioactive compounds such as saponins, protease inhibitors, phytic acid, and isoflavones (Setchell *et al.*, 2003). The most important isoflavones in soy is genisteinl; and others are composed by daidzein and glycitein, and the metabolism of isoflavones is different from that of parent compounds (Markiewicz *et al.*, 1993). Soy isoflavones have weak estrogens, and they can function as agonists, partial agonists, or antagonists to endogenous estrogens and xenoestrogens at estrogen receptors (Tikkanen *et al.*, 1998; Ishii and Tanizawa, 2006). Filho *et al.* (2014) stated that the conversion of isoflavone was influenced directly by the characteristics of each sample, inhibiting or promoting the action of the enzyme. Silva and Perrone (2018) concluded that soybean meals presented 43% higher protein content, from 29% to 101% higher bioactive compounds contents and 52% higher antioxidant capacity than soybeans. High moisture thermal procedure employed during soybean meal processing led to a 13-fold increase in aglycone isoflavones contents, which could affect the bioavailability of isoflavones in the residue. They have concluded that dry soybean meal extracts are suitable materials for performing long-term in vivo studies, as these extracts were stable when stored at room temperature unprotected from light for 180 days. Vernaza *et al.* (2012) reported that consumption of soybean has been linked to cholesterol reduction and prevention of cardiovascular and gastrointestinal diseases, cancer, diabetes and obesity. They have found that the health benefits of soy are attributed to the presence of bioactive compounds such as isoflavones, saponins, lunasin and others. Lokuruka (2011) concluded that many of the chemical reactions affecting amino acid residues are often accompanied by protein-protein interactions involving formation of covalent bonds, which may reduce their bioavailability. Excessive thermal denaturation and heat-induced interactions may from mutagenic and toxic compounds. Hydrogenation results in the formation of the hypercholesterolemic trans fatty acids isomers implying potential loss of the unsaturated essential fatty acids. He concluded processing can cause changes in the sensory appeal and the nutritive value of soybeans and soy products, and to minimize the adverse changes, minimal washing, fermentation and thermal processing below 100°C for short periods are suggested, although the higher temperatures used during soy oil hydrogenation will unavoidably introduce health-related adverse changes. Martino *et al.* (2019) found that a 50% substitution of casein with soybean protein reduced lipid peroxidation and liver fat, and improved intestinal morphology, while a 100% substitution reduced cholesterol and triglyceride levels; therefore, whole soybean, a source of vitamin E and isoflavone, is a functional food, which has cardio-protective effects and reduces cardiovascular disease risk associated with oxidative stress. Chatterjee *et al.* (2018) showed that some soy peptides like lunasin and soy morphins possess more than one of the properties and play a role in the prevention of multiple chronic diseases. Meghwal and Sahu (2015) revealed that isoflavones are the most abundant phytoestrogen in soybeans which are structurally similar with 17 β-estradiol. The antioxidant property of genistein and daidzein are well established in different experimental and clinical models. Isoflavones compounds have been found effective in the management of diabetes. It reduces low-density lipoprotein and triglycerides and hence minimizes the risk of coronary heart disease. Soy isoflavones was found useful for treatment of osteoporosis by inhibiting tyrosine kinase. In soy isoflavones, genistein is effective in the treatment of cancer by acting on androgen receptor and inhbiting tyrosine kinases. Many nutraceuitical and medicinal uses and applications of soy isoflavones have been investigated such as treatment and prevention of cardiovascular diseases, cholesterol lowering, osteoporosis, diabetes, cancer, cognitive decline, and menopausal symptoms. Content of vitamin E, total phenols and isoflavone of whole soybean flour is presented in Table 1. Comparison of levels of some bioactive compounds (%) from different saponified deodorizer distillate sources is shown in Table 2. Composition of unsaponified deodorizer distillates (%) obtained from chemical or physical refining of different soft oils is presented in Table 3. Various soybean fermented foods and their processing is presented in Table 4. Fatty acid composition of soybean oil (SO) and fully hydrogenated soybean oil is shown in Table 5. Sterols profile of the bioactive compounds loaded in the lipid nanoparticles is presented in Table 6.

Table 1. Content of vitamin E, total phenols, and isoflavone of whole soybean flour (Martino *et al.*, 2019).

