



Mineral Compositions of Lemon Fruit (*Citrus Limon*) Extracted Using Various Solvents

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Abstract

This study aimed to investigate selected mineral elements of Lemon fruits (*Citrus limon*), extracted using methanol, ethanol and acetone. These samples were collected from Igboora, Oyo State, Nigeria. The lemon fruits were oven dried at 50°C and ground to homogeneous particle size. Minerals such as Magnesium, Calcium and Iron were determined by the atomic absorption spectrophotometer; sodium and potassium by the flame photometer at average of three replicates. The results of the analyses indicated that *Citrus limon* fruit contains Na, K, Mg, Ca and Fe at 50.43±0.15, 67.17±0.15, 182.27±0.15, 109.70±0.10 and 1.02±0.01 mg/100ml respectively for methanol extract also, 48.20±0.10, 56.90±0.10, 120.33±0.58, 106.70±0.10 and 1.93±0.05 mg/100ml for ethanol extract and 48.80±0.10, 56.80±0.10, 78.73±0.05, 100.50±0.10 and 1.63±0.05 mg/100ml for acetone extract. These results revealed methanol as good extractant for these micronutrients except iron. Inclusion of lemon fruits in our daily meal will help human body to meet demand for individual minerals.

Key Words: *Citrus limon*, Minerals, Atomic Absorption Spectrometer, solvents.

Introduction

Diets rich in fruits and vegetables have been strongly associated with numerous health benefits and lower risk of disease (Radhika *et al.*, 2008). Citrus fruits contain a variety of vitamins, minerals, fiber, and phytochemicals such as carotenoids, flavonoids, and limonoids, which appear to have biological activities and health benefits.

Citrus lemon, the most common name is lemon and it is an edible fruit. After orange, lemon is the third most significant specie of citrus fruits which is cultivated more than 4.4 million ton in each year (Rafique *et al.*, 2020).

Lemon fruit (*Citrus limon*), species is from the Rutaceae family, is nutritious, economical and has a distinct medicinal properties, also a common diet source for millions of people in Middle East and around the world (Yapo, 2009). The benefits of plants are numerous. In lemon, there are important natural compounds containing ascorbic acid, minerals, citric acid, essential oils and flavonoids presents in high quantity (Makni, *et al.*, 2018). Lemon shows anticancer and antibacterial activity due to the presence of alkaloid constituent in different parts of lemon leaves, stem, root and flower (Dhanavade, *et al.*, 2011). There are different varieties of lemon include: Avon, Berna,

Baboon, Bearss, Cameron (Mshelia, *et al.*, 2018). Peels of lemon consist of various phytochemicals, such as glycosides, volatile oils, β and γ -sitosterol. There are various significant activities found in lemon like polyethoxylated, ascorbic acid, flavones, phenolic compounds which are exceptional in other plants. The antioxidant components of plants reduce oxidative stress (Agudo *et al.*, 2007).

Lemon fruit is used in beverages and cooking, and is also used as a preservative due to its antioxidant properties and is often added to fresh fruit to prevent oxidation and browning. Lemon fruits can be highly acidic and have a high content of citric acid and vitamin C and other key nutrients, providing health benefits. Lemons are an interesting source of phenolic compounds, vitamins, minerals, dietary fibers, essential oils, organic acids, and carotenoids (Gonza'lez-Molina *et al.*, 2010).

Lemon was cure the plague and a syrup known as acridinecitri is prepared from its juice which is used for quenched the thirst of someone and also fought over at the same time. Honey is boiled with lemon and used as digests. It is also used for the removal of pimples and dark spots on face (Uduake *et al.*, 2014).



