

Proximate 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 this study was to evaluate the proximate composition of the *Morinda citrifolia* juice and the blackcurrant juice used for supplementation on the performance of university athletes. The study compared the ergogenic effects of both juices. The blackcurrant juice was used as a placebo drink in a double-blind trial because it is indistinguishable from *Morinda citrifolia* juice in colour, flavor and taste. *Morinda citrifolia* and placebo juices were subjected to proximate analysis. The standard procedures of AOAC (2003) were followed to analyze the proximate composition and mineral analysis. The caloric value was calculated from crude protein, crude fat, crude fiber, carbohydrate, moisture and ash content. The results revealed that *Morinda citrifolia* juice revealed that *Morinda citrifolia* contained ash (1.14%), crude protein (0.13%), crude fat (0.24%), crude fiber (1.677%); moisture (87.91%), crude carbohydrate (61.66%), fructose (3.8g/100ml), glucose (3.5g/100ml), sucrose (<0.1g/100ml), specific gravity (1.250g/dm³) and a pH value of 5.17. While the popular blackcurrant juice used as placebo drink revealed that it contained ash (0.093%), crude protein (0.09%), crude fat (0.02%), crude fiber (0.0%); moisture (36.20%), crude carbohydrate (10.80%), fructose (1.2g/100ml), glucose (1.0g/100ml), sucrose (<0.1g/100ml), specific gravity (1.018g/dm³) and a pH value of 4.76. It further showed that *Morinda citrifolia* juice has higher amounts of protein and dietary fibre than the placebo juice. It also showed that *Morinda citrifolia* juice has higher carbohydrate, fructose and glucose content than the placebo juice. This study concluded that the tested *Morinda citrifolia* juice contained highest amount of carbohydrate and moisture compared to the placebo drink. The pH values of the tested drinks fall outside the range that incidentally favours bacterial growth.

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1. Introduction

Fruit juice of *M. citrifolia* has a history of use as a topical preparation for joint pain and skin conditions. Today, people drink *Morinda citrifolia* fruit juice as a general health tonic, as well as for cancer and chronic conditions such as cardiovascular disease and diabetes (Pawlus *et al.*, 2005; Tolle *et al.*, 2011). *M. citrifolia* is widely available as the juice or liquid concentrate. It can also be found in tablet and capsule form. *M. citrifolia* fruit powder contains carbohydrates and dietary fibre in moderate amounts (Nelson, 2006). These macronutrients evidently reside in the fruit pulp, as *M. citrifolia* juice has sparse nutrient content (Nelson, 2006).

Approximately 41 percent of women are utilizing complementary and alternative medicine (CAM) forms of medicine to manage their breast cancer (Wanchai *et al.*, 2010), including products from the *Morinda citrifolia* plant (Clafshenkel *et al.*, 2012). An edible and medicinal tropical plant, *Morinda citrifolia*, has been used for over 2000 years by Polynesian cultures as an herbal remedy for infection, arthritis, diabetes, asthma, hypertension, and pain (Wang *et al.*, 2002).

All parts of the plant including the roots, bark, stems, flowers, leaves, and fruit are components in various combinations of 40 known and recorded herbal remedies (Wang *et al.*, 2002), with the fruit being the most researched (Pawlus and Kinghorn, 2007). The popularity of *Morinda citrifolia* has spread from Polynesian and Hawaiian cultures with its global introduction in the early 1990s (Potterat and Hamburger, 2007), and its products are now readily available in health food stores and on the internet (Clafshenkel *et al.*, 2012).

Morinda citrifolia preparations are very popular in Nigeria as a nutritional supplement. The supplements are sold in capsule form, powder, and juices (Clafshenkel *et al.*, 2012). The approval of noni fruit as a novel food ingredient will greatly increase the use of these ingredients in foodstuffs, and consequently, their consumption among the general population (West *et al.*, 2011). As such, an understanding of the nutritional profile of processed *Morinda citrifolia* (noni) fruit puree is important for food technologists, nutritionists, as well as consumers (West *et al.*, 2011). The aim of this study was to evaluate the proximate composition of the *Morinda citrifolia* juice and the blackcurrant juice used for

supplementation on the performance of university athletes.

