Peanut as a Smart Food and their Nutrients Aspects in Planet: A Review

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Abstract
Peanuts are a legume crop that belong to the family Fabaceae, genus Arachis and botanically named as Arachis hypogaea L. Peanuts are considered as a vital source of nutrients plays an important role in growth and energy gain of living organisms. They are rich in calories and contain many nutrients, minerals, antioxidants and vitamins that are essential for optimum health. All these biomolecules are essential for pumping vital nutrients into the human body for sustaining normal health. This paper presents an overview of the peanut composition in terms of the constituent biomolecules and their biological functions, also discusses about the relationship between consumption of peanuts and their effect on human metabolism and physiology. It highlights the usefulness of considering peanuts as an essential component in human diet considering its nutritional values.

Key words: Bioactive, Health benefits, Nutritional profiles, Peanuts, Plant protein.

Groundnut (Arachis hypogaea L.), is a species of legume family (Fabaceae) which is believed to have its origin in South America from where it spread to other parts of the world. They are widely cultivated in India, Africa, South America, United States, China and a few other countries. China leads in production of peanuts, having a share of about 45% of overall world production, whereas India is second in production and has (16%) share and the United States of America has 5% share (USDA, 2014). There are thousands of peanut cultivars around the world the most popular cultivars being Spanish, Runner, Virginia and Valencia. Preference by cultivars is based on differences in flavour, oil content, size, shape, and disease resistance. Spanish peanuts are used mostly for peanut candy, salted nuts and peanut butter whereas majority of the runner cultivars are used to make peanut butter (Woodroof, 1983). Apart from oil, peanuts are widely used for preparation of peanut butter, confectionaries such as roasted peanuts, snack products, extenders in meat product formulation, soups and desserts.

The colour of groundnut varies from red to brown and are usually coarse in their appearance. The nutritional importance of peanuts is attributed mainly to the carbohydrates, lipids, proteins, vitamins, minerals, some organic acids and purines which are known as energy and growth supplementing constituents. Peanuts, which are a rich source of protein and essential amino acids, can help in preventing malnutrition (Peltz and Klemesu, 2011). Moreover, energy rich compounds such as lipids and carbohydrates in peanuts are highly capable of complementing the basic energy demands of the human body. This review article describes chemical composition of peanuts and the importance of groundnut as a smart food is discussed.

Peanuts are grown in the ground, as the seeds of the ovary from the peanut plant. They contain anywhere from 21-36.4% protein, 18% carbohydrates and 36-54% fat (Woodroof, 1973). In their natural state, peanuts contain at least 10% of the recommended daily intake for vitamin E, folate, niacin, magnesium, copper, phosphorus and potassium, their fat content 30-35% is polyunsaturated and 40-45% is oleic, a monosaturated fatty acid (Woodroof, 1973). Peanut contain about 100-120 grams of fiber per kg (Kris-Etherton et al., 2011). Peanuts have been recognized as a valuable protein source since the 1800s. Since the protein in peanuts is plant-based, it carries with its additional components promoting positive health benefits like fibre and unique bioactive, unlike animal protein. Peanuts are high in arginine, an amino acid, which is one of the building blocks of protein. This amino acid is a precursor to nitric oxide, a compound that expands your blood vessels. Adding peanuts to your diet is a great way to add healthy protein bioactive compounds promoting positive health benefits like fibre and unique bioactive, unlike animal protein.
like arginine that can improve blood pressure, decrease chronic disease risk and promote longevity. Plant-based proteins such as peanuts contain healthy monounsaturated and polyunsaturated fats and other important nutrients. In addition, the peanut diets reduced triglyceride levels, which were increased in the low-fat diet. Moreover, peanuts contain lipids and carbohydrates which are energy rich compounds, capable of complementing the basic energy demands of the human body.

a) Vitamins
Vitamins are a group of organic compounds that are not synthesized in the body, but have to be supplied to the body to maintain normal health and metabolism. Vitamins are classified as fat soluble and water-soluble vitamins. Vitamins A, D, E and K are fat soluble vitamins and water-soluble vitamins are B-Complex and vitamin C. Fat soluble vitamins exert an important role in the maintenance of certain essential physiological functions. Vitamin A is associated with normal vision and epithelial functions, vitamin D is associated with calcium metabolism, and vitamin K for coagulation of blood. Vitamin E, a powerful antioxidant is also vital for a healthy immune system. Consumption of Vitamin E even in low quantities provides protection against coronary heart disease (Bramley et al., 2000).

