Micronutrient and phytochemical screening of a commercial *Morinda citrifolia* juice and a popular blackcurrant fruit juice commonly used by Athletes in Nigeria

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Abstract: This study was carried out to evaluate the phytochemical constituents of a commercial *Morinda citrifolia* juice and a popular blackcurrant fruit juice used by athletes in Nigeria. The popular fruit juice was used as a placebo in the study which compared its ergogenic effect to that of *Morinda citrifolia* juice. The placebo juice was chosen in this double-blind study because it is indistinguishable from the *Morinda citrifolia* juice in colour, flavor and taste. The *Morinda citrifolia* and a popular blackcurrant fruit juice were tested for the presence of bioactive compounds using standard methods. Three milliliter (ml) of each juice was measured into a test tube for each test. Phytochemicals tested for were phenols, tannins, flavonoids, saponins, cardiac glycosides, steroids, terpenoids, alkaloids, anthraquinones, acidic components, resins and phylobatannin using standard methods. While the micronutrients tested for include proteins, carbohydrates, reducing sugars and lipids. Two duplicates were maintained for each test. From qualitative phytochemical screening, it was observed that the fruit juice of *M. citrifolia* L. contains secondary metabolites such as reducing sugars, phenols, tannins, flavonoids, saponins, glycosides, steroids, terpenoids, alkaloids, and acidic components. They do not contain anthraquinones, phylobatannins and resins. The result also showed the presence of proteins, carbohydrates and lipids. The results also show slight presence of protein, carbohydrate, reducing sugars, phenols, tannins, flavonoids, saponins, steroids, alkaloids, lipids and fats, as well as acidic compounds in the placebo juice. There were no cardiac glycosides, terpenoids, anthraquinones, phylobatannins and resins. From quantitative phytochemical screening, it was observed that the crude extracts of *M. citrifolia* and the placebo juice contain different amounts of secondary metabolites such as tannins, flavonoids, saponins and alkaloids. *M. citrifolia* juice has higher amounts of alkaloids, saponins, tannins and flavonoids than the placebo juice. So, although these two juices are used as energy drinks by sports persons and healthwatchers, they differ in their production of secondary metabolites. Further analysis showed that *M. citrifolia* juice does not contain any toxic or prohibited substance. The result highlights the fact that the studied drinks are potential sources of phytochemical constituents and antimicrobial agents which may be useful for pharmaceutical industries and could be used as an effective nutraceuticals. However, further studies are needed to isolate and purify the bioactive compounds of this useful traditional plant *Morinda citrifolia* for industrial drug formulation and drug development programmes.

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1. Introduction

The search for 'legal' preparations with which to achieve optimum performance in sports has revolved around the sciences of biochemistry and nutrition. The involvement of biochemistry and nutrition in the training of sportsmen and women has opened a new research field, sports nutrition, which represents the application of nutritional and biochemical principles aimed at improving the athletic performance of sports persons (Higgins *et al*., 2006; Gaur, 2012). It is based on the knowledge that an insufficient intake of certain nutrients may impair sports performance due to inadequate energy supply, inability to regulate metabolic processes at an optimal level during exercise, or a decrease in the synthesis of vital body tissue or enzymes (Higgins *et al*., 2006; Gaur, 2012).

Many plants have limitless ability to synthesize secondary metabolites of which at least 12,000 have been isolated. These substances serve as plant defense mechanism against predation by microorganisms, insects and herbivores (Sahoo *et al*., 2012). Many plants and their extracts are used against microbial infections due to the presence of secondary metabolites such as phenols, essential oils, terpenoids, alkaloids and flavanoids (Sahoo *et al*., 2012).

Medicinal plants contain some organic compounds which provide definite physiological action on the human body and these bioactive substances include tannins, alkaloids, carbohydrates, terpenoids, steroids and flavonoids (Yadav and Agarwala, 2011). These compounds are synthesized by primary or rather secondary metabolism of living organisms (Yadav and Agarwala, 2011).

M. citrifolia juice is a very popular nutritional supplement used by sportsmen especially in Nigeria and many Asian countries. *Morinda citrifolia* fruit is rich in phytochemicals such as flavinoids, indoids, fatty acid, lignans, oligosaccharide, polysaccharide, catchin, alkaloids, β-sitosterol and α-tocopherols. Recently, vegetable oil have been extracted from it seeds (West *et al*., 2008).