Phytochemical	Amount
Vitamin E (mg/100 g)	3.84
α-tocopherol	0.42
γ-tocopherol	2.53
δ-tocopherol	0.89
Total phenols (mg de EAG/100g)	60
Isoflavones (mg/g)	1,566.81
Daidzein	658.23
Genistein	753.34
Glicitein	155.25

Table 2. Comparison of levels of some bioactive compounds (%) from different saponified deodorizer distillate sources (Winter, 1990).

Bioactive compounds	Deodorizer Distillates			
	Sunflower	Cotton	Soybean	Rapeseed
Unsaponifiables matter	39.0	42.0	33.0	35.0
Tocopherols	9.30	11.40	11.10	8.20
α-Tocopherols	5.70	6.30	0.90	1.40
Sterols	18.0	20.0	18.0	14.60
Stigmasterol	2.90	0.30	4.40	1.80

Mean values of replicate samples.

Table 3. Composition of unsaponified deodorizer distillates (%) obtained from chemical or physical refining of different soft oils (Verleyn *et al.*, 2001; Dumont and Narine, 2007).

Bioactive compounds	Soybean	Corn	Sunflower	Sunflower	Rapeseed	Rapeseed
	Chemical	Physical	Physical	Chemical	Physical	Chemical
δ-Tocopherol	4.4-5.6	2.0	0.1	n.d.*	n.d.	0.2-0.3
β-Tocopherol	0.4-0.5	n.d.	0.1	n.d.	n.d.	0.1-0.2
γ-Tocopherol	10.7-11.3	5.0	1.1-2.8	0.3	0.1	2.3-2.5
α-Tocopherol	0.8	0.5	0.2-0.4	4.8	1.2	0.9-1.4
Total Tocopherols	16.3-18.2	7.5	1.5-3.4	5.1	1.3	3.5-4.4
Brassicasterol	n.d.	n.d.	n.d.	n.d.	n.d.	1.6-2.8
Campesterol	5.1-5.7	1.9	0.8-1.7	1.6	0.5	2.9-4.4
Stigmasterol	4.1-4.8	1.4	0.2-0.4	2.0	0.6	n.d.
β-Sitosterol	7.9-8.3	3.0	1.7-3.4	8.6	2.6	4.1-6.2
Other sterols**	n.d.	n.d.	n.d.	1.7	0.6	n.d.
Steryl esters	2.3-2.6	4.5	0.6	0.3	0.1	1.4-5.3
Total sterols	19.4-21.4	10.8	3.3-6.1	14.2	4.4	10.0-18.7
Mono-acylglycerols	1.2-1.9	1.9	0.1	0.9	n.d.	1.4-2.1
Diacylglycerols	2.7-3.8	8.1	0.5-1.3	1.9	0.7	3.8-3.9
Triacylglycerols	5.1-5.9	3.8	0.1-0.8	2.6	2.7	3.0-7.5
FFA (as C18:1)	33	73.8	77.-81	9.2	70.8	39-42
Squalene	1.3-2.1	0.6	0.2-1.0	0.7	1.0	0.1-0.4

n.d.*, Not detected
**Δ5 avenasterol, Δ7 avenasterol and Δ5 stigmasterol

Table 4. Various soybean fermented foods and their processing (Varnosfaderani *et al.*, 2019).

Name	Definition and Production
Doenjang	Doenjang is a representative traditional Korean fermented food that has played an important role in providing protein in typically graincentered, protein-scarce diets. It is prepared by fermented soybean paste.
Sufu	Sufu is a traditional and highly flavored fermented tofu. Its preparation consists of a former fermentation by inoculation of tofu with *Actinomucor elegans* and incubation for 48 h to produce pehtze (pizi). Fermentation is usually performed between 20° C and 35° C.
Miso	Miso is commonly produced from koji. Soybean koji can be prepared by soaking soybeans in water and mixing with the conidia of *A. oryzae* or *A. sojae* and incubated at room temperature.
Natto	Natto is a *B. subtilis* fermented soybean. Its preparation consists of splitting, soaking, and boiling of soybeans, followed by fermentation with *B. subtilis* at 37° C for 48 h.
Tempeh	Tempeh is produced by soaking soybeans at room temperature for 10-12 h and dehulling them by hand. They are heated up to the boiling point and boiled for 20 min. After colling to 35-40°C, and inoculums of *R. oligosporus* for incubation in the dark at 37° C for 22 h.
Douchi	Douchi is prepared by soaking soybeans in water for 8 h at room temperature; after raining, soybeans are cooked (>100°C) and then inoculated either with Mucor, Bacteria, or Aspergillus strains at 30-35°C (pre-fermentation)
Tofuyo	Tofuyo is a traditional fermented tofu from Okinawa in Japan.
Chunggugjang	Chunggugjang is a traditional fermented Korean soybean product.

