The beneficial role of peanuts in the diet – Part 2

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Abstract

This paper reviews the nutritional profile of peanuts and summarises recent evidence for their potential as a beneficial food for long-term health. As such, a more constructive positioning for peanuts and peanut butter within the UK diet is proposed.

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Introduction

A decade ago the potentially protective effects of nuts were recognised when results from the Californian Adventists Study indicated that frequent nut consumption was inversely related to the risk of having a myocardial infarction or dying from ischaemic heart disease (Fraser *et al.*, 1992). At that time other experimental work had shown that consumption of nuts has a cholesterol-lowering effect in both hypocholesterolaemic and normocholesterolaemic subjects (Spiller *et al.*, 1990, 1992). It was suggested, therefore, that the fatty acid composition of nuts, through its effect on serum lipids, may be responsible for their protective effects on ischaemic heart disease (Sabate, 1993). Furthermore, the unique composition of nuts was recognised as offering protection, via other potentially beneficial constituents, in particular, nuts are high in dietary fibre. In addition, their arginine content, their antioxidant tocopherols content and other micronutrients were all highlighted as candidates. Nevertheless, the overriding issue during these years was to reduce total fat intake and the fact that nuts were viewed as a high fat food continued to overshadow the potentially beneficial role that they might play. Today, a wealth of research is now available and also in progress, that indicates a positive role for nuts in the battle against CHD, cancer, obesity and type II diabetes as a consequence of several nut constituents, working via different mechanisms.

Background

Peanuts (*Arachis hypogaea L.*) have been valued for their high nutritional content throughout the world for many years. Originating from South America, where the Incas consumed them over 3,500 years ago, peanuts are grown today in many countries including India, Vietnam, several African countries and principally by the main exporters the USA, China, and Argentina.

The latest UK National Food Survey (NFS) (Department of the Environment, Food and Rural Affairs, 2001) indicates that domestic consumption of nuts and nut products varies seasonally between 10g and 22g per person per week, traditionally being higher around the Christmas period. Average purchases amount

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to 14g per person per week by 10 per cent of UK households. Individual nut data are not broken out, due to the overall low consumption. In the UK, at least, by far the greatest retail shelf space for nuts is occupied by peanuts, which are also more economical on the purse. In addition, peanut butter is the predominant nut butter available. In the absence of official quantitative data, these observations support the notion that peanuts are the most commonly consumed nut in the UK diet. As such, it can be assumed that they make up a significant proportion of the NFS total consumption and purchase figures for nuts. To these figures must be added data from the "Eating Out Survey" that records foods purchased and consumed outside the home, in addition to that purchased within the household. This suggests that consumption of crisps, nuts and snacks has reduced from 12g/d in 1996 to 8g/day in 2000. This appears to contradict the general view that consumption of such foods is on the increase. Clearly there is a need for more accurate figures on the purchase and consumption of peanuts and peanut products in the UK.

The Dutch National Food Consumption Survey (DNFCS) (Kistemaker *et al.*, 1998) calculated that of the 5,958 people surveyed, 1,237 or 21 per cent of the population, ate nuts and peanuts regularly. Of the frequent nut consumers, some 8 per cent specifically said they ate peanuts both salted and unsalted, although this is likely to be an underestimate since peanut butter intake was not measured and this product is popular in The Netherlands. Also, account should be taken of the significant proportion of peanuts present in mixed nuts and confectionery. The frequent nut and peanut consumers in the study were eating some 24g/day of nuts.

Total nut consumption in the USA is much higher than in Europe, averaging 77g per person per week in 1997, according to US disappearance data (USDA, 2000). Of this figure, peanuts and peanut butter made up some 68 per cent. According to the US Peanut Advisory Board, nearly 50 per cent of the 2001 US peanut crop was used to make peanut butter (www.peanutbutterlovers.com).

Some work has looked at the nutritional impact on the diet that regular peanut consumption can make. This is based on US consumption figures calculated from both individual intakes and disappearance data. Results from two studies suggest that nut eaters, overall, score slightly higher on overall healthy eating and nutrient adequacy indices (USDA, 2000; Eissenstat *et al.*, 1999). Furthermore, peanut consumers had significantly higher recommended daily allowances (RDA) for vitamin E, folate, magnesium and dietary fibre than non-consumers, with lower cholesterol intakes, lower body mass index (BMI) and a total energy intake from fat at 34 per cent (Eissenstat *et al.*, 1999).