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.

Knowledge of the phytochemical profile of processed *Morinda citrifolia* (noni) fruit is also important in understanding potential bioactivities, as well as in understanding the compounds responsible for health effects already demonstrated in human clinical trials (West et al., 2011). A few publications have provided some limited nutritional and phytochemical information on the composition of *Morinda citrifolia* (noni) fruit (West et al., 2011). Thus, this study was carried out to evaluate the phytochemical constituents of *Morinda citrifolia* and placebo juice used among athletes in Nigeria.

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. Qualitative and Quantitative Micronutrient and Phytochemical Screening of *Morinda citrifolia* and Placebo Juice

Morinda citrifolia and placebo juices were subjected to micronutrient and phytochemical screening at the Research Laboratory, Department of Plant Science and Biotechnology, University of Port Harcourt, Nigeria. The *Morinda citrifolia* and placebo juices were tested for the presence of bioactive compounds using standard methods (Harborne, 1973; Trease and Evans, 1989; Sofowora, 1984, 1992, 1993, 2008; Harborne, 1998; Awe and Sodipo, 2001; Trease and Evans, 2002; Evans, 2002, Aiyegroro and Okoh, 2010; Yadav and Agarwala, 2011). Three milliliter (ml) of each juice was measured into a test tube for each test. Phytochemicals tested for were phenols, tannins (Trease and Evans, 1978, 1983, 2002, 2005); flavonoids (Mabry *et al.,* 1970); saponins (Hungund and Pathak, 1971); cardiac glycosides (Balbaa *et al.,* 1981); steroids (Claus, 1967 and Schmidt, 1964); Irodoids (Weiffering, 1966); terpenoids (Claus, 1967 and Schmidt, 1964); alkaloids (Shellard, 1957); anthraquinones (Farnsworth *et al.,* 1969); acidic components [Chlorides and Sulphates] (Islam *et al.,* 1993), resins and phylobatannin using standard methods (Harborne, 1973; Trease and Evans, 1989; Sofowora, 1993; Evans, 2002; Nagalingam *et al*., 2012) while the micronutrients tested for include proteins, carbohydrates (Stank *et al.,* 1963); reducing sugars (Stank *et al.,* 1963) and lipids. Two duplicates were maintained for each test. The previously mentioned substances were investigated for their presence/amount within different juice extracts.

3. Results

3.1. Qualitative Micronutrient and Phytochemical contents of *Morinda citrifolia* and Placebo Juice

Preliminary qualitative phytochemical screening of *Morinda citrifolia* fruit juice and the placebo juice revealed the presence of various bioactive compounds and the results are summarized in Table 1. From qualitative phytochemical screening, it was observed that the fruit juice of *M. citrifolia* L. contains secondary metabolites such as reducing sugars, phenols, tannins, flavonoids, saponins, glycosides, steroids, terpenoids, alkaloids, and acidic components (Table 1). They do not contain anthraquinones, phylobatannins and resins (Table 1). The result also showed the presence of proteins, carbohydrates and lipids. The results also show slight presence of protein, carbohydrate, reducing sugars, phenols, tannins, flavonoids, saponins, steroids, alkaloids, lipids and fats, as well as acidic compounds in the placebo juice (Table 1). There were no cardiac glycosides, terpenoids, anthraquinones, phylobatannins and resins (Table 1). So, although these two juices are used as energy drinks by sports persons and healthwatchers, they differ in their production of secondary metabolites.

Table 1: Qualitative micronutrient and phytochemical contents of fruit extract of *Morinda citrifolia* and Placebo juice

Constituents	Placebo Juice	*Morinda citrifolia* Juice
Protein	+	++
Carbohydrates	+	++
Reducing sugar	+	++
Lipids and fats	+	+
Phenol	+	++
Tannins	+	++
Flavonoids	+	++
Saponins	+	++
Cardiac Glycosides	-	++
Steroids	+	++
Terpenoids	-	++
Alkaloids	+	++
Anthraquinones	-	-
Acidic Compounds	+	+
Phylobatannins	-	-
Resins	-	-

+ Indicates the slight presence of compound.
++ Indicates heavy presence of compound.
- Indicates the absence of compound.