The nuts are packed with many important water-soluble vitamins comprising B complex groups of vitamins such as riboflavin, niacin, thiamine, pantothenic acid, vitamin B6, and B9 folates are associated with certain biochemical reactions by forming coenzymes that assist the enzyme in converting a substrate into a product. Riboflavin (vitamin B2) in the form of Flavin mono nucleotide (FMN) and Flavin adenine dinucleotide (FAD), participate in electron transfer and hydrogen transfer reactions in the human body. Vitamin B6, more commonly known as folate or folic acid. Folic acid is the synthetic form of folate and folate occurs naturally in foods. Vitamin B9 is useful for human growth and helps the mechanism of normal nerve and brain functioning (Fishman et al., 2003). Estimation suggests that 100 g of peanuts provide about 85% of RDI of niacin, which contributes to health and blood flow to the brain.

b) Minerals
Groundnut consumption can meet the most part of Recommended Daily Allowance (RDA) of many minerals which are crucial for health and proper functioning of the body as mentioned in the Table 1. It is clear from the data's that 100g of peanut can provide RDA levels of 127% copper, 84% manganese, 57% iron, 54% phosphorus, 42% magnesium intake is associated with reduced inflammation (King 2005; Song et al., 2005) and a decreased risk of metabolic syndrome (Song et al., 2005) and type II diabetes (Larsson and Wolk 2007).

c) Fat
Fatty acids that are present in groundnut belong to the category of lipids. In addition to carbohydrates, they also are considered as energy producing biomolecules. They compose sufficient levels of monounsaturated fatty acids (MUFA), especially oleic acid. MUFA helps lower LDL or "bad cholesterol" and increases HDL or "good cholesterol" level in the blood. Research studies suggest that the Mediterranean diet which is rich in monounsaturated fatty acids help prevent coronary artery disease and stroke risk by favouring healthy serum lipid profile. Groundnut contains about 50% monounsaturated fatty acids (MUFAs), 33% Paraformaldehyde (PFAs) and 14% saturated fatty acids which is a healthy combination of fatty acids. The amount of trans fat in peanut butter with 2% stabilizer is 156 times less than what is needed to reach the 0 g trans-fat cut-off on food labels (Sanders, 2001).

Groundnut products (raw, butter and oil) are more beneficial to heart health when compared to the low-fat diets. The high monounsaturated fat of groundnut diets is believed to lower the total body cholesterol by 11% and bad LDL cholesterol by 14%. The benefits of the groundnut diets on cholesterol were comparable to the olive oil diet. There is a strong association between monounsaturated fat as well as

| Principle | Nutrient value | Recommended daily allowance |
|-----------|----------------|-----------------------------|
| Energy    | 567 Kcal       | 28%                         |
| Carbohydrates | 16.13 g     | 12%                         |
| Protein   | 25.80 g        | 46%                         |
| Total fat | 49.24 g        | 165%                        |
| Cholesterol | 0 mg           | 0%                          |
| Dietary fibre | 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%                         |
| Thiamine  | 0.640 mg       | 53%                         |
| Vitamin A | 0              | 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, 2014).
overall nut intake and decline in the risk of coronary heart disease (Matilsky et al., 2009).

d) Proteins
Groundnuts are actually a legume and have more protein than any other nut with levels comparable to that of beans. After the groundnut oil is extracted, the protein content in the cake can reach up to 50% (Zhao et al., 2011). Groundnut contain all the 20 amino acids in variable proportions and is the biggest source of the protein called Barginine (USDA., 2014). According to Protein Digestibility Corrected Amino Acid Score (PDCAAS) groundnut proteins and other legume proteins such as soy proteins have been found to possess equal nutrition to meat and eggs for human growth and health (FAO 2002). The amino acid profile of the groundnut meals shows that it can effectively be used as an ingredient for protein fortification (Yu et al., 2006). Since the proteins in groundnuts is plant based, it carries with its additional components that have positive health benefits like fibre and unique bioactive components, unlike animal protein. In addition, groundnut proteins have been found to have good emulsifying activity, emulsifying stability, foaming capacity, excellent water retention and high solubility, and can also provide a new high protein food ingredient product formulation and protein formulation in food industry (Wu et al., 2009).

e) Bioactives in peanuts
i) Arginine
Arginine or L-arginine is an amino acid that is essential in maintaining the liver, skin, joints and muscles healthy. Arginine is an amino acid that acts as a precursor to nitric oxide which helps to keep the arteries relaxed, improving blood flow and healing time in tissues in the body with respect to functional activity and that arginine is one of the protective nutrients for the gastro intestinal tract Duggan et al. (2002).