Peanuts (groundnuts) are, botanically speaking, a legume, not a tree nut. Gastronomically, however, they are considered as a nut, being consumed in the same way as other nuts, so dietary studies include peanuts alongside other tree nuts. Sharing many of the characteristics of both tree nuts and pulses, peanuts contain slightly less fat (46g/100g) than most other nuts and more protein (25g/100g) than most nuts and seeds. At least 75 per cent of the fat in peanuts is unsaturated, with nearly half of this being monounsaturated, oleic acid. Peanuts and peanut butter are an energy dense, nutritious food, providing a valuable supply of a wide range of vitamins, minerals, phytochemicals and dietary fibre. Given their uniqueness and potential benefit to health, it is interesting to ponder on the appropriate food group positioning for peanuts. Considering the Government's "Balance of Good Health" model for teaching healthy eating (Health Education Authority, 1994), when considered at all, peanuts tend to be allocated to the meat, fish and alternatives food group. However, this underplays their role as a (legume) vegetable, given their phytochemical and dietary fibre content. Hu and Stampfer (1999) concluded in their epidemiological nut review, that the evidence was sufficiently strong, in relation to reducing risk of CHD, to justify moving nuts to a more prominent place in the USDA Food Guide Pyramid, alongside fruit and vegetables. Encouraging the population to swap convenience, high calorie, snacks for healthier fruit and vegetables has proved difficult, whereas potential health benefit from snacking on nuts as a preferred alternative tends to be overlooked.

Peanuts and their bioactive components

It is now acknowledged that as well as modifying the fat component of the diet,

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other dietary constituents can confer additional protection from CHD (Ashwell, 1997). Nuts contain several of these cardioprotective constituents including dietary fibre, plant protein, micronutrients (copper, magnesium, vitamin E), plant sterols and phytochemicals. The significance of each of these constituents in protecting our health through regular nut consumption is yet to be determined. There are still limited data available on the exact composition of different nuts and the relative amounts of these potentially bioactive components in different nuts. Such data are required before any meaningful analysis can be made of the broader role to be played by individual nuts to protecting health. Nevertheless, in summarising the data currently available, it is fair to conclude that nuts and legume peanuts have the potential to contribute significantly to human health. Indeed, it has been suggested that because peanuts have specific properties, unique from other nuts, they deserve further investigation to evaluate their potential chemopreventative properties (Kris-Etherton, 2001).

Macro and micronutrients

Non-starch polysaccharides (NSP)

Like other legumes, peanuts are an important source of NSP, with an average 6g/100g of which 1.9g is soluble fibre. NSP has an important role to play in guarding against bowel disease. Soluble fibre reduces total- and LDL-cholesterol and improves glycaemic control, important for improving insulin resistance. The high fibre content of peanuts may in part contribute to the satiating properties of peanuts, compared to other snack foods (Kirkmeyer and Mattes, 2000).

Arginine

The low ratio of lysine to arginine in plant proteins has been recognised as having an anti-atherogenic effect in animal studies. More recently, a cardioprotective role for L-arginine, the precursor of nitric oxide (NO) has been recognised. Dietary arginine enhances NO synthesis. NO induces smooth muscle cell relaxation (vasodilation), inhibits platelet adhesion, activation and aggregation and is antithrombotic. Studies have shown that the depression of endothelial vasodilation seen in hypercholesterolaemic animals and humans can be prevented by administering L-arginine (Feldman, 2002).

Levels of L-arginine are higher in peanuts, weight for weight, than in any other common nut or legume in the British diet (Paul *et al.*, 1987). Studies to date on the potential for arginine to contribute to heart health are interesting and illustrate that nuts have a potential beneficial contribution to make to human health far beyond their fat content. Cooke first proposed in 1993 that the anti-atherogenic effect of nuts might be due to their arginine content (Hu *et al.*, 1999).

Vitamin E

High doses of vitamin E (more than 100IU/day) have been associated with reduced risk of CHD via inhibition of LDL oxidation (where vitamin E is transported within the LDL particle) (Kris-Etherton *et al.*, 1999). Epidemiological studies have found an inverse association between fatal stroke and intake of the most concentrated sources of vitamin E, such as nuts (Yochum *et al.*, 2000). Nuts are one of the best dietary sources of tocopherols, after vegetable oils, although since typical consumption of nuts is relatively low, their contribution to vitamin E intakes is lower than the amounts shown to benefit CHD risk reduction. Even so, they offer the potential to effectively increase vitamin E intakes where consumed on a daily basis.

