Vitamin Analysis of a commercial *Morinda citrifolia* juice and a Popular blackcurrant fruit Juice commonly used by Athletes in Nigeria

ANUGWEJE KC

Department of Health Services, University of Port Harcourt, P.M.B. 5323 Choba, East-West Road, Port Harcourt, 500102, Nigeria. E-mail: kanugweje@hotmail.com; Tel: +2348033382154

Abstract: 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. The trial compared the ergogenic properties of both drinks. *Morinda citrifolia* and placebo juices were subjected to vitamin analysis using standard methods. Results of vitamin analysis of *Morinda citrifolia* showed substantial amounts of vitamin C and moderate amount of vitamin A. In this study, the vitamins profiles of *Morinda citrifolia* juice revealed the presence of medicinally important constituents and vitamins. Vitamin C content of *Morinda citrifolia* juice was 28.69 mg/100ml and that of placebo drink was 15.40 mg/100ml while the vitamin A contents of *Morinda citrifolia* juice and placebo drink were 2.71 mg/100ml and 1.11 mg/100ml respectively. It indicates that the *Morinda citrifolia* juice contains vital vitamins (C and A). Vitamin analysis shows that *Morinda citrifolia* juice has higher vitamin contents than the placebo juice. The findings of this present study has shown that the sampled *Morinda citrifolia* juice and placebo drink are potential dietary source of vitamin C, vitamin A, alpha-carotenes, beta-carotenes and total carotenes. However, it showed that in terms of concentration, vitamin C is the major vitamin present. The results in this study indicate that *Morinda citrifolia* juice would improves endurance in athletes very probably via potent antioxidant effects.

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1. Introduction

Fruits and vegetables are good sources of antioxidants. 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). When the *Morinda citrifolia* fruit is ground, analysis of the resultant powder shows that it contains moderate amounts of carbohydrate and fibre, embodied in the pulp of the fruit. The powder also contains micronutrient such as Niacin and Vitamin C, Potassium and Iron in significant amounts and Vitamin A, Calcium and Sodium in moderate amounts (Rivera *et al.,* 2011).

Traditionally, the leaves of the *Morinda citrifolia* tree were used topically for healing wounds. *Morinda citrifolia* juice, like the juice of many other fruits, is a source of vitamins, minerals and antioxidants. The antioxidants may help to prevent certain diseases and help slow age-related changes in the body (Natural Standard Database, 2009; Natural Medicines Comprehensive Database, 2009; Tolle *et al.*, 2011).

A number of major components have been identified in the *Morinda citrifolia* plant, such as potassium, vitamin C, scopoletin, terpenoids, alkaloids, anthraquinones (nordamnacanthal, morindone, rubiadin, rubiadia-1-methyl ether, antraquinone glycosides) β-sitosterol, carotene, vitamin A, flavone glycosides, linoleic acid, alizarin, amino acids, acubin, l-asperuloside, caproic acid, caprylic acid, ursolic acid, rutin and putative proxeronine (Muralidharan and Srikanth, 2009). 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 carbohydrate and fibre, embodied in the pulp of the fruit. The powder also contains micronutrients such as niacin and vitamin C, potassium and iron in significant amounts and vitamin A, calcium and sodium in moderate amounts (Rivera *et al.,* 2011).

Ascorbic acid or vitamin C is a monosaccharide oxidation-reduction (redox) catalyst found in both animals and plants. As one of the enzymes needed to make ascorbic acid has been lost by mutation during primate evolution, humans must obtain it from the diet; it is therefore an essential vitamin (Smirnoff, 2001). Most other animals are able to produce this compound in their bodies and do not require it in their diets (Linster and Van Schaftingen, 2007). Ascorbic acid is required for the conversion of the procollagen to collagen by oxidizing proline residues to hydroxyproline. In other cells, it is maintained in its reduced form by reaction with glutathione, which can be catalyzed by protein disulfide isomerase and glutaredoxins (Padayatty *et al*., 2003). Ascorbic acid is a redox catalyst which can reduce, and thereby

neutralize reactive oxygen species such as hydrogen peroxide (Padayatty *et al*., 2003). In addition to its direct antioxidant effects, ascorbic acid is also a substrate for the redox enzyme ascorbate peroxidase, a function that is particularly important in stress resistance in plants (Shigeoka *et al*., 2002). Ascorbic acid is present at high levels in all parts of plants and can reach concentrations of 20 millimolar in chloroplasts (Smirnoff and Wheeler, 2000).