3.2. Quantitative Micronutrient and Phytochemical contents of *Morinda citrifolia* and Placebo Juice

From quantitative phytochemical screening, it was observed that the crude extracts of *M. citrifolia* and placebo juice contain different amounts of secondary metabolites such as tannins, flavonoids, saponins and alkaloids. *M. citrifolia* juice has higher amounts of alkaloids, saponins, tannins and flavonoids than the placebo juice (Table 2).

Table 2: Quantitative phytochemical bioactive components of *Morinda citrifolia* and Placebo juice

Bioactive Component	Placebo Juice (%)	*Morinda citrifolia* Juice (%)
Alkaloids	4.96	14.02
Saponins	0.068	5.12
Tannins	0.009	0.18
Flavonoids	6.25	43.9

4. Discussion

Medicinal plants contain some organic compounds which provide definite physiological action on the human body and these bioactive substances include tannins, alkaloids, carbohydrates, terpenoids, steroids and flavonoids (Yadav and Agarwala, 2011). These compounds are synthesized by primary or rather secondary metabolism of living organisms (Yadav and Agarwala, 2011). Secondary metabolites are chemically and taxonomically extremely diverse compounds with obscure function. They are widely used in human therapy, veterinary, agriculture, scientific research and countless other areas. A large number of phytochemicals belonging to several chemical classes have been shown to have inhibitory effects on all types of microorganisms *in vitro* (Yadav and Agarwala, 2011). Plant products have been part of phytomedicines since time immemorial (Yadav and Agarwala, 2011). These can be derived from barks, leaves, flowers, roots, fruits, seeds (Criagg and David, 2001). Knowledge of the chemical constituents of plants is desirable because such information will be valuable for synthesis of complex chemical substances (Parekh and Chanda, 2007, 2008; Yadav and Agarwala, 2011).

Phytochemical investigations of raw noni fruits, and some commercial juices, have identified the presence of several different types of compounds (Basar and Westendorf, 2010; Potterat et al., 2007; Kamiya et al., 2005; West et al., 2011). According to previous studies, iridoids constitute the major phytochemical component of noni fruit (Deng et al., 2011; West et al., 2011), with a few other compounds, such as scopoletin, quercetin, and rutin occurring in significant, although much less, quantities (Deng et al., 2010; West et al., 2011). These previous analyses have been limited in the amount of nutrient data provided (West et al., 2011). Further, they have not been representative of commercially processed noni fruit puree, as processing conditions do alter the nutritional and phytochemical profiles of fruits and vegetables (Murcia et al., 2009; Rodrigues et al., 2009; West et al., 2011). However, this iridoids with a few other compounds, such as scopoletin, quercetin, and rutin were not screened for in this present study.

Morinda citrifolia and the placebo juice were subjected to phytochemical study. The qualitative phytochemical analysis of *Morinda citrifolia* and the placebo juice showed the presence of major phytochemicals: steroids, cardiac glycosides, terpenoids, carbohydrates and flavanoids in appreciable amounts, and other components in moderate amounts. Cardiac glycosides and terpenoids were absent in the placebo juice, phylobatannins, anthraquinones and resins were absent in both the *Morinda citrifolia* and placebo juices.

This study indicates that *Morinda citrifolia* juice contains a broad spectrum of secondary metabolites. Alkaloids, tannins, flavonoids, terpenoids, cardiac glycosides, carbohydrates and reducing sugars were predominantly found in the juice, followed in lesser amounts by phenols, steroids, lipids and fats. These findings are in agreement with those of previous studies (Kumar *et al.,* 2007; Muralidharan and Srikanth, 2009; Suresh *et al.*, 2010; Ramappa and

Mahadevan, 2011; Sahoo *et al*., 2012 and Nagalingam *et al*., 2012).