Folate

Peanuts are a good source of folate and one of the richest nut sources of folate (plain peanuts provide 110mcg/100g, dry roasted 66mcg/100g, peanut butter 53mcg/100g). It has been suggested that regularly consuming nuts may favourably influence homocysteine levels. Homocysteine levels are reduced by folate and increased by methionine, the latter being low in nuts. The vascular toxicity of homocysteine may be partly related to inhibition of NO, so that the arginine content of nuts, together with the folate content, may have complementary effects acting to aid prevention from CVD, via their effects on homocysteine (Feldman, 2002; De Logeril, 1998)

Magnesium, copper, potassium and calcium

Nuts are a rich source of copper and magnesium, intakes of which are often quite low in Western diets. Nuts can potentially contribute a significant proportion of the daily requirement for copper and magnesium, if regularly consumed in modest amounts.

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Copper is important in haematopoiesis and diets low in copper are associated with adverse changes in lipids, glucose tolerance, blood pressure and electrocardiograms. Magnesium is important for maintaining correct calcium to potassium balance and low magnesium status results in dysrhythmias, myocardial infarction and possibly hypertension. Additionally, magnesium is essential for enzyme function, muscle relaxation, nerve transmission and healthy tooth enamel (Kris-Etherton *et al.*, 1999).

Peanuts, like all legumes, are low in sodium and good sources of potassium, calcium and magnesium, a combination that, collectively, is associated with reduced risk of CVD in epidemiological studies. A recent analysis of the NHANES I Epidemiologic Follow-up Study (NHEFS) has looked at legume consumption and risk of CHD in US men and women after 19 years follow-up (Bazzano *et al.*, 2001). Legume consumption was determined at baseline from a food frequency questionnaire and legumes included dried beans and peas (including pinto, black-eye, soya and red), peanuts and peanut butter. The authors conclude that a significant inverse relationship exists between legume intake and risk of CVHD.

Phytochemicals

Phytochemicals are plant chemicals produced in plants to protect them from disease and attack. Peanuts and peanut butter contain many different bioactive phytochemicals including several flavonoids, such as luteolin (an antioxidant), quercetin, kaempferol, rutin, and isoflavones (phyto-oestrogens); phenolic compounds, such as ellagic acid and resveratrol; lignans; and phytosterols, in particular, beta-sitosterol. There is evidence that flavonoids are cardioprotective and reduce human cancer cell lines *in vitro* (Kris-Etherton, 1999, 2001).

Resveratrol

Resveratrol, a polyphenol phytoalexin (3,5,4'-trihydroxy-trans-stilbene) is present in peanuts to protect the plant from plant pathogens and it is also one of the components of red wine thought to be responsible for associating moderate red wine consumption with reduced risk of heart disease. Resveratrol has been shown from *in vitro*, *ex vivo* and animal studies to have many attributes that may provide protection from atherosclerosis (via antioxidant activity, modulation of apolipoprotein and lipid synthesis and inhibition of platelet aggregation). Additionally, experimental and animal studies have indicated that resveratrol may offer protection from cancer too, since it stops the growth of damaged cells in the body. There is now a large amount of data on the antiproliferative and proapoptotic properties of resveratrol with breast, colon, prostatic and leukaemia cells (Wolter *et al.*, 2001). Further work *in vivo* is required on the absorption, metabolism, bioavailability and biological effects to determine the human significance of resveratrol. Red wine, grapes, soy and peanuts are the main dietary sources of this phytochemical. Some studies have now started to quantify the levels of resveratrol present in dietary sources and, although results differ markedly, levels appear higher in red wine (0.6-18 microgram/ml) than in peanuts (0.02-5 microgram/g) (Sanders *et al.*, 2001; Burn *et al.*, 2002). Much research is still required to fully understand the minimum quantity that would be required for resveratrol to make an active contribution, either directly or as part of an array of dietary phytoprotective "nutrients", to protecting human health.