ii) Resveratrol
Groundnut is an excellent source of resveratrol, another polyphenolic antioxidant. Resveratrol (3,4,6-trihydroxystilbene) belongs to a class of polyphenolic compounds called stilbenes. Groundnut is an excellent source of resveratrol, a polyphenol antioxidant (Geulein, 2010) which have been found to have protective function against cancers (Gagliano et al., 2010), heart disease (Juan et al., 2002), degenerative nerve disease, Alzheimer’s disease (Chen, 2005), tumour (Bishayee et al., 2010) and inflammation (Kang et al., 2010). Furthermore, research evidence suggest that resveratrol may reduce stroke risk through altering molecular mechanisms in the blood vessels such as reducing susceptibility to vascular damage through decreased activity of angiotensin, a systemic hormone responsible for blood vessel constriction that would elevate blood pressure and by increasing production of vasodilator hormone, nitric oxide.

iii) Phytosterols
Phytosterols also referred to as plant sterol and stanol esters are found in plant cell membranes which belongs to a group of naturally occurring compounds. They compete with cholesterol for absorption in the digestive system because phytosterols are structurally similar to the body’s cholesterol, when they are consumed. Groundnut, peanut butter, groundnut flour, and groundnut oil are all filled with phytosterols (bisetosterol, campesterols and stigmasterol) that block the absorption of cholesterol from the diet (Lopes et al., 2011).

Phenolic acids and flavonoids
The functional compounds such as phenolic acids and flavonoids are very high in groundnut and their skin. Hence groundnut are exceptional sources of functional compounds, including phenolic acids (Francisco and Resurreccion, 2008). Research studies have revealed that groundnut contains high concentrations of polyphenolic antioxidants, primarily in p-coumaric acid levels, boosting it overall antioxidant content by as much as 22% (Duncan et al., 2006). Furthermore, roasted peanut skin has greater antioxidant capacity than the roasted whole groundnut. Lopes et al. (2011) have also described the role of phenolic acids as antioxidants. Flavonoids are in all parts of the groundnut plants.

Health benefits of peanuts
Several studies have looked at the health benefits of regular consumption of peanuts. The consumption of either peanuts or processed peanuts has been shown to be beneficial to health, due to their desirable lipid profile, which is higher in unsaturated fatty acids than in saturated fatty acids peanut oil is naturally trans-fat-free, cholesterol-free and low in saturated fats. It shows many positive biological effects, which are mostly connected with its high oleic acid content (Woodroof 1983). Peanut skins contain potent rich antioxidants. Recent research studies suggest that boiling enhances antioxidant concentration in the peanuts. It has been found that boiled peanuts have two and four fold increase in isoflavone antioxidants biochanin A and genistein content, respectively (Craft et al. 2010). As much as 40% reduction in mortality due to any factor has been reported when peanuts were included as an integral part of the routine diet (Fraser et al. 1992). Reduction in deaths due to cardio vascular diseases in particular was found in population who consume peanut or peanut butter regularly (Fraser et al. 1992). Peanuts and peanut butter contain health monounsaturated fatty acids, plant proteins, magnesium, potassium, fiber arginine and many bioactive components, each of which could be contributing to lowering blood pressure.

a) Alzheimer’s and gallstone disease
Peanuts have a high content of niacin and are an excellent source of vitamin E, both of which have been shown to protect against Alzheimer’s disease and age-related cognitive decline. It has also been found that the consumption of vitamin E from supplements had no effect on the incidence of Alzheimer’s, vitamin E intake from food has been was protected (Morris 2002). In those who were
in the top fifth of intake, incidence of Alzheimer’s disease was reduced by 70%. Resveratrol has also been recognized as beneficial in Alzheimer’s disease and other nerve degeneration disease (Chen 2005). It has been found that those who eat peanuts and peanut butter five times a week or more have a reduced risk of gallbladder disease bias much as 25% (Tsai et al. 2004).

b) Peanuts and weight management

Considerable evidences show that incorporating peanut and peanut butter into the diet does not lead to weight gain or higher bodyweight (Mattes et al. 2008). In another research exclusively on school children it was found that there was weight loss in peanut fed group whereas the control group gained weight in a span of 2 years (Johnston et al. 2007). Similar data has been published in many more epidemiological studies where it was found that peanuts reduced the total and LDL cholesterol (Pekman 2004).

c) Hunger maintenance

Research data show that peanut and peanut butter consumption improved the feeling of fullness and satisfied the consumers better than the carbohydrates snacks like rice cakes in equal quantities (Kirkmeyer and Mattes 2000). Another study showed that peanut consumption curbed the appetites of the subject due its fullness effect (Alpher and Mattes 2002). Emerging evidence is also showing that the type of healthy monounsaturated fat in peanuts may stimulate a hormone that helps to feel satisfied after consumption (Schwartz et al. 2008).

d) Malnourishment

Peanut milk although not very popular is used extensively incases of emergencies and malnutrition for rapid recovery and gain of health. In the past, Peanut based product like a RUTF (Ready-to-Use Therapeutic Food) has been formulated to overcome severe malnourishment. It is a lipid-based mix containing ground, roasted peanuts. In addition, vegetable oil, powdered milk, vitamins, minerals, and sugar are added. Peanuts as the basis for RUTF enable better delivery of a full range of balanced lipids, essential amino-acids, minerals and vitamins required by developing children (Patel et al. 2005).