Aspergillus= A, *B. subtilis*= *Bacillus subtilis*, *R. oligosporus*= *Rhizopus oligosporus*

Table 5. Fatty acid composition of soybean oil (SO) and fully hydrogenated soybean oil (FHSO) (Santos *et al.*, 2019).

Fatty acids (%)	SO[a]	FHSO[a]
C16:0- Palmitic acid	10.70 ± 1.12	11.22 ± 0.50
C16:1- Palmitoleic acid	0.09 ± 0.02	-
C18:0- Stearic acid	4.26 ± 0.26	87.11 ± 0.06
C18:1- Oleic acid	23.38 ± 0.96	-
C18:2- Linoleic acid	53.32 ± 0.58	-
C18:3- Linolenic acid	6.66 ± 0.10	-
C20:0- Arachidonic acid	0.41 ± 0.03	0.60 ± 0.18
C22:0- Behenic acid	-	0.75 ± 0.28
Σ Saturated	15.83	100
Σ Unsaturated	83.45	<1

[a] Average of three replicates ± Standard Deviation. Values 0.2% were omitted from the table.

Table 6. Sterols profile of the bioactive compounds loaded in the lipid nanoparticles (Santos *et al.*, 2019).

Composition of free phytosterols	(%)[a]
Cholesterol	0.60 ± 0.02
Brassicasterol	0.30 ± 0.01
Campesterol	23.56 ± 0.23
Campestanol	0.66 ± 0.11
Stigmasterol	26.77 ± 0.22
Δ-7-Campesterol	0.78 ± 0.04
Δ-5,23-Stigmastadienol	0.48 ± 0.01
β-Sitosterol	44.05 ± 0.15
Sitostanol	1.18 ± 0.08
Δ-5-Avenasterol	0.84 ± 0.04
Δ-5-24-Stigmastadienol	0.14 ± 0.01
Δ-Stigmastenol	0.47 ± 0.02
Δ-7-Avenasterol	0.68 ± 0.01
Total of phytosterols	98.00

[a] Average of three replicates ± Standard Deviation

Kunitz-Trypsin inhibitor (KTI), Bowman-Birk inhibitor (BBI), and lunasin are three major and best characterized bioactive proteins/peptides of soybean seeds (Park *et al.*, 2005). KTI and BBI are serine protease inhibitors with molecular weights of 20.1 and 8 kDa, respectively [47]. Both of these proteins have been shown to exhibit anti-carcinogenic and/or anti-invasive metastatic activities (Isanga and Zhang, 2007; Dia *et al.*, 2012). Two essential fatty acid (EFAs) present in soy oil is presented in Figure 1. Functional components of soy and their impact is shown in Table 7. Soy phytosterols and their structural similarity with cholesterol are presented in Figure 2. Duenas *et al.* (2012) observed that fermentation process caused significant changes in the phenolic composition of soybean seeds, and therefore, it could also affect the beneficial biological effects associated with these components. These changes could be due to enzymes production and activation by the microbiota used in order to perform the fermentation process, brining out complex biochemical metabolism of soybean during the process. In general, the fermentation process produced a significant increase in the levels of the phenolic acids and flavonoids, mainly aglycones isoflavones. The chemical structure and types of soy sapnins is shown in Figure 3. Bioactive peptide production from legume sources as anticancer agents is shown in Figure 4. Structure of genistein, daidzein and glycitein is shown in Figure 5. Structure of glyceollins is presented in Figure 6.

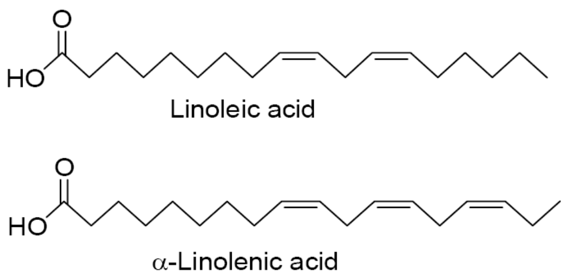


Fig. 1. Two essential fatty acid (EFAs) present in soy oil (Dixit *et al.*, 2011).

Table 7. Functional components of soy and their impact (Sugano, 2006).