Many plants have limitless ability to synthesize secondary metabolites of which at least 12,000 have been isolated. These substances serve as plant defence mechanism against predation by microorganisms, insects and herbivores (Sahoo *et al*., 2012). Many plants and their extracts are used against microbial infections due to the presence of secondary metabolites such as phenols, essential oils, terpenoids, alkaloids and flavanoids (Sahoo *et al*., 2012). According to Varadarajan *et al*. (2008), the secondary metabolites (phytochemicals) and other chemical constituents of medicinal plants account for their medicinal value (Agbafor and Nwachukwu, 2011). For example, saponins are glycosides of both triterpene and steroids which have hypotensive and cardiodepressant properties (Olaleye, 2007; Agbafor and Nwachukwu, 2011), while anthraquinones possess astringent, purgative, anti-inflammatory, moderate antitumor, and bactericidal effects (Agbafor and Nwachukwu, 2011). Saponins and flavonoids have received considerable attention due to their beneficial effects on animal and human health (Hassan *et al*., 2013).

The medicinal values of plant leaves may be related to their constituent phytochemicals. Steroids are known to be important cardio-tonic agents and are also used in herbal medicines and cosmetics (Nagalingam *et al*., 2012). Steroids have been reported to have antibacterial properties (Raquel, 2007) and are very important proliferating compounds especially due to their relationship with sex hormones (Yadav and Agarwala, 2011). The androgenic effects of steroids in the body include increase in muscle mass especially injuction with training reduction of fatigue and improvement in muscle strength and endurance (Drug In Sports, 2010; Encyclopedia of Sports Science & Medicine, 1997).

Glycosides are known to lower blood pressure according to many reports (Yadav and Agarwala, 2011). Also, cardiac glycosides are natural cardioactive drugs used in the treatment of congestive heart failure and cardiac arrhythmia (Yadav and Agarwala, 2011). Many plants contain non-toxic glycosides that can get hydrolyzed to release phenolics that are toxic to microbial pathogens (Samoylenko *et al.,* 2006 and Sahoo *et al*., 2012). Cardiac glycosides have been shown to play a major role in the functioning of heart muscles by inhibiting the Na+ and K+ pump that increase the availability of sodium and calcium ions to heart muscles, thereby improving cardiac output and reducing heart distension. This explains their use in the treatment of congestive heart failure and cardiac arrhythmia (Nagalingam *et al*., 2012).

Phenolic compounds are one of the largest and most ubiquitous groups of plant metabolites (Singh *et al*., 2007 and Yadav and Agarwala, 2011). They possess biological properties such as antiapoptosis, antiaging, anticarcinogen, antiinflammation, antiatherosclerosis, cardiovascular protection and improvement of endothelial function, as well as inhibition of angiogenesis and cell proliferation activities (Han *et al.*, 2007; Yadav and Agarwala, 2011). Several phenolic compounds like tannin present in the cells of plants are potent inhibitors of many hydrolytic enzymes such as proteolytic enzymes used by plant pathogens (; Nagalingam *et al*., 2012). Tannins bind to proline rich protein and interfere with protein synthesis (Yadav and Agarwala, 2011).

In this study, total tannin content of 0.18% in *Morinda citrifolia* juice and 0.09% in the placebo juice were obtained. These results may improve the relationship between the plant metabolic synthesis and the climacteric conditions and also to justify the evidence in phytochemical content variations presented in the same medicinal plant produced in different countries, with specific soil and climatic conditions (Vinha *et al.*, 2012a). Flavonoids and tannins are the groups of phenolic compounds that act as primary antioxidants and possess antimicrobial, anti-inflammatory, antiallergic, anticancer, antineoplastic activity, and for the treatment of intestinal disorders (Nagalingam *et al*., 2012).

In this study, total flavonoid content was 43.90% in *Morinda citrifolia* juice and 6.25% in the placebo juice. The diversity of polyphenolic constituents and their different distribution in plants may explain the different ranges obtained for the total phenolic and flavonoid contents analyzed (Pereira *et al*., 2009; Vinha *et al.*, 2012a). Flavonoids are hydroxylated phenolic substances known to be synthesized by plants in response to microbial infection and they have been found to be antimicrobial substances against wide array of microorganisms *in vitro* (Yadav and Agarwala, 2011). Their activity is probably due to their ability to form complexes with extracellular and soluble proteins and also with bacterial cell wall (Marjorie, 1996). They also are effective antioxidants and show strong anticancer activities (Yadav and Agarwala, 2011).

