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Comparative Studies of Mineral Contents, Nutrient Density (ND) and Contributed Recommended Dietary Allowance (CRDA) of Punica Granatum Pulp from Nigeria and Saudi Arabia

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Abstract

The study compared mineral contents, nutrient density (ND) and contributed recommended dietary allowance (RDA) of Punica granatum pulp: source from Nigeria and Saudi Arabia. The study showed that some micro and macro elements such as Fe, Zn, Mg, Ca, Cu, and P were determined using Atomic Absorption Spectrophotometer (A.A.S) while Na, K were determined using flame photometer for Na and K. The Saudi Arabia and Nigerian samples contained Magnesium (637.0±0.10-842.0±0.11), Copper (24.30±0.06-4.7±0.06) and Zinc (8.50±0.12-1.80±0.06). in all of the results are within the allowance values. The results from this study showed that the fruit's pulp can provide the basic nutrients that is required by an adult. The percentage of nutrient density analysis for the entire elements Fe, Zn, Mg, Ca, Cu, Na, K, were found higher than 100% except for phosphorus in Nigeria sample, it means that it can provide the daily nutrient of an adult. The results indicated that Punica granatum pulp of Nigerian origin are better sources of Cu, Fe and Zn compared to Saudi Arabian Sample. The results can be used as a source of information for dietary planning by the government.

Key words: Pomagranate, *Punica granatum,* Pulp, Nigeria, Saudi Arabia, ND, RDA

Introduction

Good health is achieved by eating the right kinds of amounts of food containing adequate amount of nutrients likes micro and macro nutrients, the shortage of which leads to malnutrition, (Katib 2026 and Brend, 1985). Developing nations are devastated by hunger and diseases even though the nations have abundant fruits and other natural resources which if properly used could solve these problems. (Vainio - Maltila, 2000, Dangoggo et. Al 2012). The relevance of fruits and the need to introduce more plant food in order to bridge the gap of alarming food shortage in human nutrition have aroused attention of various researchers throughout the world especially Nigeria into evaluation of some micro and macro elements status of various fruits (Amer et. Al., 2019; Liu et al., 2024: Anhwange et al., 2004; Hassan et al., 2004; Umar et al., 2007). Malnutrition is a major health problem in Africa, despite government efforts to promote food production. Some diseases such as diabetes, obesity, cancer, and cardiovascular diseases are manifesting in developing countries than ever before; and are due to inadequate consumption of fruits and vegetables. If this trend continues, world Health organization (WHO 2002) projected that, the percentage of people living with diabetes alone in developing countries will rise by 170% by the year 2025 (Ganry, 2008, Dangoggo et. Al.,2012).*Punica granatum*, commonly known as "*pomegranate" (Hausa-Rumann*), borrowed from Arabic name of the plant. Kingdom: *plantae*, division: *magnohophyta,* class: *magnohopsida*, subclass: *Rosidae,* order: *myrtales*, family: *Lythraceace,* Genus: *Punica*, species: *P. granatum*, Bionomial name: *Punica granatum L*., synonyms; *Punica Malus* (Amir, et. Al., 2019, Morton, 1987, Dangoggo et. Al.,2012). *Punica granatum L (pomagranate)*fruit is known to be an important source of bioactive phenolic compounds belonging to hydrolysable tannins, (Brighenti., 2021). The fruit is cultivated throughout the world in Mediterranean, subtropical and tropical climatic conditions (Ezeora, 2024). A single fruit of pomegranate (about 282g) or 1 cup of pulp provides a substantial portion of your daily micronutrient and fiber needs based on USDA standards (Frey., 2024). Pomegranates contained high amount of natural flavonoids and polyphenols, or proanthocyanidins, and they are widely eaten as nutritional foods for therapeutic purposes, health promotion, or antioxidant activity (El-Hadary et. Al., 2019 and El-Beltagy 2022). The two major categories of mineral nutrients are major and trace elements.

While the main elements (Ca, P, Mg, S, K, Cl, Na) make up 1% of body weight and are needed in doses more than 100 mg per day, trace minerals (Zn, Fe, Mn, Cu, Si, Fl, I, Cr)

make up less than 0.01% of body weight and are required in considerably smaller doses (Ezeora, 2024). According to research by (Ezeora, 2024), the mineral elements contained in pomegranate arils fulfil the dietary recommended daily allowances (RDA), showing that pomegranate arils are a healthy source of minerals for consumers (Ezeora, 2024). The main objectives of this study was to determine and compare the mineral elements in the juice (pulp) of the fruits of pomegranate from Nigeria and Saudi Arabia and also to determine the nutrient density and contribution of each elements analyzed in the two samples to recommended dietary allowance and compare the results from the two sources and ascertain which one contained higher nutrient values nutrient density.