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. Proximate Analysis of *Morinda citrifolia* and Placebo Juice

Morinda citrifolia and placebo juices were subjected to proximate analysis at the Research Laboratory, Department of Plant Science and Biotechnology, University of Port Harcourt, Nigeria. The standard procedures of AOAC (2000a,b,c,d, 2003) were followed to analyze the proximate composition. The proximate tested for include pH, moisture, ash, crude proteins, crude carbohydrates, crude fibre, reducing sugars and lipids. Moisture was determined using Air-Oven Methods. Ash was determined using Furnace Method. Crude Carbohydrate was carried out by Cleg Anthrone Method. Lipids were determined by Soxhlet Extraction Method. Total Nitrogen (Crude Protein) was carried out according to Kjeldahl method.

2.3. Determination of pH value

The pH was measured using a pH meter of a glass electrode. The glass electrode was immersed in water for several hours before use. The measurement started about 5 minutes after the equipment was switched on and the detecting unit was rinsed well with water and cleaned with a piece of filter paper. The pH meter was adjusted at one pH value and the temperature compensation dial was rotated to set the temperature of the pH standard solution. The detecting unit was then immersed in the pH standard solution and measurement taken about 2 minutes when the pH meter is set to the pH of the standard solution. The detecting unit was removed from the standard solution, washed well with water and gently blotted with a piece of filter paper to remove water. It was then immersed in *Morinda citrifolia* and placebo juice samples, and the pH value measured. The temperature of the *Morinda citrifolia* and placebo juice samples and that of the pH standard solution was the same.

3. Results

Proximate analysis showed that *Morinda citrifolia* juice has higher amounts of protein and dietary fibre than the placebo juice. It also showed that *Morinda citrifolia* juice has higher carbohydrate, fructose and glucose content than the placebo juice (Table 1). *Morinda citrifolia* juice has a pH value of 5.17 while the placebo juice has a pH value of 4.76 (Table 1).

Table 1: Proximate Composition of *Morinda citrifolia* and Placebo Juice

Proximate	<i>Morinda citrifolia</i> Juice Content	Placebo Juice Content	Unit
Moisture	87.91	36.20	%
Protein	0.13	0.09	%
Ash	1.14	0.093	%
Lipids (fats)	0.24	0.02	%
Crude Carbohydrate	61.66	10.8	%
Crude dietary fibre	1.677	0.0	%
Fructose	3.8	1.2	g/100ml
Glucose	3.5	1.0	g/100ml
Sucrose	< 0.1	< 0.1	g/100ml
Specific Gravity	1.250	1.018	(g/dm ³)
pH value	5.17	4.76	

4.0. Discussion

The purpose of the study was to evaluate the effect of *Morinda citrifolia* 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 (Muralidharan and Srikanth, 2009). Proximate nutritional, fiber, sugar, partial amino acids, and some mineral analyses of juice pressed from raw noni fruits from Cambodia have been reported (Chunhieng *et al.*, 2005; West *et al.*, 2011). 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.

In this study, proximate analysis of *Morinda citrifolia* juice revealed that *Morinda citrifolia* contained ash (1.14%), crude protein (0.13%), crude fat (0.24%), crude fiber (1.677%); moisture (87.91%) and crude carbohydrate (61.66%). It showed that it contained fructose (3.8g/100ml), glucose (3.5g/100ml), sucrose (<0.1g/100ml), specific gravity (1.250g/dm³) and a pH value of 5.17. *Morinda citrifolia* fruit juice does not contain a significant quantity of protein or fat (West et al., 2011). It also showed that proximate analysis of a popular blackcurrant drink used as placebo drink revealed that it contained ash (0.093%), crude protein (0.09%), crude fat (0.02%), crude fiber (0.0%); moisture (36.20%), crude carbohydrate (10.80%), fructose (1.2g/100ml), glucose (1.0g/100ml), sucrose (<0.1g/100ml), specific gravity (1.018g/dm³) and a pH value of 4.76.

The values reported for fructose (3.8g/100ml) and glucose (3.5g/100ml) contents of *Morinda citrifolia* juice was higher than the values reported by West et al. (2011). However, that of the popular blackcurrant drink used as placebo drink were inclusive and comparable with the values previously reported (West et al., 2011). The sucrose (<0.1g/100ml) content reported in this study for *Morinda citrifolia* juice and placebo drink were exactly the value reported by West et al. (2011) in noni fruit puree. The fructose, glucose and sucrose content ranges of *Morinda citrifolia* juice and placebo drink are inclusive of the amounts reported for Cambodian noni fruit juice (Chunhieng et al., 2005; West et al., 2011).