Phytosterols

Peanuts and peanut butter are also good sources of a number of plant sterols (phytosterols) such as betasitosterol. The cardioprotective properties of phytosterols have been recognised since the 1950s and they now provide the functional ingredients in a number of cholesterol-lowering margarines. It has been suggested that the phytosterol component in peanuts may be a contributory factor in their ability to lower cholesterol (Awad *et al.*, 2000a; Hu *et al.*, 1998). Phytosterols have a structure similar to cholesterol, but are absorbed at a lower rate. Phytosterols lower blood cholesterol levels via inhibition of dietary and biliary cholesterol absorption. The main dietary sources of plant sterols are unrefined plant oils, seeds, nuts and legumes. A recent analysis of the phytosterol content of peanuts has confirmed that peanuts and peanut products, including peanut butter, peanut (groundnut) oil and peanut flour are better sources of phytosterols than olive oil. Roasted US peanuts contain 61-114mg/100g, depending on the peanut variety, and 78-83 per cent of this is in the

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form of beta-sitosterol. Unrefined peanut oil contains 207mg/100g and even taking account of the losses due to refining and processing, the levels remain higher than for olive oil. US peanut butter contains 144-157mg/100g of product (Awad *et al.*, 2000a). Consumption of plant sterols averages 345-400mg/day by Asians and vegetarians but is as little as 80mg/100g within Western cultures. Awad *et al.* (2000a) suggest that peanuts offer a versatile and unique tool for increasing the phytosterol content of the US diet.

Epidemiologic and experimental studies indicate that phytosterols may provide some protection from cancers of the colon, breast and prostate (Awad and Fink, 2000). Awad *et al.* (2000) has shown that phytosterols inhibit colon, breast and prostate cancer cell division *in vitro*, at doses equivalent to the blood levels seen in Asians and vegetarians (Awad *et al.*, 2000a). Phytosterols also appear to reduce the growth and metastasis of prostate cancer by reducing tumour cell adhesion, migration and invasion (Awad *et al.*, 2001). Prostate cancer is one of the most common cancers in Western men, yet incidence is low in Asian men. The main sterol consumed by Western men is cholesterol, with intakes of plant sterols very low. The reverse is true of Asian men. Awad has shown experimentally that cholesterol increases prostate cancer cell proliferation whereas beta-sitosterol reduces it (Awad *et al.*, 2001; Awad and Fink, 2001). He suggests the phytosterol-rich diets of Asian men may be causatively related to their lower incidence of prostate cancer. Further research in mice has shown that phytosterols reduce the growth and spread of breast cancer cells (Awad *et al.*, 2000b). The exact mechanisms by which phytosterols work to reduce cancer risk have yet to be confirmed, however, it appears that the levels of intake required are similar to those recommended for phytosterols to be effective in reducing cholesterol levels.

Phyto-oestrogens

Some phytochemicals, isoflavonoids (a class of flavonoids) and lignans, exert oestrogen-like effects due to their chemical structures being similar to steroids, enabling them to bind to and activate the nuclear oestrogen receptors. These compounds are hormone-like, diphenolic phyto-oestrogens and epidemiological studies have stimulated much interest in the potential of such compounds to exert anticancer effects through modulating the human hormonal system. It is recognised that semi-vegetarian Asian countries have lower incidences of hormone-dependent cancers, as well as colon cancer, atherosclerosis and CHD, compared to developed Western countries. All of these diseases are associated with sex hormone metabolism in some way, for instance, the sex steroid hormones are involved with the signalling pathway for cell division. There is strong experimental evidence that lignans and isoflavonoids, identified in body fluids and transformed to hormone-like compounds by intestinal bacteria, have the ability to protect against both cancer and atherosclerosis (Mazur and Adlercreutz, 1998). The principal phyto-oestrogens include the isoflavonoid isoflavones (daidzein, genistein) and the lignan (secoisolariciresinol (SECO)). These are all present in peanuts in quantities comparable to the levels found soyabean products, the latter having been extensively studied in recent years. In fact peanuts rank among the prominent contributors of isoflavones from the legume family, alongside soybeans, clover, mung bean, alfalfa, and kudzu (Japanese arrowroot) (Mazur and Adlercreutz, 1998). Although lignans are widespread within plant foods, providing structure to the plant, the isoflavone phyto-oestrogens are restricted to the legume family.

Losing weight? ... it's peanuts!