Materials and Methods

Sample collection

Punica granatum fruits were randomly plucked from different trees at Dadin Kowa Area, and Federal University of Education, in Kontagora metropol y, Kontagora Local Government Area of Niger State, Nigeria. The sites were chosen because of the abundance of this plant. The fruits were collected from different branches of the selected trees as described in the method of (Ayaz et al., 2002), and (Asaolu and Asaolu, 2002). The Saudi Arabia sample was obtained from Bab sheriff market, Jedda and Othaim shop of Hafral-baten both in the Kingdom of Saudi Arabia. The samples were then transported to the laboratory in paper bags after washing. The fresh fruits were authenticated at the Herbarium unit of the Department of Biological Sciences, Usmanu Danfodiyo University, Sokoto. The two samples were treated in the same way but separately. The sample was thoroughly washed with distilled water to avoid surface contamination (Ahmed and Birnin Yauri, 2008). 1kg representative of the sample was obtained using alternate shovel method (Alam, 1996). The analysis was carried out using flame photometer for Na and K and Atomic Absorption Spectrometer (AAS) using (Sentrallabgentik/January 21, 2026/ Insight) for other elements. Why Metal Analysis Remains a Critical Issue in Laboratories Methods and (AOAC 2005).

The Results were presented in the table below

Table 1: This table showed the mineral composition of *Punica granatum* fruit's pulp sourced from Nigeria and Saudi Arabia in mg/100g. This results showed that there is a significant difference in the mineral content of the fruit's pulp from the two countries ($p<0.05$).

S/NO.	ELEMENTS	NIGERIA (Mg/100g dw)	SAUDI ARABIA (Mg/100g dw)
1	Fe	8.50±0.12	1.80±0.06
2	Zn	18.10±0.06	5.00±0.06
3	Mg	637.0±0.10	842±0.11
4	Ca	78.2±0.10	86.00±0.06
5	Cu	24.30±0.06	4.7±0.06
6	Na	52.50±0.10	62.50±0.10
7	K	140.0±0.10	190.00±0.10
8	P	45.6±0.10	45.2±0.10

The data are mean ±standard deviation of triplicate results. dw= dry weight

Nutrients Density

This table showed the Nutrient density and contributed to recommended dietary allowance (%) of *Punica granatum* fruit's pulp: sourced from Nigeria and Saudi Arabia

S/NO.	Mineral Element	RDA	PULP ND Nigeria	C/R Nigeria	PULP ND Saudi Arabia	C/R Saudi Arabia
1	Fe	10	1306	85	318	18
2	Zn	15	1834	120.7	584	33.3
3	Mg	1200	100	6.52	100	7.2
4	Ca	350	2760	182	4092	240.1

5	Cu	1.5-3	12310	810	2737	156.7
6	Na	500	159	4.77	218	12.46
7	K	2000	106	7.0	165	23.7
8	P	800	54	5.7	105	5.65

dietary allowance of adult.

The table showed that there is significant difference in the two samples ($p<0.05$).It also indicate the nutrient density and contribution of each elements analyzed in the two samples to recommended dietary allowance.

Discussion of Results

Calcium

The calcium concentration in the pulp of both Nigerian and Saudi Arabian fruits are 78.2 mg/100g and 86.00mg/100g respectively. The values compared to those values reported by Mele et al., (2007) which has range of 35-326 ppm for different varieties of *Punica granatum* fruits are within the range. These values are higher than that reported by other researchers 3-12 mg/100g and USDA 10mg (Morton 1987; USDA 2019). These values were also lower compared to grape fruit pulp 722 mg/100g, grape fruit fed 1165 mg/100g, guava (1456 mg/100g) and pawpaw (2964 mg/100g) while it is higher than the calcium level of 16 mg/100g of banana, 88 mg/100g and 93 mg/100g of apple and sweet orange (Olaode et al., 1990), and (Onibun et el., 2007).

The Calcium helps in regulating the nerve impulses, muscle contractions and in bone formation and transmittance (Bello et al., 2008).

In comparison with recommended dietary allowance (RDA) for adults (NRC, 1989), 100g of Saudi and Nigeria fruits could provide the daily body calcium requirement of 9.09, 1.98 and 6.52% for rind (peel), seed and pulp of Nigeria fruits and 11.9%, 3.67%, 7.17% for Saudi Arabia fruits. These values showed that the fruits parts could be a better supplement than other calcium sources even better compared to some conventional fruits.

Phosphorus

The concentration in the pulp of Nigerian sample was 55.2 mg/100g while that of Saudi Arabian samples was 60.0mg/100g respectively. The pulp of the two fruits (Nigeria and Saudi Arabia) were lower compared with the value recorded by (Mele and Elcin 2007). 12-43 ppm. But the values are higher than that of (USDA 2019) 36mg/100g and that of banana (40 mg/100g) sweet Orange (23 mg/100g), similar with that of cinnamon 42.4 mg/100g (Shumaila and Guil 2009). The recommended Dietary Allowance for adult is 800 mg/100g (NRC, 1989)

Magnesium

The concentration of magnesium in both Nigeria and Saudi Arabia fruit's pulp are 637 mg/100g and 842.0 mg/100g respectively. These results obtained when compared with that of (Mele and Elcin, 2007) are higher (176-427 mg/100g) and also higher than the value 12mg/100g reported by (USDA 2019).