α-Linolenic acid	Essential fatty acid, hyptriglyceridemic, improves heart health
Isoflavones	Estrogenic, hypocholesterolemic, improves digestive tract function, prevents breast, prostate, and colon cancer, bone health, improve lipid metabolism
Lecithins	Improve lipid metabolism, improve memory and learning abilities
Lectins	Anti-carcinogenic, immunostimulator
Linoleic acid	Essential fatty acid, hypocholesterolemic
Peptides	Readily absorbed, reduce body fat, anticancer
Phytosterols	Hypocholesterolemic, improves prostate cancer
Protein	Hypocholesterolemic, antiatherogenic, reduces body fat
Saponin	Regulates lipid metabolism, antioxidant

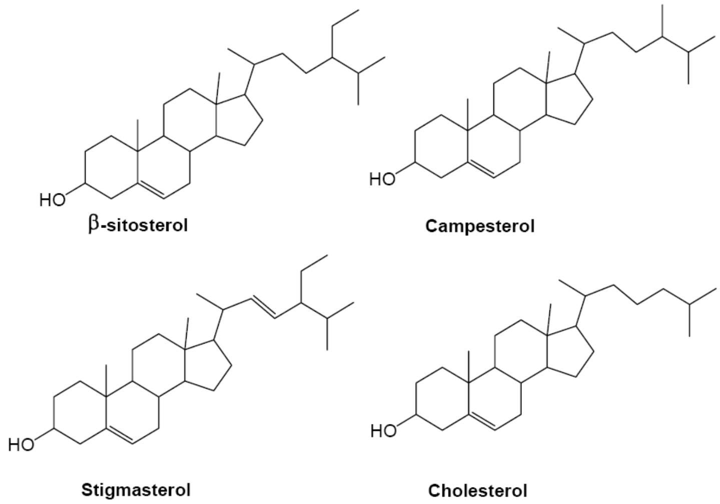
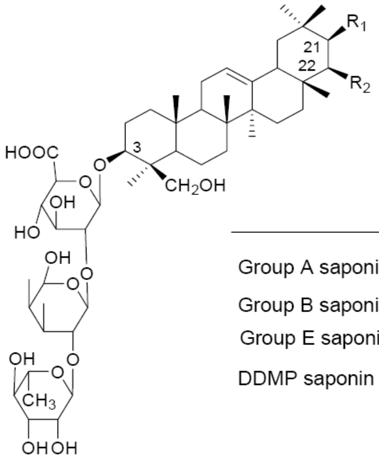


Fig. 2. Soy phytosterols and their structural similarity with cholesterol (Dixit *et al.*, 2011).



	R_1	R_2
Group A saponin	OH	Disaccharide
Group B saponin	H	OH
Group E saponin	H	=O
DDMP saponin	H	Maltol

Fig. 3. The chemical structure and types of soy saponins (Dixit *et al.*, 2011).

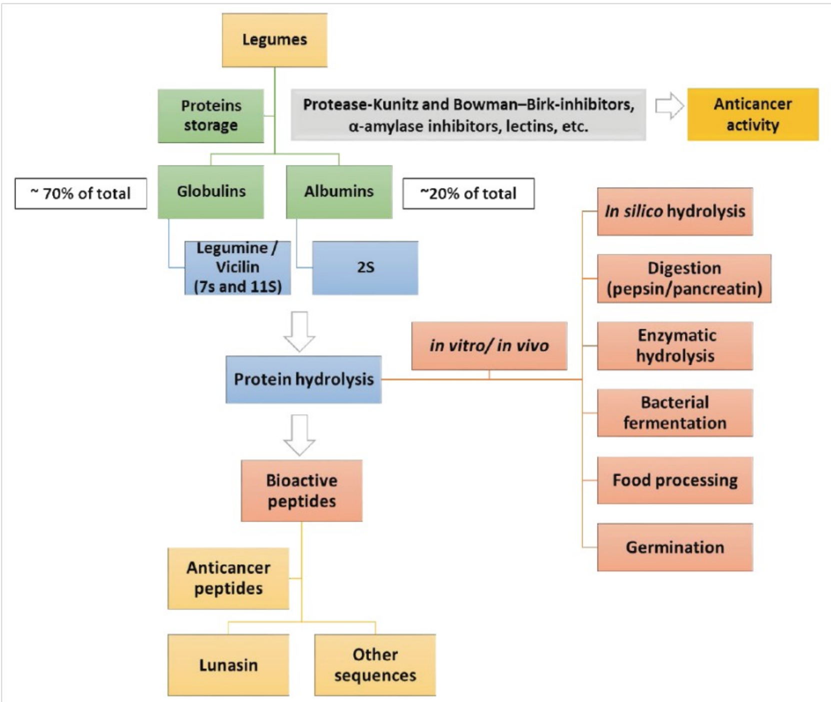


Fig. 4. Bioactive peptide production from legume sources as anticancer agents (Marcela *et al.*, 2017).