Obesity itself is a risk factor for long term health, including CHD, and it is assumed that the key to weight loss is via a low-fat diet, since fat calories are more concentrated (9kcal/g) than carbohydrate or protein (4kcal/g). However, long-term trials have failed to demonstrate convincingly that low fat diets will lead to successful weight loss (Willett, 1998). Furthermore, US fat intakes have steadily reduced in recent years – yet obesity rates have soared. To control weight, total calorie intake relative to calorie output is crucial. There is a need for the population to both increase physical activity and watch calorie intake. Fat is a concentrated source of calories, however, fat itself can have a positive role in weight management since it is an important influencer of satiety. Furthermore, low fat diets tend to deprive individuals of a large number of foods, which brings into play

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the psychological effects associated with following restrictive diets that, all too often, result in long-term failure.

In a move away from restrictive low fat diets, recent research has demonstrated that peanuts can help as part of a Mediterranean-style, weight loss diet, with successful results long-term (McManus *et al.*, 2001). Nutrition researchers affiliated with Harvard School of Public Health, USA, studied 101 overweight men and women, who followed either a moderate fat diet (35 per cent energy from fat), or a standard low fat diet (20 per cent energy from fat). Both groups ate the same total calories (women: 1,200kcal; men: 1,500kcal) and saturated fat intake was kept low. The moderate fat diet encouraged inclusion of good sources of monounsaturated fats such as peanuts, peanut butter, olive oil, rapeseed oil, avocados and other nuts. Historically, such foods have been forbidden on standard low fat diets, due to their total fat content. Until recently, these typically Mediterranean foods were not a traditional part of the British diet, contributing little to nutrient intakes, unlike the USA where peanut butter, for instance, is considered a staple food. Now that the British diet has become more cosmopolitan, with multiethnic cuisines commonplace, the opportunity for greater variety in dietary choices, even for weight loss, is significantly increased and Mediterranean foods can make a notable contribution here.

The McManus *et al.* (2001) study found that three times as many people were able to stick to the Mediterranean-style, moderate fat diet versus the low fat diet. Those following the moderate fat diet were able to keep off a significant amount of their lost weight up to two-and-a-half years after the start of the study, whereas the low fat group had regained some of their initial weight loss by 18 months. The authors conclude that motivation and adherence are very hard to sustain in any weight loss program. These results demonstrate that people have to enjoy what they eat to stick with it. Further evidence for this view is mounting as a result of publication of *The Peanut Butter Diet* book in the USA (McCord, 2001). Returning peanut butter to the status of staple food, even for people on weight loss diets, appears to be a motivational success in the USA (www.prevention.com). The diet plans used for this research have been adapted by this author for use in the UK, with the researchers consent (www.peanutsusa.org.uk/mu2).

The fact that peanuts were considered forbidden foods for weight loss programmes is being challenged somewhat by recent research demonstrating that daily snacks of peanuts are an effective way to control hunger. Kirkmeyer and Mattes (2000) have shown that following a 500kcal snack of peanuts or peanut butter, participants' hunger was reduced for two and a half hours. However, when participants were fed typical portions of other snacks, such as rice cakes, hunger returned within half an hour. Furthermore, following the peanut and peanut butter snacks, subjects adjusted their caloric intake spontaneously and did not add extra calories to their daily diets.

In the most recent study (Alper and Mattes, 2002), when 500kcal (90g) peanut snacks were given to subjects daily, on top of their normal diet, participants subconsciously compensated by eating less of other foods. Over the eight weeks of the study, predicted weight gain, as a result of the extra snacks, should have been 3.6kg, whereas in fact, because of the satiating effects of the peanut snacks, weight gained was only 1kg. The authors conclude that peanuts pose limited risk for weight gain. In fact, O'Byrne *et al.* (1997) found that where subjects were given peanuts as a substitute for other sources of fat, in a low fat diet, despite being told to maintain their normal weight, subjects gradually lost 3kg weight over a six-month period. The authors conclude that the solidity of peanuts and the fact that they are such nutrient dense foods, specifically due to their fibre, protein and energy content, may explain the strong dietary compensation experienced by subjects. Two major US prospective diet studies, the Adventist Health Study and the Nurses Health Study have both shown that those consuming more nuts tended to weigh less (Hu and Stampfer, 1999).