Minerals are inorganic substances, present in all body tissues and fluids and their presence is necessary for the maintenance of certain physicochemical processes which are essential to life. They are chemical constituents used by the body in many ways, although they yield no energy, but have important roles to play in many activities in the body (Malhotra, 1998; Erubetina, 2003). Plants absorb significant amount of minerals from the environment and usually passed them along the food chain to animals (Zhao *et al.*, 2016). As the body cannot synthesize micronutrients, therefore, they need to be supplied in the diet in adequate amounts. To assess the dietary intake and adequacy of minerals, information needs to be collected on mineral element content of foods, diets and water (Rao and Rao, 1981; Simsek and Aykut, 2007). The numerous uses of lemon fruits aforementioned necessitate awareness on its mineral compositions and the best solvent for the extraction. Present study focused on determination of selected mineral element compositions of lemon fruits in three extracting solvents, methanol, ethanol and acetone.

Materials and methods

Study Area: The experiment was carried out at the Research Laboratory, Oyo State College of Agriculture and Technology, Igboora, Oyo state. Igboora lies on latitude 7°15'N and longitude 3°30'E of the equator with annual rainfall of 150mm and temperature of 27°C Oyo State. The area falls within south west region of Oyo state Nigeria (Akamigbo and Nnaji, 2011).

Sample collection: Mature and good quality lemon fruits (*Citrus limon*) were purchased from Towobowo market in Igboora, Oyo State, Nigeria.

Sample and sample preparation: The whole fruit (pulp, seed, peel and juice) was

Results and discussion

Table 1: Mineral composition of methanol, ethanol and acetone extracts of *Citrus limon*

Minerals	Methanol (mg/100 ml)	Ethanol (mg/100 ml)	Acetone (mg/100 ml)
Sodium (Na)	50.43±0.15 ^a	48.20±0.10 ^b	48.80±0.10 ^b
Potassium (K)	67.17±0.15 ^a	56.90±0.10 ^b	56.80±0.10 ^b

cut into smaller pieces before they were dried in an oven at 50°C for 2 days (48 hours) till they were considerably maintained constant weight. Afterward, the dried *Citrus limon* fruits was pulverized with a blender. The pulverized materials was sieved with 0.020mm mesh size and then packed into plastic sample bag and labeled for analysis.

Preparation of Sample extracts: Fifty gram (50g) of the powdered form of *Citrus limon* fruit were weighed separately and soaked in 250ml of methanol, ethanol and acetone solvent at ambient temperature for 72 hours (Dupont *et al.*, 2006). The solvents were evaporated using rotating evaporator apparatus to recover the used solvents.

Mineral content determination: Absorption spectroscopy method was used to analyze the minerals separately after acid digestion of the samples, as described in the official method of the Association of Official Analytical Chemists (2005).

Digestion of samples: An acid digest of the powdered samples was prepared by oxidizing 0.2g of each sample with conc. HCl/nitric acid followed by kjeldahl heating at 70°C until brown fumes disappeared. The digests were diluted with distilled water and heated again (until colourless solution is obtained) to a certain volume and thereafter filtered with Whatmann filter paper No. 1 (110mm). The filtrates were then made up to 100ml with distilled water. Aliquots were thereafter used for mineral analysis using the Atomic Absorption Spectrophotometer (AAS) and flame photometer. The blank and working standards were first run followed by the samples based on Association of Official Analytical Chemist A.O.A.C. (2005) methods.

Statistical analysis: All determinations were replicated three times and results were reported in mean (±) standard deviation.

Magnesium (Mg)	182.27±0.15 ^a	120.33±0.58 ^c	78.73±0.05 ^d
Calcium (Ca)	109.70±0.10 ^b	106.70±0.10 ^b	100.50±0.10 ^b
Iron (Fe)	1.02±0.01 ^b	1.93±0.05 ^d	1.63±0.05 ^d

All values are the mean ± Standard error (n=3). Means within a row with different letters significantly differ at $p < 0.05$.