Flavonoids have many beneficial effects on human and animal health such as anti-aging, antioxidant, antibacterial and antifungal activities, anticancer, anti-cardiovascular disease and anti-inflammatory (Hassan *et al.*, 2010, 2013). Some researchers found extensive variability in flavonoid content among seeds of different plants (Wang and Morris, 2007; Hassan *et al.*, 2013). Yang *et al*. (2008) in their study reported that the total flavonoid content ranged from 0 to 254 mg/100 g fresh weight of edible plants species. They found that about 75% of samples were seen to contain flavonoids of more than 0.5 mg/100 g with the mean average of 33 ±48 mg/100 g. Prati *et al*. (2007) in their study determined the total flavonoid content and composition in forage and grain legume crops.

In this study, total alkaloid content was 4.96% in the placebo juice and 14.02% in *Morinda citrifolia* juice. Heinicke (1985) stated that the *Morinda citrifolia* fruit contains a natural precursor for xeronine that he named proxeronine. Proxeronine is converted to the alkaloid xeronine in the body by an enzyme proxeroninase (Heinicke 1985; Wang *et al.*, 2002). This alkaloid is a critical normal metabolic coregulator. The ailments that he believes can be managed by *Morinda citrifolia* include high blood pressure, menstrual cramps, arthritis, gastric ulcers, sprains, injuries, mental reduction, senility, poor digestion, drug addiction, and pain (Wang *et al.*, 2002). According to Heinicke (2001), tremendous benefits can be achieved by furnishing the body with a proper supply of this material. Alkaloids are one of the largest groups of phytochemicals that have led to the invention of powerful pain killer medications (Nagalingam *et al*., 2012). Alkaloids have been associated with medicinal uses for centuries and one of their common biological properties is their cytotoxicity (Nobori *et al*., 1994). Several workers have reported the analgesic, antispasmodic and antibacterial properties of alkaloids (Yadav and Agarwala, 2011). The alkaloid extracts obtained from medicinal plant species have multiplicity of host-mediated biological activities, including antimalarial, antimicrobial, antihyperglycemic, anti-inflammatory and pharmacological effects (Yadav and Agarwala, 2011; Nagalingam *et al*., 2012).

In this study, total saponin content was found to be 5.12% in *Morinda citrifolia* juice and 0.68% in the placebo juice. This differs from the findings of previous studies on different plants species. Previous studies reported that the concentration of crude saponins in the guar meal was 4.8 ± 0.6% (Hassan *et al*., 2010) and 13% dry matter in guar meal. Battal (2002) has reported that total saponin was 11.58-19.58% in soapwort extract. Baylan (1990) reported total saponin content of Tahini Halvah as 119-266 mg/kg. In a study by Hassan *et al.* (2013), the crude saponin was extracted and the concentration of crude saponin was found to be about 6.2 ± 0.7% dry matter of guar meal.

Saponins which act as bioactive antibacterial agents in plants are used to treat hypercholesterolemia, hyperglycemia and obesity (Nagalingam *et al*., 2012). Saponins also have antifungal properties (Sahoo *et al*., 2012). This study showed that *Morinda citrifolia* fruit juice and placebo juice contain saponins which are known to produce inhibitory effect on inflammation (Yadav and Agarwala, 2011). Saponins have the property of precipitating and coagulating red blood cells (Yadav and Agarwala, 2011). Saponins are among several plant compounds which have beneficial effects. Among the various biological effects of saponins are antibacterial and antiprotozoal (Avato *et al*., 2006; Hassan *et al.*, 2013) and anticancer (Ma *et al*., 2007; Hassan *et al.*, 2013) activities. Some of the characteristics of saponins include formation of foams in aqueous solutions, hemolytic activity, cholesterol binding properties and bitterness (Yadav and Agarwala, 2011). Several studies have reported that saponin concentrations are affected by plant species and plant variety (Hassan *et al.*, 2013), degree of maturity, growing environment, agronomic factors such as climate and soil, cultivation year, location grown, season and extraction method (Hassan *et al.*, 2013). Saponin content depends on factors such as the cultivar, the age, the physiological state and the geographical location of the plant. There can be considerable variation in composition and quantity of saponins in vegetable material from different places (Ceyhun-Sezgin and Art2k, 2010).