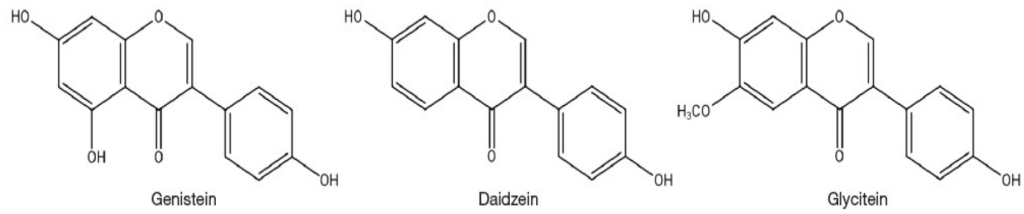


Fig. 5. Structure of genistein, daidzein and glycitein (Wu *et al.*, 2017).

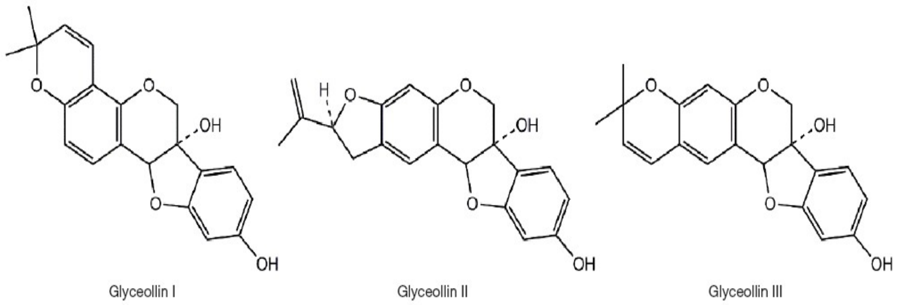


Fig. 6. Structure of glyceollins (Wu *et al.*, 2017).

PEANUTS

Peanut is one of the most widely used legumes due to its nutrition and taste, and it has been recognized recently as a functional food (Francisco and Resurreccion, 2008). The peanut industry 's byproducts such as peanut hulls and shells, skins, and even leaves and roots have also been identified as possible sources of bioactive compounds (Bhat *et al.*, 2019). Peanuts are also a source of helpful biologically active components found in plant foods, such as phytochemicals. Some of the phytochemicals in peanuts include flavonoids and phenolic compounds. This article discusses bioactive compounds and nutraceuticals in peanuts that could be used in prevention and management of illnesses such as cancer, cardiovascular disease, osteoporosis, and other degenerative diseases. The biological activity of anti-nutritional factors in peanuts is also briefly discussed (Isanga and Zhang, 2007). The most important bioactive compounds in s a hell of peanut is 1) arginine: an amino acid with high levels in peanuts, is a precursor to nitric oxide, which helps expand blood vessels and decrease blood pressure, 2) Resveratrol: also found in grapes and wine, improves longevity and performance and reduces inflammation, 3) Phytosterols: are well-known for their ability to reduce cholesterol levels and research shows they have cancer-preventing qualities, 4) Phenolic acids: are found in plants and act as a defense mechanism for environmental stress and pest attacks. They may also defend our bodies and keep the bodies healthy, 5) Flavonoids: are the class of compounds found in peanuts that reduce inflammation and inhibit platelets from sticking to arteries. Bhat *et al.* (2019) reported that peanut consists of different functional components such as coenzyme Q10 which secures the heart amid absence of oxygen, for example at high altitudes and in case of clogged veins. Also, peanut possess various health benefits beyond basic nutrition. Peanuts act as efficiency source of dietary fiber, and other essential nutrients that include few B complex group of vitamins, vitamin E, minerals such as iron, zinc, potassium, magnesium and antioxidant minerals such as selenium, manganese and copper. The antioxidant activity of peanut is because of vitamin E, caffeic, coumaric acid, flavonoids and stilbenes, and these bioactive compounds possess preventative properties (Yu *et al.*, 2006). Akl *et al.* (2019) observed that the analysis of soluble and insoluble of peanut meal protein by native and SDS-PAGE showed peptide bands at low molecular weight in range (up to 25 kDa); which were extracted by acid and base treatments. These peptides were easily digested and were recommended as baby, sports people and geriatric food. The soluble extracts showed high contents of phenolic compounds especially that extracted by ethanol: 1N NaOH, and it also contains appreciable amounts of saponins and flavonoids that exhibited anti-oxidant activities especially DPPH scavenging activities 91% extracted by ethanol: 1N NaOH. The protein extract of 60% ethanol were the most effective on (MCF7) and 100% ethanol were the most effective on (HEPG2). Bioactive compounds in peanuts are shown in Figure 7. Groundnuts (*Arachis hypogae*), all types, nutritional value per 100 g is shown in Table 8. Components in nuts that are thought to be beneficial is presented in Table 9. The chemical structure of *trans*-resveratrol and *trans*-piceatannol is shown in Figure 8.

