

Physico-Chemical and Mineral Analysis of a commercial *Morinda citrifolia* juice and a Popular blackcurrant fruit Juice commonly used by Athletes in Nigeria

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Abstract: The aim of the study was to evaluate the physico-chemical and mineral contents of the commercially available *Morinda citrifolia* juice and a popular blackcurrant fruit juice used as supplements on the performance of university athletes in Nigeria. The popular blackcurrant fruit juice was used as a placebo drink in a double-blind study because it has similar colour, flavor and taste as the commercially available *Morinda citrifolia* juice. Physico-chemical and mineral analysis of *Morinda citrifolia* and placebo juice were carried out using standard methods of AOAC. These include Specific Gravity, Phosphate – Phosphorus, Total Solid, and Total Dissolved Solid. The iron (Fe), zinc (Zn), calcium (Ca), copper (Cu), lead (Pb), manganese (Mn) and magnesium (Mg) were determined by Atomic Absorption Spectrophotometer, sodium (Na) and potassium (K) by Flame Photometer and phosphorus (P) by Spectrophotometer. The results revealed that *Morinda citrifolia* juice contained iron (3.42 ppm), Zinc (1.64 ppm), Calcium (11.40 ppm), Manganese (0.733 ppm) and Magnesium (32.86 ppm), sodium (28.17 ppm), Potassium (379.97 ppm), Nitrogen (0.047%), Sodium chloride (0.09%), Sulphates (5.73%), Phosphates (0.002%) and total solids (136.60 mg/l). It also revealed that the placebo drink contained iron (2.59 ppm), Zinc (1.74 ppm), Calcium (8.80 ppm), Manganese (0.740 ppm) and Magnesium (6.58 ppm), sodium (4.74 ppm), Potassium (13.350 ppm), Nitrogen (0.021%), Sodium chloride (0.12%), Sulphates (4.56%), Phosphates (0.002%) and total solids (693.400 mg/l). The result of the mineral profile of *Morinda citrifolia* juice indicated that the *Morinda citrifolia* juice contains vital minerals (potassium, sodium, calcium, magnesium, iron, manganese, zinc and salt). Mineral analysis showed that *Morinda citrifolia* juice had higher mineral contents except for manganese, zinc and Na⁺ salt compared to the placebo juice. Physico-chemical analysis showed that *Morinda citrifolia* juice had higher nitrogen and sulphate contents compared to the placebo juice, while the placebo juice has higher value for total solids compared to *Morinda citrifolia* juice. However, both have the same phosphate contents. The compositional profile of *Morinda citrifolia* juice revealed that it contains vital minerals (potassium, sodium, calcium, magnesium, iron, manganese, zinc and salt).

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1. Introduction

Fruit juice of *M. citrifolia* is a well-known health drink and has various pharmacological properties including antioxidant and anti-inflammatory effects (Harada *et al.*, 2010; Rivera *et al.*, 2011). *M. citrifolia* fruit contains a number of phytochemicals, including lignans, oligo- and polysaccharides, flavonoids, iridoids, fatty acids, scopoletin, catechin, beta-sitosterol, damnacanthal, and alkaloids. Although these substances have been studied for bioactivity, current research is insufficient to conclude anything about their effects on human health (Deng *et al.*, 2007; Lin *et al.*, 2007; Mohd *et al.*, 2007; Levand and Larson, 2009). These phytochemicals are not unique to *M. citrifolia*, as they exist in various plants.

The main micronutrients of *M. citrifolia* pulp powder include vitamin C, niacin (vitamin B₃), iron and potassium (Nelson, 2006). Vitamin A, calcium and sodium are present in moderate amounts. When

M. citrifolia juice alone is analyzed and compared to pulp powder, only vitamin C is retained (Nelson, 2006) in an amount that is about half the content of a raw navel orange (Nelson, 2006). Sodium levels in *M. citrifolia* juice (about 3% of Dietary Reference Intake, DRI) (Nelson, 2006) are high compared to an orange, and potassium content is moderate. *M. citrifolia* juice is otherwise similar in micronutrient content to a raw orange (Nelson, 2006).

The aim of the study was to evaluate the physico-chemical and mineral contents of the commercially available *Morinda citrifolia* juice and a popular blackcurrant fruit juice used as supplements on the performance of university athletes in Nigeria.

