Study to Avoid the Negative Effects of the Use of Arabic Coffee on the Health Status of Saudi Society

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Abstract: This investigation was carried out to try finding healthy coffee as alternative unhealthy Arabic coffee to be used in Kingdome of Saudi Arabia. Arabic and green coffees powder was prepared using some additives as cardamom, cloves, ginger and qassim mixture (caramel, saffron, glucose, milk protein and plum) to give six mixtures. The first mixture was made from cardamom to green coffee, the second mixture was prepared by adding mixture from cardamom, cloves and ginger, respectively and the third mixture was consisted of green coffee and qassim mixture. The three Arabic coffee mixtures were prepared the same prepared green coffee mixture. The coffee mixtures with additives and without additives were prepared by boiling 30 g of coffee powder in one liter of water for 20 min and the sensory evaluation was determined. The chemical composition, vitamins and minerals content were determined in green and Arabic coffees mixture powder and their boiling. The results from chemical analysis showed that the powder of green and Arabic coffee mixtures with qasium mixture were the highest content in protein, fat and crude fiber. Moreover, the resultant reported that the sample No., 3 and 3/ was prepared by adding from cardamom, cloves and ginger to green and Arabic coffee powder had the highest in antioxidant activity. The resultant from fat, protein, ash, total carbohydrate, antioxidants and pH values in green and Arabic coffee and their different mixtures after boiling were paralleled for green and Arabic coffee powder and their different mixtures. The results from vitamins content showed that the coffee sample No., 3 and 3/ consists of green and Arabic coffee had the highest in nicotinic, thiamin, pyridoxine, folic acid, B12 and riboflavin (88.05, 55.8, 0.41, 0.41 0.423 and 2.23 mg/100g in green coffee mixture) (sample No., 3). Whereas, in Arabic coffee mixture (sample No., 3/) the same vitamins were 83.84, 51.6, 0.37, 0.41, 0.37 and 2.08 mg/100g respectively, followed by samples No., 4, 4/, 2 and 2/, respectively. The results from minerals content as iron (Fe), calcium (Ca), potassium (K), zinc (Zn) and sodium (Na) for powder green and Arabic coffee and their different mixtures after boiling were paralleled the obviously results of vitamins content. It may be recommended that the mixture No., 3 and 3/ were the best mixture in coffee followed by the coffee mixture samples 4 and 4/ and also samples 2 and 2/ respectively. Moreover, the green and Arabic coffee free additions were the lowest amounted in all parameters. Therefore, the replacement of Arabic coffee and using green coffee is low harmful, safety, nutrition, beneficial health and sensory acceptable, with some additives such as cardamom, cloves, ginger, which works to improve the taste.

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1. Introduction

The word "coffee" comes from the name of a region of Ethiopia where coffee was first discovered ‘Kaffa’. The name ‘Kaffa’ is inherited from the hieroglyphic nouns ‘KA’ and ‘AfA’. ‘KA’ is the name of God; ‘AFA’ is the name of earth and all plants that grow on earth. So the meaning of Koffee (Coffee) from its birth-place bells on as the land or plant of God. Botanically, coffee is belonging to the family Rubiaceae in the genus *Coffea*. Although the genus Coffea includes four major subsections, 66% of the world production mostly comes from *Coffea arabic* L. and 34% from *Coffea canophora* Pierre ex Froehner (robusta type), respectively **(Mekuria *et al.*, 2004).**

The coffee tree belongs to the Rubiaceae family, genus Coffea. Although more than 80 coffee species have been identified worldwide **Clarke (2003)** only two are economically important. *Coffea arabic,* also known as Arabic coffee, is responsible for approximately 70% of the global coffee market, and *Coffea canephora* or Robusta coffee (commercial name of one of the main *C. canephora* cultivars) accounts for the rest **International Coffee Organization (2011).** Arabic and Robusta coffees are different in many ways, including their ideal growing climates, physical aspects, chemical composition, and characteristics of the brew made with the ground roasted seeds.

Coffee is one of the most consumed beverages in the world and is the second largest traded commodity after petroleum. Due to the great demand of this product, large amounts of residues are generated in the coffee industry, which are toxic and represent serious environmental problems. Coffee silverskin and spent coffee grounds are the main coffee industry residues, obtained during the beans roasting, and the process to prepare "instant coffee", respectively. Recently, some attempts have been made to use these residues for energy or value-added compounds production, as strategies to reduce their toxicity levels, while adding value to them **Mussatto *et al.* (2011).**

Coffee bean is constituted by several other components, including cellulose, minerals, sugars, lipids, tannin, and polyphenols. Minerals include potassium, magnesium, calcium, sodium, iron, manganese, rubidium, zinc, copper, strontium, chromium, vanadium, barium, nickel, cobalt, lead, molybdenum, titanium, and cadmium. Among the sugars, sucrose, glucose, fructose, arabinose, galactose, and mannose are present. Several amino acids such as alanine, arginine, asparagine, cysteine, glutamic acid, glycine, histidine, isoleucine, leucine, lysine, methionine, phenylalanine, proline, serine, threonine, tyrosine, and valine can also be found in these beans **(Grembecka *et al.*,2007 and Belitz *et al.*,2009)**. Additionally, coffee beans contain vitamin of complex B, the niacin (vitamin B3 and PP), and chlorogenic acid in proportions that may vary from 7% to 12%, three to five times more than the caffeine **(Trugo 2003 and Belitz *et al.*,2009).**

Arabic coffee (Coffee Arabic) is a name that refers to two types of coffee in some Arabic countries: Turkish, and Saudi Coffee. The Saudi coffee, or ''Al-Qahwa'' is made from coffee beans roasted very lightly or heavily between 165 -210°C and cardamom. Traditionally, it is roasted on the premises, ground, brewed and served in front of guests. This brewing method is common in Najd and Hijaz, and sometimes prepared with other spices like saffron (to give it a golden color), cloves, and cinnamon. It is often served with dates **Habeeb and James (2010).**

Green beans are largely non-aromatic **Holscher and Steinhart (1995)** (contain green-musty notes) but contain a large number of chemical precursors (sucrose, chlorogenic acids, proteins, carbohydrates) that contribute significantly to the aroma of R and G coffee. The relative concentration of chemical precursors varies between different coffees depending on their origin and treatment. During roasting a complex mixture of aroma compounds is formed through a number of different chemical reactions (Maillard reactions, Strecker degradation, caramelisation, and oxidation) to produce a complex mix of aroma compounds.