CONCLUSION

Peanuts are an excellent and affordable source of nutrition, supplementing vital nutrients to the human body such as proteins, carbohydrates, lipids, vitamins, minerals and fiber. They are often referred as poor man’s protein but, when taken in adequate amounts in any form, will supplement rich nutrients to the body that can provide growth and energy, and play a vital role in the prevention of diseases. Metal ions which are cofactors for many enzymes, vitamins that are not synthesized in the body, poly unsaturated and monounsaturated fatty acids, whose consumption can increase the levels of HDL cholesterol which is good for the heart, are present in peanuts. Essential amino acids that are not synthesized in the body, but are essential as building blocks of proteins and carbohydrates, which are the principle source of energy in the body, can be provided by peanuts. It is clear that there is a huge scope for the commercialization of peanut products and the market trends look extremely positive owing to all the above-mentioned factors. A diet including peanuts could provide all these vital nutrients and play a critical role in preventing disease and promoting good health.

REFERENCES

Alpher, C.M, Mattes, R.D. (2002). Effects of chronic peanut consumption on energy balance and hedonics. Int. J. Obes. Relat. Metab. Disord. 26(8): 1129-1137.

Bishayee, A., Politis, T. and Darvesh A.S. (2010). Resveratrol in the chemoprevention and treatment of hepatocellular carcinoma. Cancer Treat. Rev. 36: 43-53.

Bramley, P.M, Elmadifa, I, Kafatos A, Kelly, F.J, Manios Y, Roxborough, H.E, Schuch, W, Sheehy, P.J.A, Wagner, K.H. (2000). Review vitamin E. J. Sci. Food Agric. 80: 913-938.

Chen. (2005). SIRTI projects against microglia-dependent amyloid-b toxicity through inhibiting NF-KB signaling. J. Biol. Chem. 280(48): 40364-40374.

Craft, B.D., Hargrove, J.L., Greenspan, P., Hartle, D.K., Amarowicz, R. and Pegg, R.B. (2010). Recent Advances in food and flavor chemistry. Food flavor and encapsulation, health benefits, analytical methods, and molecular biology of functional foods, Cambridge; UK: R. Soc. Chem. 283-296.

Duggan, C., Gannon, J. and Walker, W.A. (2002). Protective nutrient and functional foods for the gastrointestinal tract 1-3. Am. J. Clin. Nutr. 75: 789-808.

Duncan, C.E, Gorbet, D.W. and Talcott, S.T. (2006). Phytochemical content and antioxidant capacity of water-soluble isolates from peanuts (Arachi shypogaea L.). Food Res. Int. 39(8): 898-904.

FAO/WHO/UNU. (2002). Protein and Amino Acid Requirements in Human Nutrition. In: Report of a Joint FAO/WHO/UNU Expert Consultation, World Health Org Tech Report No.935.

Fishman, S.M, Christian, P. and West, K.P. (2003). The Role of Vitamins in the Prevention and Control of Anemia. Public Health Nutrition. 3(2): 125-150.

Francisco, M.L. and Resurreccion, A.V. (2008). Functional components in peanuts. Crit. Rev. Food Sci. Nutr. 48(8): 715-746.

Fraser, G.E, Sabate, J, Beeson, W.L. and Strathan, T.M. (1992). A possible protective effect of nut consumption on risk of CHD. Arch. Intern. Med. 152: 1416-1424.

Gagliano, N, Aldini, G, Colombo, G, Rossi, R, Colombo, R, Gioia, M, Milizzi. A. and Dalle-Donne, I. (2010). The potential of resveratrol against human gliomas. Anti-Cancer Drug. 21: 140-150.

Geulein, I. (2010). Antioxidant properties of resveratrol: a structure activity insight. Innov. Food Sci. Emerg. Technol. 11: 210-218.

Johnston., C.A., Poston, W.S. and Haddock, C.K. (2007). Weight loss in overweight Mexican American children: a randomized, controlled trial. Pediatrics. 120(6): e1450-e1457.

