ISSN: 0975-833X

Available online at http://www.journalcra.com

International Journal of Current Research
Vol. 10, Issue, 11, pp.75651-75654, November, 2018

DOI: https://doi.org/10.24941/ijcr.33233.11.2018

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

RESEARCH ARTICLE

EFFECTS OF CASHEW NUTS AND GROUNDNUTS INTAKE ON SOME MINERALS IN APPARENTLY HEALTHY MALE SUBJECTS

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ARTICLE INFO

Article History:
Received 17th August, 2018
Received in revised form
08th September, 2018
Accepted 26th October, 2018
Published online 30th November, 2018

Key Words:
Cashew nut, Groundnut, Minerals, Nuts.

ABSTRACT

Nuts consumption has been attributed to and recognized as a source of high energy food and good nutrition. The research assessed the effect of cashew and groundnuts consumption on the levels of some minerals (sodium, potassium, bicarbonate, chloride, iron and total iron binding capacity). The nuts were administered to male subjects and the effects on electrolyte levels were assessed by comparing the results obtained before and after consumption of the nuts. The levels of sodium and potassium were determined using flame photometry while the bicarbonate and chloride were determined by titration. The results showed significant decrease ($p<0.05$) in the level of potassium after the consumption of cashew nuts. No significant changes were observed in the levels of sodium, chloride, bicarbonate, iron and total iron binding capacity after the consumption of cashew and groundnut. This may be due to the presence of high content of dietary fiber which readily accumulates in seeds.

Citation: Oluboyo, A.O., Oluboyo, B.O., Onyeaghala, A.A. and Odewusi O.O., 2018. "Effects of cashew nuts and groundnuts intake on some minerals in apparently healthy male subjects", *International Journal of Current Research*, 10, (11), 75651-75654.

INTRODUCTION

Nuts are recognized as a source of high energy food and good nutrients due to high content of fats, carbohydrates, proteins, vitamins and minerals (Bes-Rastrollo, 2009; Souza, 2015; Cardoso, 2017 and Taş, 2017). Several epidemiological studies have revealed that people who consume nuts regularly are less likely to suffer from coronary heart disease (Souza, 2015 and Jackson, 2014). Cashew (*Anacardium occidentale*) is also a source of dietary trace minerals copper, iron, manganese, magnesium and phosphorus etc (Mah, 2017). Groundnuts are known by many local names such as earthnuts, peanuts, goober peas, monkey nuts, pygmy nuts and pig nuts (Jauron, 1997).

Groundnuts are rich in nutrients and phytonutrients. Groundnuts are good source of niacin, folate, vitamin E, magnesium and phosphorus. They also are naturally free of trans-fats and sodium, and contain about 25% protein. Some studies have assessed associations between peanut consumption and postprandial blood glucose, nutrient intake, elevated fat oxidation rate and increased satiety (Reis, 2011; Wien, 2014; Alves, 2014 and Reis, 2013). They stated that there are no positive associations between peanut consumption and body fat and that the consumption of large portions did not result in changes in body composition (Wien, 20147 and Barbour, 2015).

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Nuts generally have been shown to possess a good number of electrolytes and mineral contents and these have been shown to have a lot of health benefits (Ros, 2010 and Fischer, 2013). Sodium is the major cation in extracellular fluid and essential element for normal life cycle and metabolism of both plants and animals. Sodium makes some 93% of the total cation content in blood plasma (Leeson, 2001). Potassium is an essential mineral and a major electrolyte found in the human body. It plays an important role in electrolyte regulation, nerve function, muscle control, and blood pressure. Potassium is found within all cells of the body, and its levels are controlled by the kidneys. Primarily, potassium functions to regulate water and mineral balance throughout the body (Mahan, 2012 and Martin, 2015). Chloride also plays a role in helping the body maintain a normal balance of fluids. It is mostly seen as an anion accompanying sodium and hardly exists alone. It also acts as a buffer in the exchange of oxygen and carbon dioxide in red blood cells (Yunos, 2010). Extracellular bicarbonate levels are regulated by the kidneys which regenerate and reabsorb bicarbonate ions. Unlike other electrolytes that must be consumed in the diet, adequate amounts of bicarbonate are produced through metabolic processes to meet the body's needs (Yucha, 2004). Many processes in the body, especially in the brain, nervous system, and muscles, require electrical signals for communication. The movement of sodium is critical in generation of these electrical signals. Therefore, too much or too little sodium can cause cells to malfunction, and extremes in the blood sodium levels, too much or too little can