Viani (1993) reported that coffee contains hundreds of biologically active compounds; phenolic polymers (8g/100g), polysaccharides (6g/100g), chlorogenic acids (4g/100g), minerals (3g/100g), organic acids (0.5g/100g), sugars (0.3g/100g) and lipids (0.2g/100g). **Viani (1993**) reported that of these compounds; chlorogenic acid in coffee mediates the anti-diabetic effects of coffee. Epidemiologic studies when examined coffee consumption indicated that drinking large amounts of coffee drastically reduced the incidence of type-2 diabetes **Van Dam and Feskens (2002) and Salazar-Martinez *et al.* (2003).** Paradoxically, it was found that the consumption of caffeine (5mg/kg) in coffee results in impaired glucose tolerance in both healthy **Keijzers *et al.* (2002)** and obese individuals **Chown *et al.* (2001).**

Green coffee contains antioxidants which are good for the heart and arteries. Studies suggest that moderate coffee-drinkers have an 80% lower risk of Parkinson's disease, a 25% lower risk of colon cancer, a 50% lower risk of kidney stones and an 80% lower risk of cirrhosis of the liver. In addition, it has recently been shown that coffee may cut the risk of type II diabetes and that a decaffeinated extract of green coffee may be effective in controlling weight **(Kempf *et al.*, 2010)**. Green coffee can minimize liver glucose production and enhance reverse cholesterol of high- density lipoprotein (**Henry *et al.* ,2010)**.

With the widespread consumption of Arabic coffee in Saudi Arabia, the potential health effects of coffee are important for public health as well as for helping an individual make an informed choice regarding amounts of coffee consumption. Therefore, the aim of this study was carried out to find a replacement Arabic coffee and using green coffee and their additives are beneficial in terms of health and sensory acceptable, with some additions such as cardamom, cloves, ginger, which works to improve the taste.

2. Materials and Methods

Materials:

Green coffee beans namely Yamane variety Khulany, cardamom, cloves, ginger and drinking water were obtained from the local market from Taif region `in Kingdom Saudi Arabia. Green coffee beans cardamom, cloves and ginger were milled in laboratory Mill Junior to a fine powder.

Qassim mixture was produced by Aba AL-khall Factory for Food Industry Coffee Supplies which is one of Jind All Qassim United Group Company

Kingdom Saudi Arabia. Al Qassim consists of caramel, saffron, glucose, milk protein and plum.

Green coffee bean can be roasted in saucepan as long as they are continually stirred. The roasting temperature need to be about 200°C, after that the roasted green coffee bean had been converted to namely Arabic coffee and milled in laboratory Mill Junior to a fine powder.

Methods:

Preparation of Arabic and green coffees:

Arabic and green coffees powder was prepared using some additives as cardamom, cloves, ginger and qassim mixture (caramel, saffron, glucose, milk protein and plum) to give six mixtures. Three mixtures were prepared with green coffee and the other three mixtures made from Arabic coffee and also green coffee without additives as a considered control G and Arabic coffee which free additives which considered as a control A. The first mixture was made from 20% cardamom to green coffee, the second mixture was prepared by adding 20% from cardamom, cloves and ginger at ratios 9: 2: 9, respectively and the third mixture was consisted of green coffee and 5% qassim mixture. The three Arabic coffee mixtures were prepared the same prepared green coffee mixture. The coffee mixtures with additives and without additives were prepared by boiling 30 g of coffee powder in one liter of water for 20 min according to **Mahmoud *et al.* (2013)** and the sensory evaluation was determined. The chemical composition, vitamins and minerals content were determined in green and Arabic coffees mixture powder and their boiling.

Chemical analysis in green and Arabic coffees mixture powder and their boiling:

The green and Arabic coffees mixture powder and their boiling were analyzed for their total protein%, crude fiber% and ash% according to the methods outlined in **AOAC (2005)**. Carbohydrates were determined according to **Montgomery (1961)**. Total lipids content was determined using a Soxhlet apparatus with hexan. Total solid (°Brix), acidity (ml/100g) and pH values were determined in green and Arabic coffees mixture powder and their boiled according to the methods outlined in **AOAC (2005).**

Antioxidant activity of green and Arabic coffees mixture powder and their boiling were determined by the FRAP method described by **Benzie and Strain (1996).** A portion of 5 ml of green and Arabic coffees mixture powder and their drinking was measured followed by addition of distilled water (1:9 w/v). The homogenized were centrifuged at 6000 g for 10 minutes. The supernatant was recovered and used directly for FRAP assay without storage.

Determination of vitamins and minerals content in green and Arabic coffees mixture powder and their boiling:

Vitamins nicotinic, thiamin (B1), pyridine (B6), folic acid, vit B12 and riboflavin (B2) in green and Arabic coffees mixture powder and their boiling were determined according to the method described in the **AOAC. (2005)** using High Performance Liquid Chromatography (HPLC) Beckman model equipped by double piston pump 126 with Fluorescence detector LC 240 (Perkin Elmer); pump for reaction (Dioxin); Derivatisering tube 10 m× 0.33mm; Data handling system (Software Gold); Column Supelcosil LC-18-DB, 25Cm × 4.6 mm, 5µm; Injector 20µl (Beckman).

Macro element calcium (Ca) and Microelements iron (Fe) and zinc (Zn) of green and Arabic coffees mixture powder and their boiling were determined according to the method of the **AOAC. (2005),** using Atomic Absorption Spectrophotometer (Perkin Elmer, Model 3300, Germany). Sodium (Na) and potassium (K) contents were determined by Flame Photometer (CORNING 400, serial No. 4889.UK).