Juan, M.E, Vinardell, M.P. and Planas, J.M. (2002). The daily oral delivery of a full range of balanced lipids, essential amino-acids, minerals and vitamins required by developing children (Patel et al. 2005).
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Kang, L, Heng, W, Yuan, A, Baolin, L and Fang, H. (2010). Resveratrol modulates adipokine expression and improves insulin sensitivity in adipocytes relative to inhibition of inflammatory responses. Biochemic. 92: 789-796.

King, D.E. (2005). Dietary magnesium and C-reactive protein levels. J. Am. Coll. Nutr. 24(3): 166-171.

Kirkmeyer, S.V. and Mattes, R.D. (2000). Effects of food attributes on hunger and food intake. Int. J. Obes. Relat. Metab. Disord. 24(9): 1167-1175.

Kris-Etherton, P.M, Zhao, G, Binkoski, A.E, Coval, S.M. and Etherton, T.D. (2011). The effect of nuts on coronary heart disease risk. Nutr. Rev. 59(4): 103-111.

Larsson, S.C and Wolk, A. (2007). Magnesium intake and risk of type 2 diabetes: a meta-analysis. J. Intern. Med. 262(2): 208-14.

Lopes, R.M, Agostini-Costa, T.D.S., Gimenes, M.A. and Silveira, D. (2011). Chemical composition and biological activities of Arachis species. J. Agri. Food Chem. 59(9): 4321-4330.

Matilsky, D.K, Ndekha, M. and Manary, M.J. (2009). Supplementary feeding with fortified spreads results in higher recovery rates than with a corn/soy blend in moderately wasted children. J. Nutr. 139(4): 773-8.

Mattes, R.D. Kris-Etherton, P.M. and Foster, G.D. (2008). Impact of peanuts and tree nuts on body weight and healthy weight loss in adults. J. Nutr. 138(9): 1741S-1745S.

Morris, M.C. (2002). Dietary intake of antioxidant nutrients and the risk of incident Alzheimer disease in a biracial community study. J. Am. Med. Assoc. 287: 3230-3237.

Patel, M.P., Sandige, H.L., Ndekha, M.J., Friend, A, Ashorn, P. and Manary, M.J. (2005). Supplemental feeding with ready-to-use therapeutic food in Malawian children at risk of malnutrition. J. Health Popul. Nutr. 23(4): 351-357.

Pelto, G.H. and Armar-Klemesu, M. (2011). Balancing Nurturance, Cost and Time: Complementary Feeding in Accra, Ghana. Maternal and Child Nutrition. 7(3): 66-81.

Sanders, T.H. (2001). Non detectable levels of trans-fatty acids in peanut butter. J. Agric. Food Chem. 49(5): 2349-2351.

Schwartz, G.J, Fu, J, Astarita, G, Li, X, Gaetani, S, Campolongo, P Cu mo, V. and Piomelli, D. (2008). The lipid messenger OEA links dietary fat intake to satiety. Cell Metab. 8(4): 281-288.

Song, Y, Ridker, P.M, Manson, J.E, Cook, N.R, Buring, J.E. and Liu, S. (2005). Magnesium intake, C-reactive protein and the prevalence of metabolic syndrome in middle-aged and older U.S. women. Diabetes Care. 28(6): 1438-1444.

Tsai, C.J, Leitzman, M.F, Hu, F.B., Willett, W.C and Giovannucci, E.L. (2004). Frequent nut consumption and decreased risk of cholecystectomy in women. Am. J. Clin. Nutr. 80(1): 76-81.

United States Department of Agriculture (USDA). (2014). http://www.nal.usda.gov/fnic/foodcomp/search/. Accessed 21 Aug 2014.

Woodroof, J.G. (1973). Peanuts: production, Processing, products. The Avi. Publishing Company, Inc. Westport CT. p. 330.

Woodroof, J.G. (1983). Historical background in Peanuts: production, processing, products, AVI Westport CT 181.

Wu, H. W, Wang, Q, Ma, T.Z. and Ren, J.J. (2009). Comparative studies on the functional properties of various proteins concentrates preparations of peanut protein. Food Res. Int. 42: 343-348.

Yu, J, M, Ahmedna, M, Goktepe, I. and Dai, J. (2006). Peanut skin procyanidins: composition and antioxidant activities as affected by processing. J. Food Compos Anal. 19: 364-371.

Zhao, G, Liu, Y, Zhao, M, Ren, J and Yang, B. (2011). Enzymatic hydrolysis and their effects on conformational and functional properties of peanut protein isolate. Food Chem. 127(4): 1438-1443.