Vitamin E is the collective name for a set of eight related tocopherols and tocotrienols, which are fat-soluble vitamins with antioxidant properties (Herrera and Barbas, 2001). Of these, α-tocopherol has been most studied as it has the highest bioavailability, with the body preferentially absorbing and metabolizing this form (Brigelius and Traber, 1999). This removes the free radical intermediates and prevents the propagation reaction from continuing. This reaction produces oxidised α-tocopheroxyl radicals that can be recycled back to the active reduced form through reduction by other antioxidants, such as ascorbate, retinol or ubiquinol (Seiler *et al*., 2008). This is in line with findings showing that α-tocopherol, but not water-soluble antioxidants, efficiently protects glutathione peroxidase 4 (GPX4)-deficient cells from cell death (Seiler *et al*., 2008). GPx4 is the only known enzyme that efficiently reduces lipid-hydroperoxides within biological membranes.

However, the roles and importance of the various forms of vitamin E are at present unclear (Brigelius *et al*., 2007), and it has even been suggested that the most important function of α-tocopherol is as a signaling molecule, with this molecule having no significant role in antioxidant metabolism (Brigelius *et al*., 2007). The functions of the other forms of vitamin E are even less well-understood, although γ-tocopherol is a nucleophile that may react with electrophilic mutagens and tocotrienols may be important in protecting neurons from damage (Sen *et al*., 2006).

The main micronutrients of *M. citrifolia* pulp powder include vitamin C, niacin (vitamin B_3), among others (Nelson, 2006). Vitamin A is found to be present in moderate amounts in *M. citrifolia* juice. 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).

This study was carried out to determine the vitamin contents of *Morinda citrifolia* preparations and a popular blackcurrant juice commonly used by athletes in Nigeria as ergogenic aids.

2. Materials And 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. Vitamin Screening of *Morinda citrifolia* and Placebo Juice

Morinda citrifolia and placebo juices were subjected to vitamin analysis at the Research Laboratory, Department of Plant Science and Biotechnology, University of Port Harcourt, Nigeria.

2.3. Vitamin Analysis of *Morinda citrifolia* and Placebo Juice (by Indo-Phenol Method)

Vitamin A, as β-carotene, was determined by a modified AOAC official method 941.15 for an HPLC system (AOAC, 2000a-e; West et al., 2011; Shakeri *et al.*, 2012). Vitamin C was determined by titration with 2,6-dichloroindophenol, by the microfluorometric method, or by HPLC and UV detection of oxidized ascorbic acid (AOAC, 2000a-e; West et al., 2011).

Results And Discussion

Table 1 showed the vitamin profile of *Morinda citrifolia* juice, indicating that the *Morinda citrifolia* juice contains vital vitamins (C and A). Vitamin analysis shows that *Morinda citrifolia* juice has higher vitamin contents than the placebo juice (Table 1).

Table 1: Vitamin Contents of *Morinda citrifolia* and Placebo Juice

Vitamins	*Morinda citrifolia* Juice Content	Placebo Juice Content	Unit
C	28.69	15.40	mg/100ml
A	2.71	1.11	mg/100ml
Carotene (as Vitamin A)			
Total beta Carotene	22	12	IU/100g
Total Carotene	22	10	IU/100g
Alpha Carotene	7.0	4.0	IU/100g
All-trans beta carotene	6.5	4.0	IU/100g
Cis-beta Carotene	6.8	3.4	IU/100g

The aim of this study was to evaluate the vitamin contents of *Morinda citrifolia* and blackcurrant juice 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).