Sensory evaluation in green and Arabic coffees mixture powder and their boiling:

Twenty coffee drinkers healthy from Taif University stuff in Kingdom Saudi Arabia were judgment the green and Arabic coffees mixture boiling. Green and Arabic coffees mixture boiling were exposed to sensory properties such as appearance, color, taste, bitterness, odor and homogeneity according to the procedure described by **Isengard (2001).**

Statistical Analysis:

The data obtained were analyzed by using SPSS statistical software (version 13 SPSS Inc., Chicago. USA). The results were expressed as mean ± SD, and tested for significance using one-way analysis of variance "ANOVA" according to **SAS System (SAS Institute Inc, USA (1994).**

3. Results and Discussion

Chemical characteristics green and Arabic coffees mixture powder and their boiling:

Chemical analyzed for their total protein, crude fiber, ash, total carbohydrates, total lipids content, total solid (°Brix), acidity (ml/100g) and pH values were determined in green and Arabic coffees mixture powder and their boiled. The results are reported in Tables 1 and 2, respectively. Table (1) showed that the chemical analyzed to green and Arabic powder and their mixtures. From the results it can be noticed that the green and Arabic mixtures with 5% qasium mixture (No., 4 and 4/) were the highest content in protein, fat and crude fiber 14.51, 15.96 and 37.27 % in sample No., 4 and also sample No., 4/ was 15.07,

15.08 and 37.21%, these increased due to the qasium mixture consisted of saffron, milk protein and plum. Moreover, the resultant reported that the sample No., 3 and 3/ was prepared by adding 20% from cardamom, cloves and ginger at ratios 9: 2: 9, to green and Arabic coffee had the highest in antioxidant activity 95.32 and 94.42%, these increased may be to the green and Arabic coffee adding separately with 20% from cardamom, cloves and ginger at ratios 9: 2: 9, which is rich in natural antioxidants this may be due to the basic compounds such as caffeine and chlorogenic acid, these compounds are considered as food antioxidants and may protect animal cells against somatic mutations associated with cancer **(Richelle *et al.*, 2001).** From the same table it could be noticed that not detected variation between the samples mixture in total solids and ash, whereas, the green and Arabic coffee without addition illustrated the increasing in total carbohydrate and acidity 29.48% and 0.151 ml/100g in green coffee and 28.85% and 154 ml/100g, respectively.

Table (2) showed that the chemical composition for green and Arabic coffee and their different mixtures after boiling. From the results it could be noticed that the total solids were the highest in the sample No., 4 and 4/ after boiling (33.11 and 33.12%) due to the samples No., 4 and 4/ consists of milk protein, after boiling the heat cause denaturation of milk protein and precipitation. Moreover the resultant from fat, protein, ash, total carbohydrate, antioxidants and pH values in green and Arabic coffee and their different mixtures after boiling were paralleled for green and Arabic coffee and their different mixtures.

Protein, peptides, and free amino acids are vital for coffee favor since they are needed for the Maillard reaction. They serve as precursors for the formation of volatile compounds such as furans, pyridines, pyrazines, pyrrols, aldehydes, and melanoidins. The melanoidins are responsible for coffee's color and to some extent, its antioxidant activity. The total nitrogenous compounds (excluding caffeine and trigonelline) account for 9%–16% of the green coffee chemical composition, with a slightly higher content in *C. canephora* than *C. arabica*. However, coffee is not a good nutritional source of protein because it lacks essential amino acids. The protein content of different coffee samples was in the range of 9.21-14.33%, the same results were reported by **Santose *et al.* (2004).** According to **Franca *et al.* (2005)** the protein content of different coffee samples were in the range of 14.24-14.87%. The protein content of different coffee samples in the range of 14.00- 16.1% were also reported by **Awika *et al.* (2003).**

The fat content of different coffee samples were in the range of 11.04-12.98 (g/100g) as reported by **Oliveira *et al.* (2006).** The fat content of different coffee samples were in the range of 9.00-10.30 (g/100g) as reported by **Santos *et al.* (2004).**

The ash contents of different coffee samples are in the range of 3.64-4.44% which is in accordance to the range of 3.90-4.42% reported by **Risso et al. (2007)** showed the average ash content in different coffee samples in the range of 4.00-4.9 (g/100g**) Santose and Oliveira (2001).** The ash contents of different coffee samples in the range of 4.40-5.90 (g/100g) were also reported by **Santose *et al.* (2004).**

Carbohydrates are major constituents of coffee and may account for more than 50% of the dry weight. The poly-, oligo-, di- and mono-saccharides can be divided into reducing and non-reducing sugars **Trugo (1985).** Carbohydrates are precursors for the Maillard reaction (in the case of sucrose, after inversion) and caramelization, which are important for color and aroma development. They also contribute to the acidity of the brew after coffee roasting. Higher sucrose content is one of the reasons for the superior aroma and overall favor of Arabica coffee.

Acidity is an important feature of coffee. The main acids in green coffee beans are citric, malic, chlorogenic and quinic. During the roasting process the first three acids decrease while quinic acid increases as a result of the degradation of chlorogenic acids. The acidity and sourness of coffee brews (together with aroma and bitterness) have always been recognized as an important attributes of their sensory quality **(Camargo *et al.*, 1998).**

The total soluble solids of different coffee samples were in the range of 21.58-28.38% which was supported by the range of 25-31.02% as reported by **(Sanchez-Gonzalez *et al.*, 2005)** and illustrated the total soluble solids of different coffee samples in the range of 20.6-26.11%.

The pH levels of different coffee samples in the range of 5.91-5.98 were also reported by **(Olivrea *et al.*, 2006)**. It can be observed that, prior to extraction; the caffeinated coffee beans presented the low acidity and high pH values, whereas after the extraction the decaffeinated coffee beans showed high acidity and low pH value.

Table (1): Chemical composition of powder green and Arabic coffee:

Samples	Total solids	Fat	Total protein	Crude fibers	ash	Total carbohydrates	Acidity	Antioxidant acidity
1	94.66 [a] ±0.64	12.57 [b] ±0.28	12.26 [b] ±0.23	35.55 [b] ±0.34	4.80 [a] ±0.01	29.48 [a] ±0.45	0.151 [a] ±1.24	82.19 [b] ±0.98
2	94.31 [a] ±.0.52	12.89 [c] ±0.42	12. 14 [b] ±0.31	36.20 [b.] ±0.31	4.58 [a] ±0.02	28.50 [a] ±0.23	0.125 [c] ±1.57	91.78 [a] ±0.84
3	94.86 [a] ± 0.56	14.74 [b] ±0.12	11.97 [c] ±0.24	36.14 [b] ±0.23	4.44 [a] ±0.05	27.56 [a] ±0.51	0.122 [c] ±1.36	95.32 [a] ±0.73
4	94.96 [a] ±0.71	15.96 [a] ±0.13	15.51 [a] ±0.28	37.27 [a] ±0.15	4.81 [a] ±0.04	21.41 [b] ±0.36	0.145 [b] ±1.24	86.88 [b] ±0.54
1/	94.31 [a] ±0.49	12.46 [c] ±0.07	12.16 [b] ±0.19	36.15 [b] ±0.28	4.69 [a] ±0.02	28.85 [a] ±0.27	0.154 [a] ±1.35	78.77 [c] ±.0.38
2/	94.01 [a] ±0.61	12.07 [c] ±0.35	12.01 [b] ±0.123	36.47 [b] ±0.34	4.78 [a] ±0.06	28.68 [a] ±0.16	0.128 [c] ±1.21	90.30 [a] ±0.78
3/	94.19 [a] ±0.75	14.58 [b] ±0.24	11.07 [c] ±0.22	37.11 [a] ±0.15	4.53 [a] ±0.01	26.90 [a] ±0.34	0.125 [c] ±1.12	94.42 [a] ±0.69
4/	94.79 [a] ±0.91	15.08 [a] ±0.19	15.37 [a] ±0.35	37.21 [a] ±0.34	4.03 [a] ±0.03	23.10 [b] ±0.52	0.148 [b] ±1.24	84.42 [b] ±0.86
LSD at 5%	0.752	0.972	0.981	0.351	0.028	0.965	0.016	1.573