The result of the mineral elements composition of *Citrus limon* extracts were presented in Table 1. Sodium is the major positive ion (cation) in extracellular fluid and a key factor in body fluid maintenance. The average amount of sodium in the three solvents, methanol, ethanol and acetone extracts of *Citrus limon* fruit were 50.43 ± 0.15 , 48.20 ± 0.10 and 48.80 ± 0.10 mg/100ml respectively. The results obtained for sodium were higher than that carried out by Dipak and Ranajit (2004) who reported Sodium content of *Citrus maxima* juice of 10 mg/100 g, observed differences may due to absence of other components (pulp, seed and peel). Sodium regulates fluid balance in the body and helps in the proper functioning of muscles and nerves (Jacob *et al.*, 2015).

The values of potassium in this study (methanol 67.17 ± 0.15 , ethanol 56.90 ± 0.10 and acetone 56.80 ± 0.10 mg/100ml) were lower to those reported by Hegedűs *et al.* (2008) for current Citrus fruit cultivars grown at Nagyred, Hungary ($277.45 \text{mg}/100\text{g}$ and $190.64 \text{mg}/100\text{g}$). The results also in line with the work carried out on mineral composition of different varieties of citrus fruits by Okwu and Emenike (2007) that revealed potassium was $56.9 \text{mg}/100\text{g}$ in citrus fruits. Potassium is recognized for its function in fluid balance and nerve impulse transmission (Dagde, 2009). In addition to potassium, sodium is also responsible for regulation of the water and electrolyte balance. There is much less sodium than potassium in citrus fruits, which is important information for those who have problems with blood pressure regulation and conditions associated with hypertension (Baghurst, 2003).

Magnesium (Mg) is needed for over 300 of our bodies 'most important biological processes, not the least of which is ATP energy production and muscular contractions (Noure *et al.*, 2011). Analysis of the magnesium content in *Citrus limon* fruits revealed that Magnesium had highest content than other micronutrients (182.27 ± 0.15 , 120.33 ± 0.58 and 78.73 ± 0.05 mg/100g). This result was higher when compared with results of Assa *et al.* (2013), who reported higher Magnesium content for orange peel to be $62 \text{mg}/100\text{g}$. The higher result obtained for magnesium here is also in line with that obtained by Barros *et al.* (2012) for orange, lime, and mandarin peel at 200mg

which is four times higher in the peel of lime than in the pulp.

Calcium is an important constituent of bones and teeth and it is actively involved in the regulation of nerve and muscle functions (Soetan *et al.*, 2010). The concentration of calcium was found to be 109.70 ± 0.10 , 106.70 ± 0.10 and $100.50 \pm 0.10 \text{mg}/100\text{g}$ in methanol, ethanol and acetone respectively. The result of calcium obtained in this study is in line with that of Feumba *et al.* (2016), who analyzed the mineral composition of fruit peels and the result showed that orange and mango peel (162.03 ± 7.54 and $60.63 \pm 4.58 \text{mg}/100\text{g}$) had calcium as the most abundant mineral analyzed.

Iron (Fe) is said to be an important element in the diet of pregnant women, nursing mothers, infants, convulsing patients and the elderly to prevent anaemia and other related diseases, (Oluyemi *et al.*, 2006). In the result of the minerals studied, it showed that Fe had the lowest concentrations (1.02 ± 0.01 , 1.93 ± 0.05 and $1.63 \pm 0.05 \text{mg}/100\text{g}$) and in comparison with the work of Onibun *et al.* (2007), who reported $2.40 \text{mg}/100\text{g}$ for sweet orange. The result of Fe is lower when compared with dietary allowance of iron for adult men (10-15mg) according to NRC (1989).

Conclusion and recommendation

The results reported in present study delivered some basic information on the selected mineral elements of Lemonfruit, a locally consumed fruits. This fruit can be considered as source of minerals like Mg, Ca, K, Na and Fe. Mineral contents like Mg, Ca, K, and Na were extracted more in methanol, highest polar solvents. Taken lemon fruit as part of diets will supply these mineral elements and assist in the prevention of mal-nutrition related to these minerals.

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