2. Methods

2.1. Sources of *Morinda citrifolia* and Placebo Juice

Morinda citrifolia juice was procured from vendors in Port Harcourt, Nigeria with the assistance

of the State Ministry of Sports. The placebo blackcurrant juice was procured from a supermarket in Port Harcourt, Nigeria.

2.2. Physico-Chemical Analysis of *Morinda citrifolia* and Placebo Juice

Physico-Chemical Analysis of *Morinda citrifolia* and Placebo Juice were carried out using standard methods. These include Specific Gravity, Phosphate – Phosphorus, Total Solid, and Total Dissolved Solid. The standard procedures of AOAC (2000a,b, 2003) were followed to analyze the physico-chemical composition and mineral analysis. Physico-chemical and mineral analysis of *Morinda citrifolia* and placebo juice were carried out using standard methods of AOAC. These include Specific Gravity, Phosphate – Phosphorus, Total Solid, and Total Dissolved Solid. The iron (Fe), zinc (Zn), calcium (Ca), copper (Cu), lead (Pb), manganese (Mn) and magnesium (Mg) were determined by Atomic Absorption Spectrophotometer, sodium (Na) and potassium (K) by Flame Photometer and phosphorus (P) by Spectrophotometer.

3. Results And Discussion

Table 1 showed the mineral profile of *Morinda citrifolia* juice, indicating that the *Morinda citrifolia*

juice contains vital minerals (potassium, sodium, calcium, magnesium, iron, manganese, zinc and salt). The results revealed that *Morinda citrifolia* juice contained iron (3.42 ppm), Zinc (1.64 ppm), Calcium (11.40 ppm), Manganese (0.733 ppm) and Magnesium (32.86 ppm), sodium (28.17 ppm), Potassium (379.97 ppm), Nitrogen (0.047%), Sodium chloride (0.09%), Sulphates (5.73%), Phosphates (0.002%) and total solids (136.60 mg/l). It also revealed that the placebo drink contained iron (2.59 ppm), Zinc (1.74 ppm), Calcium (8.80 ppm), Manganese (0.740 ppm) and Magnesium (6.58 ppm), sodium (4.74 ppm), Potassium (13.350 ppm), Nitrogen (0.021%), Sodium chloride (0.12%), Sulphates (4.56%), Phosphates (0.002%) and total solids (693.400 mg/l). Mineral analysis showed that *Morinda citrifolia* juice had higher mineral contents except for manganese, zinc and Na⁺ salt compared to the placebo juice (Table 1). Physico-chemical analysis showed that *Morinda citrifolia* juice had higher nitrogen and sulphate contents compared to the placebo juice, while the placebo juice has higher value for total solids compared to *Morinda citrifolia* juice. However, both have the same phosphate contents (Table 1).

Table 1: Mineral Compositions of *Morinda citrifolia* and Placebo Juice

Metals	<i>Morinda citrifolia</i> Juice	Placebo Juice	Unit
Potassium (K)	379.97	13.350	Ppm
Sodium (Na)	28.17	4.74	Ppm
Calcium (Ca)	11.40	8.80	Ppm
Magnesium (Mg)	32.86	6.58	Ppm
Iron (Fe)	3.42	2.59	Ppm
Manganese (Mn)	0.733	0.740	Ppm
Zinc (Zn)	1.64	1.74	Ppm
Salt (as sodium chloride)	0.09	0.12	%
Nitrogen (N ₂)	0.047	0.021	%
Sulphate (SO ₄)	5.73	4.56	%
Phosphate (P O ₄)	0.002	0.002	%
Total Solids	136.600	693.400	(mg/l)

The purpose of the study was to evaluate the physico-chemical and metal contents of *Morinda citrifolia* and placebo juice used for supplementation on the performance of university athletes. Various combinations of substances have been introduced as sports food, drinks and pills (Nayak and Mengi, 2010; Harada *et al.*, 2010; Farhadi *et al.*, 2011). These supplements commonly contain mainly carbohydrates, vitamins, minerals and trace elements. The use of supplements by competitive athletes has involved the ingestion of these preparations some of which inadvertently contain substances which are on the World Anti-Doping Agency's list of banned substances (Tsai *et al.*, 2009).