1: Green coffee without additives 2: Green coffee+20% Cardamoms powder
3: Green coffee + 9% Cardamoms powder + 9%Ginger powder +2% Cloves powder
4: Green coffee +5% Qasium mixture 1/:Arabic coffee without additives 2/:Arabic coffee+20% Cardamoms powder
3/:Arabic coffee + 9% Cardamoms powder + 9%Ginger powder + 2% Cloves powder 4/:Arabic coffee+5% Qasium mixture

Table (2): Chemical composition of boiling Green and Arabic Coffee:

Samples	Total solids	Fat	Total protein	ash	Total carbohydrates	pH	Antioxidant acidity
1	31.60 [a] ±.0.23	4.2 [b] ±.0.024	10.20 [b] ±.0.22	3.54 ±.0.012	13.66 [a] ±.0.16	5.4 [a] ±.0.015	73.5 [c] ±.0.81
2	29.80 [b] ±.0.32	4.2 [b] ±.0.038	10.13 [b] ±.0.34	3.48 [a] ±.0.024	11.99 [c] ±.0.24	5.2 [a] ±.0.021	85.95 [b] ±.0.91
3	30.52 [a] ±.0.41	4.7 [b] ±.0.012	10.31 [b] ±.0.42	3.480 [a] ±.0.015	12.03 [b] ±.0.31	5.2 [a] ±.0.023	90.70 [a] ±.0.87
4	33.11 [a] ±.0.28	5.9 [a] ±.0.034	11.41 [a] ±.0.35	3.72 [a] ±.0.023	12.09 [b] ±.0.41	5.2 [a] ±.0.014	71.10 [c] ±.0.94
1/	30.60 [b] ±.0.51	4.1 [b] ±.0.041	9.87 [c] ±.0.46	3.30 [a] ±.0.026	13.33 [a] ±.0.24	5.5 [a] ±.0.024	71.37 [c] ±.0.78
2/	28.80 [c] ±.0.29	4.1 [b] ±.0.025	9.50 [c] ±.0.28	3.22 [a] ±.0.017	11. 98 [c] ±.0.29	5.2 [a] ±.0.015	84.04 [b] ±.0.95
3/	29.84 [b] ±.0.38	4.5 [b] ±.0.042	10.11 [b] ±.0.39	3.24 [a] ±.0.024	11.99 [c] ±.0.28	5.2 [a] ±.0.024	90.13 [a] ±.0.64
4/	33.12 [a] ±.0.31	5.8 [a] ±.0.032	11.99 [a] ±.0.29	3.24 [a] ±.0.043	12.09 [b] ±.0.23	5.2 [a] ±.0.016	67.70 [d] ±.0.72
LSD at 5%	0.968	0.0471	0.825	0.0215	0.694	0.0124	1.983

Vitamins content in green and Arabic coffee and their boiling:

Vitamins as nicotinic, thiamin, pyridoxine, folic acid and riboflavin were determined in green and Arabic powder and their mixtures and the results are reported in Table (3). Whereas, the vitamins were determined in green and Arabic powder and their mixtures after boiling and the results are reported in Table (4).

From the results in Table (3), it could be noticed that the coffee sample No., 3 and 3/ consists of green and Arabic coffee were prepared by adding 20% from cardamom, cloves and ginger at ratios 9: 2: 9, had the highest in nicotinic, thiamin, pyridoxine, folic acid, B12 and riboflavin were 88.05, 55.8, 0.41, 0.41 0.423 and 2.23 mg/100g in green coffee mixture (sample No., 3). Whereas, in Arabic coffee mixture (sample No., 3/) in the same vitamins were 83.84, 51.6, 0.37, 0.41, 0.37 and 2.08 mg/100g respectively. Whilst, the sample No., 4 and 4/ had contained 5% qasium mixture were added to green and Arabic coffee gave quintets 69.94, 58.1, 0.35, 0.39, 0.37 and 0.1.95 mg/100g in green coffee (sample No., 4). Arabic coffee (sample No., 4/) had amounted 59.19, 50.6,

0.34, 0.37, 0.39 and 1.76 mg/100g, respectively, followed by green and Arabic coffee with mixture 20% cardamoms powder (samples No., 2 and 2/) were reported 68.84, 54.8, 0.31, 0.38, 0.38 and 1.81 mg/100g in green coffee and also, 53.65, 49.7, 0.29, 0.37, 0.37 and 1.63mg/100g, respectively in Arabic coffee. Moreover, the green and Arabic coffee free addition were the lowest amounted in all vitamins due to the coffee mixture had contained different amounts from cardamom, cloves, ginger and qassim mixture may be increased in vitamins content.

Table (4) showed that the vitamins content for green and Arabic coffee and their different mixtures after boiling. The resultant from vitamins as nicotinic, thiamin, pyridoxine, folic acid and riboflavin in green and Arabic coffee and their different mixtures after boiling were paralleled for powder green and Arabic coffee and their different mixtures.