A useful bonus from the McManus *et al.* (2001) study was that those on the moderate fat diet increased their intake of vegetables and fibre by one portion per day, so helping to improve their eating habits overall, whereas, those people following the low fat diet decreased their intake of vegetables and fibre. These results were significant. Since peanuts are nutrient-dense, choosing peanuts in preference to other common snack foods can,

in fact, improve the nutritional profile of the diet overall (USDA, 2000).

Diabetes

Some of the major nutrients of nuts, including unsaturated fatty acids, dietary fibre and magnesium, are inversely associated with risk of type II diabetes. New research has indicated for the first time that frequent consumption of nuts themselves is associated with reduced risk of type II diabetes in women. This beneficial effect of nuts on diabetes might be achieved by improving blood-glucose concentration and lowering insulin requirements, as well as through their role in weight control (Segasothy and Philips, 1999) (see Table I).

Peanuts have a very low glycaemic index (GI). The GI ranks foods according to how they affect blood glucose levels. On digestion, peanuts are absorbed slowly into the bloodstream, so do not cause a rapid rise in blood sugar. In diabetes, the key to good control is to keep blood glucose levels steady, which can be achieved by consuming foods predominantly with low GIs. The GI of peanuts is low at 14, compared to boiled lentils at 25 to 30 and wholemeal bread at around 70.

An additional bonus afforded by peanuts is that snacking between meals will have a beneficial effect on dental health since the pH of peanuts helps to reduce plaque formation.

Peanuts and peanut butter – a nutritious choice for fast food lifestyles!

Escalating rates of CVD, type II diabetes, obesity and cancer are serious cause for concern. Encouraging permanent lifestyle changes is necessary if we are to protect our nation's long-term health. Lessons learnt over the last 30 years of healthy eating advice suggest that dietary changes have to be both beneficial and acceptable for individual health. It is refreshing to see that, once again, a food that was labelled as "naughty but nice" during the low fat era has finally been repositioned to the more appropriate status of "good for you!" Peanuts offer a range of nutrients and bioactive substances with

Table I Nutrition composition of peanuts and peanut butter

		Per 100g peanuts			Per 30g	
Nutrient		Plain (fresh)	Roasted and salted	Peanut butter (2 tbsp)	Peanuts, roasted (single serving)	Peanuts as % of DRVs
Energy	kcal	389	602	187	181	9
Protein	g	17.7	24.5	6.8	7.3	16
Carbohydrate	g	8.6	7.1	3.9	2.1	
Fat	g	46	53	16.1	15.9	21
Saturated fatty acids	g	5.7	9.5	3.5	2.8	13
Monounsaturated fatty acid	g	14.5	24.2	6.4	7.3	28
Polyunsaturated fatty acids	g	9.9	16.5	5.5	4.9	38
Dietary fibre (Englyst)	g	4.3	6	1.6	1.8	10
Sodium	mg	1	400	105	120	7.5
Potassium	mg	460	810	210	243	7
Magnesium	mg	140	180	54	54	52
Vitamin E	mg	6.97	0.66	1.5	0.2	6.6
Vitamin B6	mg	0.41	0.63	0.17	0.19	16
Folate	ug	76	52	16	16	8
Thiamin	mg	0.79	0.18	0.05	0.05	6.3
Riboflavin	mg	0.07	0.1	0.03	0.03	2.7
Niacin	mg	9.50	13.6	3.75	4.08	31
Iron	mg	1.70	1.3	0.63	0.39	2.6
Copper	mg	0.70	0.54	0.21	0.16	13
Zinc	mg	2.40	2.9	0.9	0.87	12
Selenium	ug	2	4	1	1	3
Manganese	mg	1.4	1.9	0.51	0.57	41
Iodine	ug	14	19	N/a	6	4

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potential to independently provide health benefit. Scientists have much work still to undertake before a full picture of the protective role played by nuts, and specifically peanuts, is appreciated. Nevertheless, sufficient evidence is now published to confirm that nuts should have a place within a hearthealthy diet at least. Peanuts can be recommended as a beneficial part of our armoury to help protect against the major diseases of the modern developed world. It is their low cost, convenience and versatility that make peanuts and peanut butter attractive as a healthy snack alternative or food ingredient that requires no special cooking or storage. Their health potential has thus far been underestimated in the UK.

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