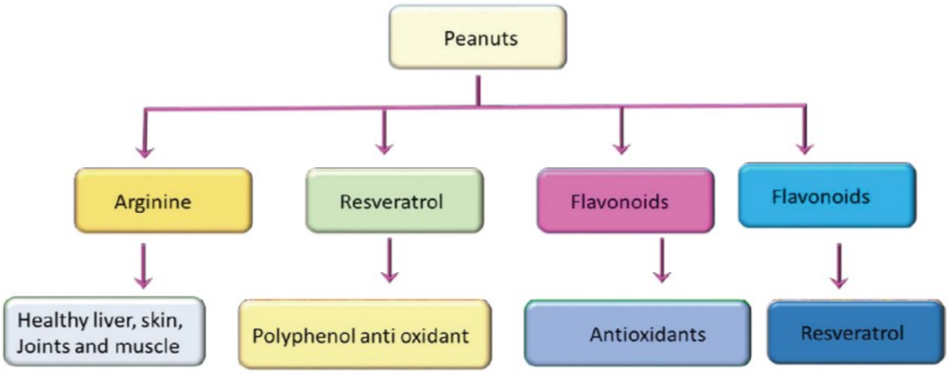


Fig. 7. Bioactive compounds in Peanuts (Bhat *et al.*, 2019).

Table 8. Groundnuts (*Arachis hypogae*), all types, nutritional value per 100 g (Bhat *et al.*, 2019).

Principle	Nutrient value	Percentage of RDA
Energy	567 Kcal	12
Carbohydrates	16.13g	12
Protein	25.80g	46
Total Fat	49.24g	165
Cholesterol	0 mg	0
Dietary Fiber	8.5 g	22
Vitamins		
Folates	240 µg	60
Niacin	12.066 mg	75
Pantothenic acid	1.767 mg	35
Pyridoxine	0.348 mg	27
Riboflavin	0.135 mg	10
Thiamin	0.640 mg	53
Vitamin A	0 IU	0
Vitamin C	0	0
Vitamin E	8.33 mg	55.5
Electrolytes		
Sodium	18 mg	1
Potassium	705 mg	15
Minerals		
Calcium	92 mg	9
Copper	1.144 mg	127
Iron	4.58 mg	57
Magnesium	168 mg	42
Manganese	1.934 mg	84
Phosphorus	76 mg	54
Selenium	7.2 µg	13
Zinc	3.27 mg	30

Source: USDA National Nutrient data base.

Table 9. Components in nuts that are thought to be beneficial (Kris-Etherton *et al.*, 1999).

n-6 and n-3 Monounsaturated and polyunsaturated fatty acids
Fiber
Micronutrients
Vitamin E
Folic acid
Copper
Magnesium
Plant protein (arginine)
Phytochemicals
Plant sterols

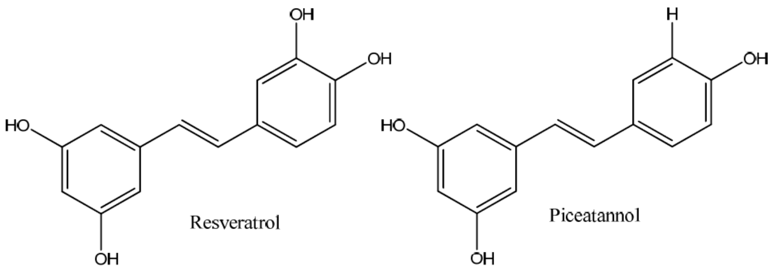


Fig. 8. The chemical structure of *trans*-resveratrol and *trans*-piceatannol (Lin *et al.*, 2007).