Thiamine is found practically in all plant and animal foods. Cereals, heart, liver and kidney are excellent sources of it. In cereals, the outer layers of seeds are especially rich in thiamine. Thiamine is easily destroyed by heat in neutral or alkaline media. Because the covering of the grains of cereals contains most of the vitamin, polishing reduces its availability. Canning processes are, however, not particularly destructive **Lehninger *et al.* (1993)** and the daily recommended dietary allowances are 1.2–1.4 mg for men and 1.0 mg for women. Pregnant and lactating mothers, however, require up to 1.5 mg daily. The thiamine requirement for infants is between 0.2 and 0.5 mg daily **National Research Council (1980).**

Riboflavin or vitamin B2 was first isolated in 1879 from milk whey which is an essential dietary factor for rats. Since it was first isolated from milk, vitamin B2 is also known as lactoflavin**.** Originally, it was also knownas ovoflavin (from eggs) and hepatoflavin (from liver). The minimum daily requirement of riboflavin varies from 0.6 to1.7 mg for children and adults. During pregnancy and lactation, the women require up to 2.0 mg daily **National Research Council (1980).**

Vitamin B6 group includes 3 compounds: pyridoxine, pyridoxal and pyridoxamine. The B6 vitamins are widely distributed in nature in plant and animal tissues. They are especially rich in cereals (wheat, rice), peas, turnip greens, brussels sprouts, carrots, potatoes, sweet potatoes, bananas, avocados, watermelons and yeasts **Dolphin *et al.* (1986)**. The minimum dietary allowance of vitamin B6 is between 0.2 and 1.2 mg for infants and children and around 2.0 mg for men and women per day. During pregnancy and lactation, the recommended daily dose is 2.5 mg.

Folic acid also functions to maintain stable levels of insulin together with vitamin B12 and vitamin C. Keeping your blood insulin levels constant is important for efficient fat burning; your body will more effectively burn the fats from foods instead of storing them **Blakley (1969).** The daily dietary allowance of folic acid is 0.1 mg for infants, 0.2 mg for children and 0.4 mg for adult men and women. Pregnant mothers may, however, require up to 0.8 mg per day and also, the recommended daily allowance of vitamin B12 is 2 to 4 µg for children and 5 µg for men and women. Pregnant and lactating mothers require 8 µg and 6µg daily **National Research Council (1980).**

Table (3): Vitamins content (mg/100g) of powder green and Arabic coffee:

Samples	Nicotinic	B12	Pyridoxine (B6)	Folic acid	Thiamin	Riboflavin
1	**50.30** ^{c} ±.0.24	**0.19** ^{c} ±.0.012	**0.25** ^{c} ±.0.013	**0.22** ^{c} ±.0.011	**45.8** ^{b} ±.0.24	**0.89** ^{c} ±.0.024
2	**68.84** ^{b} ±.0.32	**0.35** ^{b} ±.0.021	**0.31** ^{b} ±.0.025	**0.38** ^{b} ±.0.012	**54.8** ^{a} ±.0.27	**1.81** ^{b} ±.0.12
3	**88.05** ^{a} ±.0.51	**0.42** ^{a} ±.0.014	**0.41** ^{a} ±.0.022	**0.42** ^{a} ±.0.021	**55.8** ^{a} ±.0.31	**2.23** ^{a} ±.0.23
4	**69.94** ^{b} ±.0.54	**0.37** ^{b} ±.0.031	**0.35** ^{b} ±.0.024	**0.39** ^{b} ±.0.013	**58.1** ^{a} ±.0.25	**1.95** ^{b} ±.0.09
1/	**49.52** ^{c} ±.0.42	**0.17** ^{c} ±.0.25	**0.24** ^{c} ±.0.016	**0.21** ^{c} ±.0.016	**45.1** ^{b} ±.0.32	**0.82** ^{c} ±.0.07
2/	**53.65** ^{c} ±.0.32	**0.34** ^{b} ±.0.24	**0.29** ^{b} ±.0.021	**0.37** ^{b} ±.0.015	**49.7** ^{b} ±.0.24	**1.63** ^{b} ±.0.84
3/	**83.84** ^{a} ±.0.61	**0.40** ^{a} ±.0.030	**0.37** ^{b} ±.0.031	**0.41** ^{a} ±.0.014	**51.6** ^{a} ±.0.15	**2.08** ^{a} ±.0.054
4/	**59.19** ^{c} ±.0.43	**0.39** ^{d} ±.0.018	**0.34** ^{b} ±.0.028	**0.37** ^{b} ±.0.013	**50.6** ^{a} ±.0.28	**1.76** ^{b} ±.0.67
LSD at 5%	**0.541**	**0.0214**	**0.0132**	**0.0221**	**0.438**	**0.735**

Table (4): Vitamins content (mg/100g) of boiling green and Arabic coffee:

Samples	Nicotinic	B12	Pyridoxine (B6)	Folic acid	Thiamin	Riboflavin
1	**48.29** [c] ±.0.71	**0.16** [c] ±.0.021	**0.21** [b] ±.0015.	**0.10** [b] ±.0.001	**45.8** [b] ±.0.42	**0.14** [b] ±.0.015
2	**54.19** [b] **±.0.58**	**0.25** [b] **±.0.013**	**0.27** [b] **±.0.012**	**0.31** [a] **±.0.**	**53.0** [a] **±.0.48**	**1.70** [a] **±.0.35**
3	**76.32** [a] ±.0.61	**0.32** [a] ±.0.024	**0.33** [a] ±.0.014	**0.35** [a] ±.0.011	**54.0** [a] ±.0.39	**1.95** [a] ±.0.27
4	**55.25** [b] ±.0.75	**0.27** [d] ±.0.025	**0.31** [a] ±.0.016	**0.32** [a] ±.0.012	**55.0** [a] ±.0.71	**1.77** [a] ±.0.21
1/	**43.74** [c] ±.0.62	**0.15** [c] ±.0.027	**0.20** [b] ±.0.012	**0.10** [b] ±.0.001	**45.3** [b] ±.0.61	**0.10** [b] ±.0.01
2/	**50.82** [b] ±.0.80	**0.20** [b] ±.0.021	**0.30** [a] ±.0.013	**0.30** [a] ±.0.012	**50.2** [a] ±.0.38	**1.61** [a] ±.0.15
3/	**72.67** [a] ±.0.63	**0.31** [a] ±.0.021	**0.30** [a] ±.0.014	**0.32** [a] ±.0.013	**50.3** [a] ±.0.43	**1.90** [a] ±.0.17
4/	**52.46** [b] ±.0.91	**0.23** [b] ±.0.015	**0.34** [a] ±.0.016	**0.32** [a] ±.0.012	**52.9** [a] ±.0.29	**1.71** [a] ±.0.19
LSD at 5%	**0.957**	**0.0216**	**0.0135**	**0.0124**	**0.947**	**0.253**

Minerals content in green and Arabic coffee and their boiling:

Minerals content as iron (Fe), calcium (Ca), potassium (K), zinc (Zn) and sodium (Na) were determined in green and Arabic powder and their mixtures and the results are reported in Table (3). Whereas, the minerals content were determined in green and Arabic powder and their mixtures after boiling and the results are reported in Table (4).