A number of major components have been identified in the *Morinda citrifolia* plant, such as potassium (Muralidharan and Srikanth, 2009). The results revealed that *Morinda citrifolia* juice contained iron (3.42 ppm), Zinc (1.64 ppm), Calcium (11.40 ppm), Manganese (0.733 ppm) and Magnesium (32.86 ppm), sodium (28.17 ppm), Potassium (379.97 ppm), Nitrogen (0.047%), Sodium chloride (0.09%), Sulphates (5.73%), Phosphates (0.002%) and total solids (136.60 mg/l). It also revealed that the placebo drink contained iron (2.59 ppm), Zinc (1.74 ppm), Calcium (8.80 ppm), Manganese (0.740 ppm) and Magnesium (6.58 ppm), sodium (4.74 ppm), Potassium (13.350 ppm),

Nitrogen (0.021%), Sodium chloride (0.12%), Sulphates (4.56%), Phosphates (0.002%) and total solids (693.400 mg/l).

Among the minerals *Morinda citrifolia* juice contained the highest amount of potassium and lowest amount of phosphates. The calcium, iron and phosphorus contents are lower than the values reported by Hussain (1985), Farhath et al. (2001) and Shumaila and Mahpara (2009).

The physicochemical analysis also showed that *Morinda citrifolia* juice has higher nitrogen and sulphate contents compared to the placebo juice while the placebo juice has higher values for total solids compared to *Morinda citrifolia* juice. However, both have the same phosphate content. According to Rivera *et al.* (2011), when the *Morinda citrifolia* fruit is ground, analysis of the resultant powder shows that it contains moderate amounts of potassium and iron in significant amounts and calcium and sodium in moderate amounts (Rivera *et al.*, 2011). *M. citrifolia* is high in potassium. Several *M. citrifolia* juice manufacturers have received warnings from the United States Food and Drug Administration about making unsubstantiated health claims (Pawlus *et al.*, 2005; Natural Standard Database, 2009; Natural Medicines Comprehensive Database, 2009; Tolle *et al.*, 2011).

In this study, potassium appears to be the most abundant mineral in processed *Morinda citrifolia* fruit juice. This agrees favourably with the findings of West *et al.* (2011) who reported that potassium appears to be the most abundant mineral in processed noni fruit puree. This is also consistent with mineral analyses performed for noni fruit juice from Cambodia, Pohnpei and Australia (Shovic and Whistler, 2001; Chunhieng *et al.*, 2005; Peerzada *et al.*, 1990; West *et al.*, 2011).

In this study, potassium is more than ten times the concentration of magnesium, the next most abundant mineral, although neither is present in nutritionally significant quantities. This was followed by sodium and calcium content. This differs from the report of West *et al.* (2011) who reported calcium as the next most abundant mineral in noni puree. West *et al.* (2011) reported that only two minerals are present in nutritionally significant amounts.

In this study, manganese contents would meet the recommended daily allowance for adults (Institute of Medicine, 2000, 2001; West *et al.*, 2011). The average manganese content of the *Morinda citrifolia* fruit juice and placebo drink were 0.733 ppm and 0.740 ppm respectively. This is greater than the 0.47 mg 100 g⁻¹ reported by West *et al.* (2011) and greater than the 0.094 mg 100 g⁻¹ reported in raw Pohnpei noni fruit (Shovic and Whistler, 2001; West *et al.*, 2011).

The differences in mineral contents reported in this study and the different sources of noni reported in other studies could be due to stage of ripeness at harvest, climate, soil conditions, and genetic variability between the sources (Cunningham *et al.*, 2001; Razafimandimbison *et al.*, 2010; West *et al.*, 2011).

4. Conclusion

The result of the mineral profile of *Morinda citrifolia* juice indicated that the *Morinda citrifolia* juice contains vital minerals (potassium, sodium, calcium, magnesium, iron, manganese, zinc and salt). Mineral analysis showed that *Morinda citrifolia* juice had higher mineral contents except for manganese, zinc and Na⁺ salt compared to the placebo juice. Physico-chemical analysis showed that *Morinda citrifolia* juice had higher nitrogen and sulphate contents compared to the placebo juice, while the placebo juice has higher value for total solids compared to *Morinda citrifolia* juice. However, both have the same phosphate contents. The compositional profile of *Morinda citrifolia* juice revealed that it contains vital minerals (potassium, sodium, calcium, magnesium, iron, manganese, zinc and salt). The compositional profile of *Morinda citrifolia* juice revealed that it contains vital minerals (potassium, sodium, calcium, magnesium, iron, manganese, zinc and salt).

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