Table 10. Phytochemical screening of peel extracts of Arachis hypogeal (Velu *et al.*, 2015).

Secondary metabolites	Chloroform	Acetone	Ethanol	Methanol	Aqueous
Carbohydrates	+++	+++	+++	+++	+++
Tannins	-	+++	+++	+++	-
Saponins	-	-	+++	+++	-
Flavonoids	-	+++	+++	+++	+++
Alkaloids	-	+++	+++	+++	-
Betacyanin	-	+++	+++	+++	+
Quinones	-	+	+++	+	-
Glycosides	-	++	+++	+++	-
Cardiac Glycosides	-	-	-	-	-
Terpenoids	-	+	+	++	-
Triterpenoids	-	-	-	+	+
Phenols	+	+++	+++	+	+
Coumarins	-	+++	+++	+++	+
Acids	-	+	+	+	-
Protein	-	-	-	-	+++
Steroids	+	++	+++	+++	-

Table 11. Fatty acid composition of the peanut powder extracts with and without skin (Silva and Perrone, 2015).

Fatty acids (mg 100g^{-1} of lipids)	Peanut powder extract	peanut powder extract
	With skin	Without skin
Saturated	8.0000 ± 0.024	8.6203 ± 0.023
Palmitic C16:0	4.3346 ± 0.010	4.4486 ± 0.002
Stearic C18:0	1.2498 ± 0.003	1.2968 ± 0.005
Arachidic C20:0	0.6229 ± 0.002	0.6647 ± 0.005
Beenic C22:0	1.7927 ± 0.009	2.2102 ± 0.011
Monounsaturated	26.0094 ± 0.017	28.6719 ± 0.008
Oleic C18:1	25.3536 ± 0.014	27.9162 ± 0.002
Eicosenoic C20:1	0.6558 ± 0.003	0.7557 ± 0.006
Polyunsaturated	9.0854 ± 0.001	9.1751 ± 0.005
Linoleci C18:2	9.0854 ± 0.001	9.1751 ± 0.005

Note. Values expressed in mean ± standard deviation.

Velu *et al.* (2015) noted that phytochemical screening of the peel extract of *Arachis hypogaea* showed the presence of bioactive compounds such as tannins, saponin, flavonoids, alkaloids, glycosides, beta cyanin, coumarins, quinines and steroid. Silva and Perrone (2015) concluded that the bioactive compounds are found in larger amounts in the peanut powder extract with skin. The peanut powder extracts are classified as non-hygroscopic, have poor fluidity, intermediate cohesiveness in samples with skin and high cohesiveness in samples without skin. The peanut powder extracts have significant percentage of minerals like K, P, Mg, and Ca, and they are mainly composed of oleic and linoleic fatty acids. Lewis *et al.* (2013) showed that peanut skin extracts contain high levels of procyanidins and other phenolic compounds, whether extracted with acetone or ethanol. Despite measureable differences in procyanidin and phenolic content between the two extraction systems studied, both possessed similar antioxidant activity as determined by chemical assays and anti-inflammatory activity in an in vitro model of inflammation. Fatty acid composition of the peanut powder extracts with and without skin in Table 11.