From the results in Table (5), it could be noticed that the coffee sample No., 3 and 3/ were the highest amounted in all minerals 2.2 6, 5.22, 3.45, 2.39 and 9.48 mg/100g in green coffee mixture (sample No., 3), whereas, in Arabic coffee mixture (sample No., 3/) the same minerals content were 2.22, 4.91, 3.31, 2.22 and 9.40 mg/100g respectively. Whilst, the sample No., 4 and 4/ had contained 5% qasium mixture were good source of vitamins content followed by green and Arabic coffee with mixture 20% cardamoms powder (samples No., 2 and 2/) . Moreover, the green and Arabic coffee free additions were the lowest amounted in all minerals content.

Table (6) showed that the minerals content as iron (Fe), calcium (Ca), potassium (K), zinc (Zn) and sodium (Na) for green and Arabic coffee and their different mixtures after boiling. The resultant from green and Arabic coffee and their different mixtures after boiling were paralleled for powder green and Arabic coffee and their different mixtures.

Minerals are inorganic compounds and their structure is usually nothing more than a molecule, or molecules, of an element. The functions of minerals do not include participation in the yielding of energy. But they do play vital roles in several physiological functions, including critical involvement in nervous system functioning, in cellular reactions, in water balance in the body, and in structural systems, such as the skeletal system. The determination of mineral nutrients in coffee is of great interest, considering the great consumption of this product for millions of people world-wide **(Santos *et al.*, 2004).**

However, the mineral content was found to increase, which is good for human health since minerals such as potassium and magnesium aid in the maintenance of bone mineral density which can reduce osteoporosis by reducing the rate of bone attrition and calcium excretion while calcium itself is good for bone health **(Tucker *et al.*, 1999).**

The copper contents of different coffee samples were in the range of 0.10-1.98 (mg/100g) which were supported by the range 0.03-2.01 (mg/100g) as given by **(Gonzalez *et al.*, 2000)** that exhibited the concentration of copper in the range of 1.21-2.01 (mg/100g) in caffeinated coffee, 1.59-2.00 (mg/100g) in decaffeinated coffee and 0.03-0.12 (mg/100g) in instant coffee. **Gonzalez *et al.* (2000)** determined the concentration of Na in rang of 3.65-170 (mg/100g) in caffeinated coffee, 39.2-93.9 (mg/100g) in decaffeinated coffee and 2.78-347 (mg/100g) in instant coffee samples respectively. The concentrations of Na in different coffee verities (Robusta and Arabica) were in the range of 1.06-6.6 (%) as reported by The concentration of Ca in different coffee verities (Robusta and Arabica) was in the range of 0.087-0.135 as reported by **(Sanchez-Gonzalez *et al.*, 2005). Santos and Oliveira, (2001)**

reported the concentration of Ca in different Brazilian soluble coffee samples in the range of 106-167 (mg/100g).

This beverage also provides an array of minerals and other nutrients. A single cup of coffee can provide 8 percent of the daily intake of chromium as well as being a significant source of magnesium **(Santos *et al.*, 2004).**

Table (5): Minerals content in powder green and Arabic coffee mg/100g:

Samples	Fe	Ca	K	Zn	Na
1	**0.81** [c] ±.0.022	**5.19** [c] ±.0.24	**1.45** [c] ±.0.054	**1.75** [b] ±.0.034	**4.09** [b] ±.0.24
2	**0.93** [c] ±.0.021	**10.92** [b] ±.0.82	**2.21** [b] ±.0.076	**1.95** [b] ±.0.035	**4.44** [b] ±.0.25
3	**2.26** [a] ±.0.013	**15.22** [a] ±.0.65	**3.45** [a] ±.0.064	**2.39** [a] ±.0.028	**9.48** [a] ±.0.72
4	**1.86** [b] ±.0.011	**13.69** [a] ±.0.91	**2.69** [b] ±.0.57	**1.97** [b] ±.0.027	**4.83** [b] ±.0.28
1/	**0.76** [c] ±.0.015	**4.14** [c] ±.0.21	**2.02** [b] ±.0.058	**1.27** [b] ±.0.023	**4.39** [b] ±.0.29
2/	**0.78** [c] ±.0.014	**9.91** [b] ±.0.67	**2.31** [b] ±.0.098	**1.42** [b] ±.0.089	**4.40** [b] ±.0.23
3/	**2.22** [a] ±.0.013	**14.91** [a] ±.0.93	**3.31** [a] ±.0.094	**2.22** [a] ±.0.098	**9.40** [a] ±.0.61
4/	**1.37** [b] ±.0.014	**12.91** [a] ±.0.75	**2.61** [b] ±.0.087	**1.49** [b] ±.0.084	**4,72** [b] ±.0.21
LSD at 5%	**0.0572**	**0.973**	**0.127**	**0.583**	**0.619**

Table (6): Minerals content in boiling green and Arabic coffee mg/100g:

Samples	Fe	Ca	K	Zn	Na
1	**0.51** [b] ±.0.021	**2.92** [c] ±.0.14	**0.74** [b] ±.0.035	**0.65** [b] ±.0.042	**3.18** [b] ±.0.364
2	**0.77** [b] ±.0.022	**7.06** [b] ±.0.53	**0.78** [b] ±.0.038	**0.68** [b] ±.0.054	**3.53** [b] ±.0.42
3	**1.58** [a] ±.0.023	**11.40** [a] ±.0.64	**0.92** [a] ±.0.034	**0.86** [a] ±.0.035	**8.79** [a] ±.0.25
4	**1.28** [a] ±.0.025	**10.56** [a] ±.0.72	**0.90** [a] ±.0.075	**0.62** [b] ±.0.061	**3.61** [b] ±.0.21
1/	**0.58 c** ±.0.024	**2.87 c** ±0.24	**0.34 c** ±0.024	**0.55** [b] ±0.071	**3.00** [b] ±0.26
2/	**0.61** [b] ±.0.026	**6.71** [b] ±.0.34	**0.67** [b] ±.0.06+1	**0.59** [b] ±.0.024	**3.13** [b] ±.0.31
3/	**1.74** [a] ±.0.027	**13.64** [a] ±.0.92	**0.89** [a] ±.0.072	**0.71** [a] ±.0.026	**7.80** [a] ±.0.57
4/	**1.25** [a] ±.0.012	**10.70** [a] ±.0.67	**0.87** [a] ±.0.065	**0.60** [b] ±.0.019	**3.33** [b] ±.0.28
LSD at 5%	**0.0342**	**0.927**	**0.0864**	**0.0821**	**0.942**

Sensory evaluation of boiling green and Arabic coffee samples mixture:

The sensory evaluation of green and Arabic coffee samples for various attributes such as color, odor, bitterness, taste, appearance, homogeneity and evaluated by a panel of judges and the results are described in Table (7).