be fatal (Wessling-Resnick, 2014). Iron (Fe) is a mineral that is naturally present in many foods, added to some food products, and available as a dietary supplement. Iron is an essential component of hemoglobin, an erythrocyte protein that transfers oxygen from the lungs to the tissues (Wessling-Resnick, 2014). As a component of myoglobin, a protein that provides oxygen to muscles, iron supports metabolism (Aggett, 2012). Iron is also necessary for growth, development, normal cellular functioning, and synthesis of some hormones and connective tissues (Murray-Kolbe, 2010). Total iron-binding capacity (TIBC) measures the blood's capacity to bind iron with transferring its transport protein in blood and it is therefore a measure of the maximum amount of iron that it can carry, which indirectly measures transferring (Yamanishi, 2003). Thus, the study determined the effects of some serum minerals in healthy male subjects before and after cashew and groundnut consumption.

MATERIALS AND METHODS

The ethical approval for the research was obtained from College of Health Sciences and Technology, Nnamdi Azikiwe University (NAU) ethical committee and in accordance with the Helsinki Declaration by the World Medical Association (WMA) on the ethical principles for medical research involving human subjects. The research study involved thirty six (36) volunteered students. Participants were randomly assigned into two groups (A and B) of 18 subjects each. They were instructed to cut down on fatty foods. Habitual diets were consumed by these subjects for two weeks while they abstained from the nuts. Samples were collected from group A and B respectively at day zero (0) as control sample (before consumption). Serum sodium, potassium, chloride, iron and total iron binding capacity were analyzed in the samples. Subsequently, the habitual diet was supplemented with 100g of unsalted roasted cashew nuts for Group A subjects and 100g of unsalted roasted groundnut for group B subjects respectively daily for 3 weeks. Samples were collected from the subjects (after consumption) on day 22 and the serum sodium, potassium, chloride, bicarbonate, iron and total iron binding capacity were determined. The subjects consumed the nuts prior to their breakfast daily.

METHODS OF DETERMINATION OF PARAMETERS

Determination of serum sodium and potassium using flame photometry (Mosiier, 1949)

Principle: Potassium or sodium solutions under carefully controlled conditions when finely sprayed (aspirated) into a burner, the flame de-solvates the solution leaving solids – (salt) which associate to give neutral ground state atom. Some of these atoms are excited in the flame thus moving into a higher energy state; when these excited atoms falls back to the ground state – light of characteristic wavelength is emitted (590mm for sodium and 770mm for potassium). This light then passes through a suitable filter onto a photo sensitive element and the amount of current thus produced is measured. This is proportional to the amount of sodium or potassium present in the sample.

Determination of serum chloride was done using mercuric nitrate titrimetric (Roberts, 1936)

Principle: When mercuric nitrate solution is added to a solution containing chloride, un-ionized but soluble mercuric chloride is formed. At the end-point, first-excess mercuric ions combine with indicator (diphenylcarbazone) to give a violet-blue coloured complex.

Determination of serum bicarcabonate was done using back titration method (Pauss, 1990)

Principle: An excess of acid 0.01N HCl is added to serum or plasma and CO_2 is evolved (escapes into the atmosphere); the excess of acid is back titrated with alkali (0.01N NaOH); bicarbonate concentration is equal to the difference between the added acid concentration and the alkali concentration used for titrating the excess of acid after CO_2 evolution.

Serum Iron was determined colorimetrically (Horak, 1974)

Principle: The iron in serum is dissociated from its Fe (III) – transferring complex by the addition of an acidic buffer containing hydroxylamine. This addition reduces the Fe (III) to Fe (II). The chromogenic agent, ferene, forms a highly colored Fe (II) – complex that is measured photometrically at 560nm. The unsaturated iron binding capacity (UIBC) is determined by adding Fe (II) iron to serum so that they bind to the unsaturated iron binding sites on transferrin. The excess Fe (II) ions are reacted with Ferrozine to form the color complex, which measured photometrically. The difference between the amount of Fe (II) measured represents the unsaturated iron binding. The TIBC is determined by adding the serum iron value to the UIBC value.

Statistical Analysis. The data generated were subjected to statistical analysis using statistical package for social sciences (SPSS) version 20. Student't' test was used to compare the difference between the means of each group at $p<0.05$

RESULTS

Table 1 shows the mean level of minerals before and after consumption of cashew. There was a significant decrease in the level of serum potassium but there was no significant change in the mean serum concentration of sodium, chloride, and bicarbonate, iron, total iron binding capacity. Table 2 shows the mean level of minerals before and after consumption of groundnut. There was no significant change in the mean serum sodium, potassium, chloride, bicarbonate, iron, total iron binding capacity.