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). A number of major components have been identified in the *Morinda citrifolia* plant, such as potassium, vitamin C, scopoletin, terpenoids, alkaloids, anthraquinones (nordamnacanthal, morindone, rubiadin, rubiadia-1-methyl ether, antraquinone glycosides) β-sitosterol, carotene, vitamin A, flavone glycosides, linoleic acid, alizarin, amino acids, acubin, l-asperuloside, caproic acid, caprylic acid, ursolic acid, rutin and putative proxeronine (Muralidharan and Srikanth, 2009). Proximate nutritional, vitamin A, and vitamin C contents of whole unprocessed noni fruits in Pohnpei have also been reported (Shovic and Whistler, 2001; West et al., 2011).

In this study, the vitamins profiles of *Morinda citrifolia* juice revealed the presence of medicinally important constituents and vitamins. Vitamin C content of *Morinda citrifolia* juice was 28.69 mg/100ml and that of placebo drink was 15.40 mg/100ml while the vitamin A contents of *Morinda citrifolia* juice and placebo drink were 2.71 mg/100ml and 1.11 mg/100ml respectively. Evidence gathered in earlier studies confirmed the identified vitamins to be present. In addition to ascorbic acid (vitamin C), vitamin E, carotenoids and polyphenols have shown strong antioxidant capacity (Alim *et al*., 2009; Giovanelli and Buratti, 2009; Gao *et al*., 2010; Sun *et al*., 2010). Previously, vitamin C content as well as that of five minerals, has been determined for wild noni fruit from northern Australia (Peerzada et al., 1990; West et al., 2011).

The results in this study indicate that *Morinda citrifolia* juice could improves endurance in athletes very probably via potent antioxidant effects. According to Rivera *et al.* (2011), the powder contains micronutrients such as niacin and vitamin C in significant amounts and vitamin A in moderate amounts (Rivera *et al.,* 2011). This agrees favourably with the finding of this present study.

In this study, vitamin C was reported to be 28.69 mg/100ml for *Morinda citrifolia* juice and 15.40 mg/100ml for the placebo drink. This is in agreement with previous studies (Peerzada et al., 1990; Shovic and Whistler, 2001; Chunhieng et al., 2005; West et al., 2011). However, the reported vitamin C contents of *Morinda citrifolia* juice and the placebo drink fall within the range for vitamin C contents in fruits (Shovic and Whistler, 2001; Chunhieng et al., 2005; West et al., 2011). Furthermore, vitamin C has been reported to be the most prominent vitamin in noni fruit puree, with a mean content of 1.13 mg−1 g (West et al., 2011). At this concentration, it is believed and reported that 100 g of *Morinda citrifolia* fruit juice provides 251% of the recommended daily vitamin C requirement for adults (FAO/WHO, 2001; West et al., 2011).

Also in this study, vitamin A was reported to be 2.71 mg/100ml for *Morinda citrifolia* juice and 1.11 mg/100ml for the placebo drink. Also, this is in agreement with previous studies (Peerzada et al., 1990; Shovic and Whistler, 2001; Chunhieng et al., 2005; West et al., 2011; Rivera *et al.,* 2011) where vitamin C was also reported in significant amounts and vitamin A in moderate amounts. West et al. (2011) reported the value of vitamin A (β-carotene) in noni puree to be 19.09µg/g in a similar study.

In this study, appreciable quantities of β-carotene, alpha-carotene and total carotene were reported in both *Morinda citrifolia* juice and the placebo drink. According to West et al. (2011), noni fruit puree from French Polynesia as reported to contain appreciable quantities of β-carotene. From the joint FAO/WHO recommendation, the average vitamin A daily intake by adults is 270 RE for females and 300 RE for males (FAO/WHO, 1988; West et al., 2011).

Conclusion

The vitamin profile of *Morinda citrifolia* juice and placebo drink revealed that it contains vitamin C in significant amounts and vitamin A in moderate amounts. Thus, it is believed from the findings of this study, *Morinda citrifolia* juice and the placebo drink appear to have the potential to be a significant dietary source of vitamin A and C (FAO/WHO, 2001; West et al., 2011). The findings of this present study has shown that the sampled *Morinda citrifolia* juice and placebo drink are potential dietary source of vitamin C, vitamin A, alpha-carotenes, beta-carotenes and total carotenes. However, it showed that in terms of concentration, vitamin C is the major vitamin present.

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