Color has a profound influence on the acceptance of boiling green and Arabic coffee and their mixture and the results showed that the green coffee mixture (No., 3) consisted of green coffee plus 20% from cardamoms, ginger and cloves at ratios 9: 9: 2, respectively are presented in the table (7) exhibited that the highest scores (19.50) which was statistically similar to coffee mixture (No., 3/) consisted of Arabic coffee plus 20% from cardamoms, ginger and cloves at ratios 9: 9: 2, respectively as (19.20). The green and Arabic coffee

with 5% qasium mixture (No., 4 and 4/) had become good source of coffee drink followed by green and Arabic coffee plus 20% cardamoms. The green and Arabic coffee without any addition (No., 1 and 1/) gave the lowest in all parameters and total acceptability.

Odor is also important for the acceptance of product. It is combined perception of smell and mouth feels. Odor means in table (7) indicated that the best score for taste was given by green coffee (No., 3) with mean value of 14.91 and Arabic coffee (No., 3) which attain same score as 14.89 and the lowest score was obtained by green coffee (No., 1) without addition with mean value of 12.17. This means the cardamoms, ginger and cloves when added to green coffee gave the best green coffee mixture do not caused any harmful on human health.

Aroma also has a profound influence on the acceptance of coffee and other food products. The means of various brands of coffee are presented in table 13 exhibited that the highest scores (7.4) were given to T4 (caffeinated ground coffee) which was statistical at par to T2 (decaffeinated coffee beans) as (6.9) and T0 (instant coffee) as (6.8) which showed no significant relationship, while the least score was given by T1 (caffeinated coffee beans) as (6) Judges rated the T4 (decaffeinated ground coffee) treatment as best which obtained maximum score (7.4).

The resultant from appearance, homogeneity, bitterness and taste were paralleled the same obviously other parameters.

Data regarding means of various brands of coffee is presented in Table (7) revealed that samples No., 3 and 3/(green and Arabic coffee plus 20% from cardamoms, ginger and cloves at ratios 9: 9: 2) showed the highest score as 98.79 and 97.44 which was statistical at par to samples No.,4 and 4/ (green and Arabic coffee plus 5% qasium mixture) as 96.73 and 95.44 followed by 2 and 2/ green and Arabic coffee mixture plus 20% cardamoms as 92.35 and 91.56 while the least score exhibited by samples No., 1 and 1/ (green and Arabic coffee free additions) as 90.54 and 88.01, respectively.

Table (7): Sensory evaluation of boiling green and Arabic coffee samples mixture:

Samples	Homogeneity 20	Color 20	Taste 15	Bitterness 15	Odor 15	Appearance 15	Acceptability 100
1	18.95^{a} ±0.06	18.41^{ab} ±0.39	14.23^{a} ±0.92	12.85^{c} ±0.78	12.12^{c} ±0.07	13.98^{b} ±0.66	90.54
/1	18.44^{a} ±0.13	18.20^{b} ±0.65	13.45^{c} ±0.11	12.58^{c} ±0.13	12.17^{c} ±0.78	13.17^{b} ±0.66	88.01
2	19.15^{a} ±0.71	18.87^{ab} ±0.44	14.41^{a} ±0.06	13.12^{ab} ±0.85	12.45^{c} ±0.62	14.35^{a} ±0.16	92.35
/2	17.57^{bc} ±0.23	18.00^{b} ±0.12	14.35^{ab} ±0.28	13.65^{b} ±0.48	13.68^{b} ±0.09	14.31^{ab} ±0.67	91.56
3	19.75^{a} ±0.56	19.50^{a} ±0.13	14.82^{a} ±0.66	14.90^{a} ±0.11	14.91^{a} ±0.80	14.91^{a} ±0.65	98.79
/3	19.30^{a} ±1.06	19.20^{a} ±0.93	14.35^{a} ±0.97	14.80^{a} ±0.74	14.89^{a} ±0.78	14.90^{a} ±0.99	97.44
4	19.00^{a} ±1.06	19.10^{a} ±0.63	14.32^{a} ±0.97	14.80^{a} ±0.74	14.63^{a} ±0.72	14.88^{a} ±0.63	96.73
/4	18.40^{b} ±1.06	19.10^{a} ±0.12	14.25^{a} ±0.28	14.70^{a} ±0.47	14.42^{a} ±0.09	14.67^{a} ±0.67	95.44

From the obviously results, it could be recommended that the green and Arabic coffee mixture separately with 20% from cardamoms, ginger and cloves at ratios 9: 9: 2, gave the best coffee followed by the coffee plus 5% qasium mixture and coffee with 20% cardamoms.

Therefore, the replacement of Arabic coffee and using green coffee is low harmful, safety, nutrition, beneficial health and sensory acceptable, with some additives such as cardamom, cloves, ginger, which works to improve the taste.

References

AOAC (2005). Official Methods of Analysis of the Association of Official Analytical Chemists, 18th ed., Washington, D.C.

Awika, J. M., Rooney, L. W., Wu, X., Prior, R. L., Cisneros- Zevallos, L. (2003). Screening antioxidant activity of sorghum and sorguham products. Journal of Agriculture Food Chemistry 51: 6657-6662.

Belitz, H.-D., Grosch, W. and Schieberle, P. (2009). Coffee, tea, cocoa In H.-D. Belitz, W.

Grosch, & P. Schieberle (Eds.), Food Chemistry (4th ed., pp. 938–951). Leipzig: Springer.

Benzie, I. and Strain, J. (1996). The ferric reducing ability of plasma as a measure of "antioxidant power." The FRAP assay. Anal Biochemistry, 239: 70-76.

Blakley, R. L. (1969). The Biochemistry of Folic Acid and Related Pteridines. Elsevier, North Holland, Amsterdam. 1969.

Camargo, M. C. R. and Toledo, M. C. F. (1998). Caffeine content of commercial brazilian coffee. Cienc Technol Aliment 18: 421–4

Chown, S., Petrie, H. and Duncan, A. (2001). Caffeine increases the insulin/glucose response to an OGTT in obese, resting males. Can. J. Appl. Physiol. 26 (suppl.): S249.