Table 1. Levels of minerals before and after consumption of cashew nuts

Parameters	Before consumption	After consumption	t values	p values
Na^+(mmol/l)	137.17±2.71	136.61±2.77	0.609	0.547
K^+(mmol/l)	5.12±0.47	4.56±0.82	2.494	0.018*
Cl^-(mmol/l)	100.78±2.84	100.78±3.23	0.000	1.000
HCO_3^-(mmol/l)	24.33±1.94	23.94±1.59	0.658	0.515
Fe^{2+} µg/dl	131.66±29.71	131.56±30.84	0.985	0.114
TIBC µg/dl	202.38±43.58	203.72±41.49	0.837	0.150

N=18; *significant at $p<0.05$

Table 2. Levels of minerals before and after consumption of groundnuts

Parameters	Before consumption	After consumption	t values	p values
Na^+(mmol/l)	136.44±2.71	136.33±3.01	0.116	0.908
K^+(mmol/l)	4.93±0.46	4.88±0.65	0.268	0.791
Cl^-(mmol/l)	100.89±2.85	101.89±3.25	-0.982	0.333
HCO_3^-(mmol/l)	23.67±1.57	24.44±1.76	1.400	0.171
Fe^{2+} µg/dl	115.50±21.44	105.75±23.01	0.073	0.550
TIBC µg/dl	195.66±35.45	189.19±38.40	0.400	0.068

N=18

DISCUSSION

Groundnut and cashew nuts are regular nuts being consumed by a good number of people and forms a regular part of diet. In this study, it was observed that there is a significant decrease in the mean serum level of potassium after consumption of cashew nut but there was no significant change in the mean serum concentrations of sodium, chloride and bicarbonate, iron and total iron binding capacity. Although, previous studies have reported that nuts are not only rich sources of proteins, unsaturated fatty acids, fiber, vitamins (vitamins E and B6, folic acid, and niacin), they are also a rich source of minerals such as magnesium, potassium, sodium and copper, phytosterols (stigmasterol, campesterol, and sitosterol), and polyphenols (Bes-Rastrollo, 2009; Ros, 2010 and Fischer, 2013). Our report did not show significant increase in the concentration of potassium after the consumption of cashew nuts. It was also observed that there was no significant change in the mean serum level of sodium, potassium, chloride, bicarbonates, iron and total iron binding capacity after the intake of groundnut. This could be due to some factors such as the presence of dietary fibre (phytate) in the nuts. Phytic acid in dietary fibre acts as antinutritive agent by blocking the absorption of minerals. The binding results in insoluble salt with poor bioavailability of minerals (Zhou, 1995; Urbano, 2000 and Feil). Dietary fiber is often considered to have a negative effect on sodium and potassium absorption. Some nuts have been shown to be rich in phytate such as walnuts, almond, cashew nuts etc (Chen, 2004; Venktachalam, 2006; Schlemmer, 2009). It has been shown in animal studies that phytate has an inhibitory effect on sodium and potassium absorption. The phosphate groups in inositol hexaphosphate can form strong and insoluble complexes with cations such as potassium, and because the gastrointestinal tracts of higher species lack any significant phytase activity, phytate-bound minerals will be excreted in the stool. Phytate rapidly accumulates in seeds during the ripening period. It is stored in leguminous seeds and oil seeds in the globoid crystal within the protein bodies (Erdman, 1979). The study is in line with previous studies which have assessed associations between peanut consumption and postprandial blood glucose, nutrient intake, elevated fat oxidation rate, and increased satiety, found that there are no positive associations between peanut consumption and body fat. Furthermore, that the consumption of large portions did not also show changes in body composition (Wien, 2014; Alves, 2014; Reis, 2013; Barbour, 2015)

Conclusion

The study did not observe a significant change in the levels of sodium, chloride and bicarbonate after the consumption of cashew and groundnut. However, the study observed a significant decrease in the level of potassium after the intake of cashew nuts which may be due to the presence of high content of dietary fiber which readily accumulates in seeds. Therefore, we recommend the need to consume cashew nuts with other food compound that is rich in potassium especially in patients requiring potassium since it plays an important role in electrolyte regulation, nerve function, muscle control, and blood pressure.

Acknowledgement: We acknowledge the staff members of Department of Chemical pathology, Nnamdi Azikiwe University Teaching Hospital, Nnewi, Anambra State, Nigeria for providing an enabling environment for the laboratory analysis.

Competing interests: The authors declare that there is no competing interest. There was no competitive fiscal gain.

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