Magnesium activates many enzymes systems responsible for calcium metabolism in bones and in the nerves electrical potential (Ishida et al., 2000). The recommended dietary allowance of Magnesium is 350 mg. Therefore, the amount in the nutrient contributes more than 100% as such if the fruits is eaten in sufficient quantity can supply the required magnesium nutrient.

Zinc

The two fruits from both countries Nigeria and Saudi Arabia had Zinc content in the ratio, pulp are (18.10±0.06 mg/100g dw and 5.00±0.06 mg/100g) respectively These values obtained are higher than the values reported by (USDA 2019) 0.35mg/100g. The Nigerian fruits contain more of zinc than the Saudi Arabian fruit. The values when compared with 15.16 mg/100g; for Lagenaria S seed (Chinyere et al 2000), the Nigerian sample has higher value but lower compared to that of guava (22.09mg/100g) as reported by (Onibon et al.,2007). While the value of zinc in Saudi Arabia sample was higher compared with 0.80 mg/100g dry weight observed in the peel of Hasta la pasta fruits (Hassan et al., 2009), but the values obtained in the seed of Birrea S (6.24 mg/100g) as reported by (Glew et al. 2004) was higher. The zinc recommended dietary allowance was set as 15mg/100g dw for adult male (NRC, 1981). The mean contribution of the pulp from both countries were: 120% and 33% respectively. This indicates that the fruits have high potential in providing zinc if taken in the right proportion. The Zinc plays an important role in gene expression, regulation of cellular growth and participates as co-factor of enzymes responsible for carbohydrate, protein and nucleic acid metabolism (Camara and Amaro, 2003)

Copper

The Copper is essential trace element in the human body where it exists as an integral part of copper proteins ceruloplasmin, which is concerned with the release of iron from the cell into the plasma and is involved in energy metabolism (MC Donald *et al.*, 1995). The amount of copper in the pulp of the fruit from the two countries (Nigeria an Saudi Arabia) are 24.30mg/100g, and trace, 4.7mg/100g respectively. These values indicate that; the sample mean contribution to dietary allowance were 810% by pulp of Nigerian sample and 156.7% by pulp of Saudi Arabian respectively. These values are within the recommended dietary allowance of 1.5-3mg (NRC, 1989) and these values were above 100%, it indicates that the fruit if taken in the right proportion will provide the right amount of copper to the body. The USDA 2019 reported 0.158mg/100g as value of Fe obtained in 100g of pomegranate which was lower than the value obtained in this reseach.

Iron

The iron contents in the pulp of Nigeria and Saudi Arabia samples were 8.50 mg/100g dw and 1.80 mg/100g dw respectively. This showed that the Nigerian sample contained the highest amount of iron than that of Saudi Arabian sample. In comparison with other research, these values are higher than 0.3mg on pomegranate fruit reported by (USDA 2019) and lower than 13.0 mg/100g in guava, (Hassan et al., 2004), and 21-46 mg/100g was recorded on a similar work on varieties of *Punica granatum* by (Mele and Elcin,2007). So also 2.40mg/100g dw were recorded for sweet orange by (Onibon et al., 2007). The mean contribution of Nigerian and Saudi Arabian samples to dietary allowance of iron for adult men were 21% and 18% respectively.

Sodium

The sodium content of pulp from samples (Nigeria and Saudi Arabia) were 52.50 mg/100g dw and 62.50 mg/100g dw. This is higher than the one reported by USDA 2019) 3mg and lower than the fruit pulp of *Gardenia aqualla* (Muhammmad et al., 2011). The nutrient contribution of the two fruits were 10.50% (Nigeria samples) and 12.50% (Saudi Arabia samples). The RDA value is 500mg (NRC., 1981).

Pottassium

The concentration of potassium in the fruit's pulp of Nigeria and Saudi Arabia samples were 140 mg/100g dw and 190 mg/100g dw respectively. The high concentration of potassium in the fruit could play an important role in maintaining acid-base balance and nerve transmission in the body. The value is lower than that reported by (USDA 2019) 666mg/100g

Conclusion

The results from this study indicated that the fruits were very rich in nutrients and can provide the basic nutrients that is required by an adult. Therefore, based on the results obtained the two samples has shown that *Pomegranate* is a fruit that can provide that nutrients that is required for growth and development of the body. Pomegranate fruit is an excellent source of potassium, magnesium and zinc. The two fruits contained high amount potassium, zinc, copper, magnesium and calcium. It can also be concluding that it has high RDA which means it can provide the basic nutrient required by an adult, All the values obtained were within the daily allowance limit.

Recommendation

- The government should fund more research on this plant and its fruits since it is referred to as miracle plant because it contained a lot of phytochemicals and nutrients.
- The government should encourage the farming of pomegranate since it is a fruit that can provide that nutrients that is required for growth and development of the body.
- The results can be used as source of information for dietary planning by the government.
- The results can be used as a source of information by researchers.

Declaration of competing Interest.

The authors declare that they have no known competing financial interest or personal relationships that could have appeared to influence the work reported in this article.

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