Whereas anthraquinones were absent in *Morinda citrifolia* fruit and the placebo juice used in this study, Hiwasa *et al.* (1999) reported its presence in *Morinda citrifolia* root. Hiwasa *et al.* (1999) demonstrated that damnacanthal, an anthraquinone compound isolated from the *Morinda citrifolia* root, have a potent inhibitory activity towards tyrosine kinases such as Lck, Src, Lyn, and EGF receptors (Wang *et al.*, 2002).

The number of known triterpenes is very large and only a small proportion has been characterized in glycosidic form. Triterpenes are frequently isolated only after hydrolysis of plant extracts and it is not always easy to ascertain from published work whether they actually occur in the free or glycosidic forms in the plant itself (Ceyhun-Sezgin and Art2k, 2010).

Natural products, either extracts or pure compounds, provide unlimited opportunities for the development of new drugs due to the availability of chemical diversity (Cos *et al.*, 2006; Sahoo *et al.*, 2012). To overcome the problem of antibiotic resistance, ethnic medicinal plants have been extensively studied as an alternative treatment for diseases due to their ability to produce a variety of compounds of known therapeutic properties (Kumar *et al.,* 2007) and much attention has been paid to these plant extracts and their biologically active compounds (Suresh *et al.*, 2010; Sahoo *et al*., 2012).

The quantitative phytochemical analysis of *Morinda citrifolia* and the placebo juice shows the presence of major phytochemicals such as alkaloids, saponins, tannin and flavonoids in appreciable amounts. The result highlights the fact that the studied drinks are potential sources of phytochemical constituents and antimicrobial agents which need further pharmacological screening for drug development programmes. Screening of medicinal plants for antimicrobial activities and phytochemicals is important for finding potential new compounds for therapeutic use (Nagalingam *et al*., 2012). Due to modern civilization the resources of medicinal herbs are fast dwindling. Though purified plant chemicals are obtained from a significant number of studies only very few screening programmes are initiated on crude plants (Nagalingam *et al*., 2012). The medicinal value of plants depends on their bioactive phytocomponents associated with antibacterial activities (Nagalingam *et al*., 2012). There is a need to look back towards the traditional medicines which can serve as novel therapeutic agents (Nagalingam *et al*., 2012).

Several plants and herb species used traditionally have potential antimicrobial and antiviral properties and this has raised the optimism of scientists about the future of phyto-antimicrobial agents (Sahoo *et al*., 2012). Natural products of higher plants may give a new source of antimicrobial agents (Sahoo *et al*., 2012). In this study, it was observed that *M. citrifolia* juice was found to be more effective than the placebo juice probably because *M. citrifolia* has been reported to have a broad range of health benefits for cancer, infection, arthritis, asthma, hypertension and pain (Sahoo *et al*., 2012). These effects may have resulted from its antioxidant activity as well as the improvement of tissue oxygenation. Knowledge of the phytochemical constituents of plants is desirable, not only for the discovery of therapeutic agents, but also such information may be of value in disclosing new sources of such economic materials as tannins, oils, gums, flavonoids, saponins, essential oils precursors for the synthesis of complex chemical substances (Akrout *et al*., 2010; Sahoo *et al*., 2012). The *Morinda citrifolia* fruit juice has also been claimed to have antiulcer activity (Wang *et al.,* 2002), but no detailed scientific investigations have been carried out to define the antiulcer activities of *Morinda citrifolia* (Muralidharan and Srikanth, 2009).

5. Conclusion

Results obtained from the data analysis showed that: (i) Phytochemical screening of the *Morinda citrifolia* and placebo juice confirmed the presence of alkaloids in the plant juice (ii) The alkaloid, flavonoid, tannin and saponin contents of the juice of the plant species were significantly different ($p<0.05$) from one another (iii) The total alkaloid content of *Morinda citrifolia* juice was significantly ($p<0.05$) higher than the placebo juice and (iv) The total saponin, tannin and flavonoid contents of placebo juice was significantly ($p<0.05$) higher than the *Morinda citrifolia* juice.

Preliminary phytochemical surveys and the knowledge of the chemical constituents of plants are desirable to understand herbal drugs and their preparations. The phytochemical investigation of *Morinda citrifolia* fruit in this study reveals the presence of various potential phytochemical constituents which may be useful for pharmaceutical industries and could be used as an effective nutraceuticals. However, further studies are needed to isolate and purify the bioactive compounds of this useful traditional plant *Morinda citrifolia* for industrial drug formulation.

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