Clarke, R. J. (2003). Coffee: green coffee/roast and ground. In: Encyclopedia of Food Science and Nutrition, 2nd edition, Caballero, B., Trugo, L. C., Finglas, P., eds. Oxford: Academic Press; 2003, Vol. 3.

Dolphin, D., Poulson, R. and Avramovic, O. (1986). Vitamin B6 Pyridoxal Phosphate, Parts A and B. Chemical, Biochemical and Medical Aspects. John Wiley and Sons, New York. 1986.

Franca, A. S., Mendonca, J.C.F. and Oliveira, S. D. (2005). Composition of green and roasted coffees of different cup qualities. LWT 38: 709–715.

Gonzalez, A. G., Pablos, F., Martin, M. J., Leon-Camacho, M. and Valdenebro, M.S. (2000). HPLC analysis of tocopherols and triglycerides in coffee and their use as authentication parameters. Journal of Food Chemistry, 73: 93 -101.

Grembecka, M., Malinowska, E. and Szefer, P. (2007). Differentiation of market coffee and its infusions in view of their mineral composition. Science of the Total Environment, 383, 59–69.

Habeeb, S., and James, P. (2010). From the Lands of Figs and Olives. I.B.Tauris Publishers. pp. 232–233.

Henry, V. C., Ibarra, A. R., Merillon, J. M. and Vitrac , X. (2010). Contribution of chlorogenic acids to the inhibition of human hepatic gloucose 6 phosphatase activity in vitro by svetol, a standardized J. Agric. Food Chem., 14 (7):4141-58.

Holscher, W. and Steinhart, H. (1995). Aroma compounds in green coffee. In Developments in Food Science. Volume 37. Edited by George C. London: Elsevier; 1995:785–803.

International Coffee Organization (ICO) (2011). Statistics. Breakdown of exports of green Arabica and green Robusta of countries exporting significant volumes of both types of coffee June 2009, January 2011.

Isengard, H. D. (2001). Water content, one of the most important properties of food. Food Control, 12: 395–400.

Keijzers, B., De Galan, E. and Bastiaan, E. (2002). Caffeine can decrease insulin sensitivity in humans. Diabetes Care, 25: 364–369.

Kempf , K., Herder, C., Erlund, I., Kolb, H., Martin, S., Carstensen, M., Koenig, W., Sundvall, J., Bidel, S., Kuha, S. and Jaakko, T. (2010). Coffee consumption is associated with a decreased risk of type 2 diabetes. Am. J. Clin. Nutr., 91(4):950-7.

Lehninger, A. L., Nelson, D. L. and Cox, M. M. (1993). Prenciples of Biochemistry. 2nd Ed., Worth Publishers, 33 Irving Place, New York, pp 1090.

Mekuria, T., Neuhoff, D. and Kopke, U. (2004). The Status of Coffee Production And The Potential For Organic Conversion In Ethiopia. Conference on International Agricultural Research for Development.

Mahmoud, O. N., Al-Qahiz, N. M. and Ismail, M. S (2013). Different doses of Arabic coffee improve serum lipid profile, uric acid and liver enzymes of experimental rats. Food and Public Health, 3(4): 228-233

Montgomery, R. (1961). Further studies of phenol-sulphuric acid reagent for carbohydrates Brioche. Biohys.Acta , 84,591-593.

Mussatto, S. I., Machado, E. M. S., Martins, S. and Teixeira, J. A. (2011). Production, composition and application of coffee and its industrial residues. Food Bioprocess Technol., 4:661–672.

National Research Council (1980). Recommended Dietary Allowances. National Academy of Sciences (U.S.

Oliveira, L. S., Franca, A. S., Mendonca, J. C. F. and Barros-Junior, M. C. (2006). Proximate composition and fatty acids profile of green and roasted defective coffee beans. Lebensm. Wiss. Technol., 39: 235–239.

Richelle, M., Tavazzi, I. and Offord, E. (2001). Comparison of the Antioxidant Activity of Commonly onsumed Polyphenolic Beverages (Coffee, Cocoa, and Tea) Prepared per Cup Serving. Journal of Agriculture and Food Chemistry, 49: 3438-3442

Risso, E. M., Peres, R. G. and Farfan, J. A. (2007). Determination of phenolic acids in coffee by micellar electrokinetic chromatography. Food Chemistry 105: 1578–1582.

Salazar-Martinez, E., Willett, W. and Ascherio, A. (2003). Coffee consumption and risk of type 2 diabetes in men and women. Diabetes; 52: A72.

Sanchez-Gonzalez, I., Jimenez-Escrig, A. and Saura-Calixto, F. (2005). In vitro antioxidant activity of coffees brewed using different procedures (Italian, espresso and filter). Food Chemistry 90: 133–139.

Santose, E. J. D. and Oliveira, E. D. (2001). Determination of Mineral Nutrients and Toxic Elements in Brazilian Soluble Coffee by ICP-AES. Journal of Food Composition and Analysis, 14: 523-531.

Santos, E. E., Lauria, D. C. and Porto da Silveria, C. L. (2004). Assessment of daily intake of trace elements due to consumption of food stuffs by adult inhabitants of Rio de Janeiro city. Sci Total Env., 327: 69-79.

SAS Institution (1994). SAST user statistics, var 6.04, 4 th Ed.SAS. Institution.Cary,N.C.

Trugo, L. (2003). Coffee. In B. Caballero, L. Trugo, and P. Finglas (Eds.), Encyclopedia of Food Sciences and Nutrition (2nd ed.). London: Academic.

Trugo, L. C. (1985). Carbohydrates. In: Coffee, 1st edition, Clarke R. J., Macrae, R., eds. Essex: Elsevier Applied Science Publishers; 1985, Vol 1: Chemistry, p. 83.

Tucker, K.L., Hannan, M.T., Chen, H., Cupples, L.A., Wilson, P.W.F. and Kiel, D.P. (1999). Potassium, magnesium, and fruit and vegetable intakes are associated with greater bone mineral density in elderly men and women. The American Journal of Clinical Nutrition 69: 727-736.

Van Dam, M. and Feskens, M. (2002). Coffee consumption and risk of type two diabetes mellitus. Lancet 2002; 360: 1477–1478.

Viani R. (1993). The composition of coffee. In: Caffeine, Coffee, and Health. Raven, New York, NY.

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