Proximate nutritional parameters reported in this study are within the typical ranges for fruits in general (West et al., 2011) and it is comparable to the values reported in previous studies. The protein content of the *Morinda citrifolia* juice and the placebo drink is much less than that reported for pressed juice from Cambodian noni fruit, processed puree from French Polynesia and raw noni fruit from Pohnpei (Shovic and Whistler, 2001; Chunhieng et al., 2005; West et al., 2011). Previous studies reported Cambodian noni juice to contain 2.5% protein (West et al., 2011), about two times greater than that reported in this study. According to West et al. (2011), the protein content of purple passion fruit is 2.2% and it is one of the highest known among fruits (West et al., 2011), and, by comparison, the juice pressed from passion fruit is reported to have contained 0.39 g 100 g⁻¹ (USDA, 2009; West et al., 2011). Therefore, it is possible that the high protein

content previously reported in noni juice must have been reported in error (West et al., 2011).

This data was the average of the two determinations and the result obtained showed that *Morinda citrifolia* juice has high carbohydrate content compared to the placebo drink. They were both low in crude fat and crude protein contents as compared to their carbohydrate content. *Morinda citrifolia* juice also provided dietary fiber. The carbohydrate and moisture contents of *Morinda citrifolia* juice is higher than the values reported by other scientists in related studies (Hussain, 1985; Farhath et al., 2001; Shumaila and Mahpara, 2009).

The proximate analysis showed that *Morinda citrifolia* juice has the same protein and dietary fibre content with placebo juice, but lower moisture, ash and fat content. It also showed that *Morinda citrifolia* juice has higher carbohydrate; fructose and glucose content than the placebo juice, but has a lower specific gravity. The pH values of the different juice samples were closely related. The pH of the two juice types were 4.76 and 5.17 respectively which fall outside the range that incidentally favours bacterial growth. The result of the proximate analysis agrees with previous studies on other similar plants (Gesinde et al., 2008; Odu et al., 2012). The variation in results may be due to the difference in specie used and environmental conditions (Shumaila and Mahpara, 2009).

The proximate analysis showed that *Morinda citrifolia* juice has higher protein and higher moisture content than the placebo juice. This may be due to the fact that the samples undergo extensive treatment during production. This may also be attributed to their simple method of processing that most often do not incorporate heat (Tunde-Akintunde and Souley, 2009; Odu et al., 2012). The higher moisture content of *Morinda citrifolia* juice could be as a result of protein coagulation, thereby restricting the expulsion of water from the cake (Bourne, 1986).

The carbohydrate content of *Morinda citrifolia* juice was higher and similar to that reported by Wikens et al. (1967) and Odu et al. (2012) on soymilk. The fat content of the placebo juice was higher and it correlated with the report obtained by Adetunji et al. (2006) and Odu et al. (2012) on soymilk.

In this study, total fat content was 0.02% in the placebo juice and 0.24% in *Morinda citrifolia* juice. The fat content reported for *Morinda citrifolia* juice in this study is essentially higher than the value reported in both the puree, the Cambodian juice and in Pohnpei noni fruit (Shovic and Whistler, 2001; West et al., 2011). Akihisa et al. (2007, 2012) also reported the presence of fat and fatty acids in *Morinda citrifolia* juice. The higher ash content of

Morinda citrifolia juice could be due to more minerals being extractable in *Morinda citrifolia* juice due to the action of the acid. This finding is comparable to the reports of Onuorah *et al.* (2007) and Odu *et al.* (2012) on soymilk.

The dietary fiber content reported for *Morinda citrifolia* juice and placebo drink is less than the value reported in previous studies (Chunhieng *et al.*, 2005; West *et al.*, 2011).

5. Conclusion

The present study showed that *Morinda citrifolia* juice has higher amounts of protein and dietary fibre than the placebo juice. It also showed that *Morinda citrifolia* juice has higher carbohydrate, fructose and glucose content than the placebo juice. The pH values of the tested drinks fall outside the range that incidentally favours bacterial growth. Thus, the study concluded that the tested *Morinda citrifolia* juice contained highest amount of carbohydrate and moisture and is a potential dietary source of energy.

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