COW PEA

Lee *et al.* (2011) evaluated anti-inflammatory effects of methanol extract and solvent fractions of cowpea (*Vigna sinensis* L.) seeds and the isolated compounds. In their experiment, ethyl acetate and *n*-butanol fractions of VS seeds were found to strongly inhibit nitric oxide (NO) production, and inducible nitric oxide synthase (iNOS) mRNA and protein expressions in lipoplysaccharides (LPS)-stimulated RAW 264.7 macrophage cells. Among the isolated compounds, Lna and LA were found to inhibit NO production significantly. Contents of LnA and LA in VS seeds were 2.034 and 1.162 mg/g on dry weight basis, respectively. LA suppressed the production of pro-inflammatory cytokines such as interleukin (IL)-1β, IL-6, and tumor necrosis factor (TNF)-α in LPS-induced macrophage cells. Cai et al. (2003) reported that the amount of protocatechuic acid increased from trace -3.6 to 9.3-92.7 mg/100 g of flour in the 17 varieties of cowpeas after hydrolysis. Six other phenolic acids, including, *p*-hydroxybenzoic acid, caffeic acid, *p*-coumaric acid, ferulic acids, 2,4-dimethoxybenzoic acid, and cinnamic acid, were also identified. Cowpea is an important food crop in tropical countries especially in west of Africa where it is a cheap source of dietary protein; the dry seed consists of about 25% protein and 67% carbohydrate, and it is also a good source of calcium, iron, vitamins and carotene. Dalaram (2015) stated that contains phenolic compounds and it is believed that it works synergistically to promote human health through their antioxidant properties and their ability to modulate the activity of various enzymes, and these phenolics are also potent inhibitors of α-amylase and α-glucosidase, the two important enzymes involved in the regulation of glucose homeostasis. Cowpeas are low in fat and high in protein, thus, the legume can prevent cardiovascular and metabolic diseases associated with high fats; furthermore, cowpeas are rich in thiamine, riboflavin, vitamins A and C, niacin, calcium, potassium, magnesium and carbohydrates (Chipurura et al., 2018). The major polyphenols common to all cowpea varieties are phenolic acids derivatives (148-1176 µg/g), and flavonol glycosides (27-1060 µg/g). Some varieties also contain anthocyanins (875-3860 µg/g), and flavan-3-ols (2155-6297 µg/g). The flava-3-ols (tannins) are dominated by monomers, mostly catechin-7-O-glucoside. Cowpea also contains beneficial bioactive peptides. Sombie et al. (2018) noticed that cowpea genotypes with colored seed coast showed the highest phenolic content, ferric reduction ability and anti-lipid peroxidation activities. In their experiment, it has been found that nitric oxide scavenging potential was found not be related to its total phenolic and total flavonoids content. 2,2-diphenyl-1-picrylhydrazyl (DPPH) and hydroxyl radicals scavenging potentials were not correlated with the total flavooids content. Compound detected in the extracts of flours, porridge and digested porridge (µg/g) is shown in Figure 9. Traditional Chinese herbs and medicines play vital role in sustainable agriculture and food systems (Adelakun and Duodu, 2017; Khoshkharam et al., 2020; Shahrajabian et al., 2020a,b,c,d,e; Shen et al., 2020; Sun et al., 2020a,b,c).

CONCLUSION

Pulses make a major share of the human diet in many regions of the world and play a significant role in the human nutrition, especially as source of protein, vitamins, minerals, dietary fiber and folic acid. Grain pulses also contain certain biologically active components including enzyme inhibitors, lectins, phytates, oligosaccharides, and phenolic compounds. Soybean comprises isoflavones, phytosterols, saponins, and other basic nutritive constituents, such as lipids, vitamins, minerals, oligosaccharides, and biological active peptides, that are of strong therapeutic values. The soybean itself is composed of approximately 40% protein, 20% oil, 35% carbohydrates, and 5% trace minerals and other compounds. Soy protein isolates and concentrates have been used to develop a range of food products including beverages and meat alternatives and they can be processed to function similarly to the traditional sources of protein in meat and dairy products. The most important health benefits of soybean are bioactive components include protect heart health, anti-cancer, reduce the effects of menopause, promotes bone health, improve metabolism, and decrease the risk of diabetes. Peanut (*Arachis hypogaea* Linn.) belongs to the family of Rosales and is widely cultivated around the world as an important economical crop. Peanuts are considered an important source of oil, folate, antioxidants, protein, and essential fatty acids (linoleic), and it ranked fourth in oilseed crops in the world after soybeans, rapeseed, and cotton. It has been revealed the presence of flavonoids, tannins, terpenoids, saponins, steroids, alkaloids by positive reaction with the respective test reagent. The numerous bioactive components in peanut contribute to their antioxidant capacity. Cowpeas are legumes recognized as a good source of proteins in many countries especially developing countries. It contains high levels of polyphenols, and the major polyphenols commons to all cowpea varieties are phenolic acids derivatives, and flavonol glycosides. Some varieties also contain anthocyanins and flavan-3-ols. Cow peas are valuable source of protein, carbohydrate, mineral and vitamins, and it also contain biologically active components including phenols, phytic acid, saponin, oligosaccharides, fiber and etc. Growing of leguminous plants can also benefits both the plants and soils by yielding nitrogen in the compound form. Legumes in traditional Medicine are natural and organic health care system which views the body as a complex network of interconnected parts. The most important health benefits of legumes are improve metabolic activity, health weight gain, anti-cancer potential, boost heart health, relieve menopausal symptoms, boost digestion, improve bone health, prevent birth defects, improve circulation, control diabetes and relieve sleep disorders.

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CONFLICTS OF INTEREST

The authors declare that they have no potential conflicts of interest.

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