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Research Article

Comparative Studies of Phytochemistry, Proximate, Mineral and Vitamin Compositions of *Citrus tangerina* and *Citrus sinensis* Crude Fruit Peel Extracts

Omoregha Omoaregha Agbayayo[1], Ogbonna Onyemaechi John[2]*, Lawal Babatunde AS[2], Abe Pierre Noa[2] and Anele Emmanuel Ikechi[2]

[1]Department of Pharmacy Technology, College of Health Technology, Calabar, Nigeria

[2]Department of Pharmacology, Faculty of Basic Medical Sciences, University of Calabar, Calabar, Cross River State, Nigeria

***Corresponding Author:** Ogbonna Onyemaechi John, Department of Pharmacology, Faculty of Basic Medical Sciences, University of Calabar, Calabar, Cross River State, Nigeria.

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Abstract

Citrus tangerina and *Citrus sinensis* are medicinal plants cultivated in tropical and subtropical countries mainly for their fruits, leaves and roots. They are used in many cultures for prevention and treatment of diseases. But, the basis for their use in the prevention and treatment of diseases in various parts of the world has not been properly analysed. Samples of both plants were scientifically reviewed and the compositions of the phytochemistry, proximate, mineral and vitamin were revealed. The phytochemistry indicated that both *C. tangerina* and *C. sinensis* fruit extracts contain flavonoids including Rutin, Tangeretin, Nobiletin, Naringin, Hesperidin, Quercetin, and Naringenin, also found were carotenoids including beta carotene, lutein, cryptoxanthin and then Limonoids. Both plants also contain moisture, ash, protein, carbohydrate, fibre, total and saturated fats in variable amounts, and also contain some useful vitamins and minerals. There was a significant amount of ascorbic acids (*C. tangerina* 46.2 ± 0.2 and *C. sinensis* 55.1 ± 0.2), high K (*C. tangerina* 161 ± 0.2 and *C. sinensis* 188 ± 0.2) and low Na (*C. tangerina* 1.2 ± 0.2 and *C. sinensis* 1.01 ± 0.2). The high K, low Na and the anti - oxidants may be the reason behind their use in folkloric medicine in many cultures for hypertension, stroke, arrhythmia and cancer treatments and prevention.

Keywords: *Citrus tangerina*; *Citrus sinensis*; Phytochemistry; Proximate; Mineral; Vitamin; Fruit Extracts

Abbreviations

K: Potassium; Na: Sodium; Ca: Calcium; P: Phosphorus; Mg: Magnesium; Fe: Iron

Introduction

The role of traditional medicine in solving health problems is gaining recognition the world over [1-3], and this is attributed to the great number of people in developing countries who depend on traditional medicine for their health care needs [1-4]. Even individual communities have encouraged the use of plants and plant products for the prevention and cure of diabetes mellitus as alternative medicine [5]. This therefore calls for research into indigenous plant medicines to be encouraged to improve health care of those communities.

Citrus tangerina is a plant that is widely cultivated for its fruit, leaf, and root. Its main cultivated variety is mandarin orange, whose easily separated fruit is characterized by rind with a deep orange, red or orange - red colour. It is a type of Citrus plant of family *Rutaceae*. It originated in tropical and subtropical South East Asia [6,7]. The tree is small and erect with fruits at the end of the branches [3,7,8].

Citrus sinensis is a hybrid between Pomelo and Mandarin. There are both sweet and bitter oranges. The tree is an evergreen, flowering tree with an average height of 9 to 10m, the leaves are oval in shape and alternately arranged of 4 to 10cm long with crenulated margins. Brazil is the world's leading producer of oranges followed by China, India, United States, Spain and Egypt.

Materials and Methods

Plant materials

The fruit samples of the plants to be investigated were harvested from a farm in Anantigha community, Calabar South Local Government Area of Cross River State of Nigeria during the month of February 2018. The plant fruits were authenticated by a Taxonomist in Botany Department of the University of Calabar, Calabar, Cross River State, Nigeria as *Citrus tangerina* and *Citrus sinensis* and was deposited at the herbarium for reference with voucher specimen number 866-BC.

Chemicals and Drugs

All chemicals used were purchased from sigma chemical, Merck chemical supplies, SD fine and Himedia. All other chemicals used were obtained commercially and were of analytical grade.

Preparation of Extracts

The fruits were washed with tap water then rinsed in distilled water. The outer layer was peeled, discarded and later the remaining content was chopped into pieces and then its seeds removed. It was then shade dried at room temperature for two weeks. The dried samples were crushed into powder by the use of electric blender and the extraction of the active ingredient from the fruit powder was carried out using specific method [9,10]. 25g of the powdered fruit were extracted by Soxhlet apparatus using 250 ml of ethanol and n-hexane in a separate flask. The extraction lasted for six hours. The extracts obtained was concentrated by evaporation using water bath at 100°C and then stored at 4°C in cold room.

Determination of mineral compositions

The mineral compositions were determined using Atomic Absorption Spectrophotometer. 10g of each sample was weighed into a crucible and pre-washed using a heater for about 10 minutes. The appearance of a black colour was used to indicate the end of the prewashing process. This was heated using muffle furnace (Carbolite model MA450) at 500°C for about 20 hours. Nitric acid solution (1% v/v) was thereafter added to the ashed sample. The diluted sample was filtered using a whatmann filter paper. The filtrate was placed in a trace metal bottle for trace mineral analyses using a flame atomic absorption spectrophotometer (Schimadzu Model AA6800).

Determination of vitamin compositions

The vitamin compositions were determined using UV-visible spectrophotometer. 10ml of methanol was added to 0.5g of the sample. It was filtered and poured into a cuvette for analysis using UV-visible speed for various vitamins based on their standard calibration curves.

Determination of proximate compositions

The moisture content, ash content, crude fibre content, crude lipid content and total carbohydrate content were determined by the method of Association of Official Analytical Chemists [11], while crude protein content was by Kjeldahl method.

Determination of phytochemical compositions

Quantitative phytochemical analyses were carried out to determine the presence of the Phytochemicals using standard methods as described by [2,3,6,12-15].

Statistical analyses

The results obtained were expressed as Mean ± Standard Error of Mean (SEM). Significant difference between the control and experimental values were assessed using student's t-test and the results were considered significant at values less than 0.05 (P = 0.05). Graphical representations were designed using Microsoft Excel (2007).

Results

Phytoconstituents	Inference
Flavonoids	+++
Alkaloids	++
Tannins	++
Saponins	+
Phenols	+
Limonoids	+++
Oxalates	+
Carotenoids	+++

Table 1: Phytochemical composition of *Citrus tangerina* fruit extracts per 100g of edible portion.

Phytoconstituents	Inference
Flavonoids	+++
Alkaloids	++
Tannins	++
Saponins	+
Phenols	+
Limonoids	+++
Oxalates	+
Carotenoids	+++

Table 2: Phytochemical composition of *Citrus sinensis* fruit extracts per 100g of edible portion.

Components	Values (%)
Moisture	65.20 ± 0.2
Ash	0.48 ± 0.3
Protein	1.0 ± 0.1
Carbohydrate	9.3 ± 0.1
Fiber	2.5 ± 0.2
Total fat	0.2 ± 0.1
Saturated fat	0.03 ± 0.2

Table 3: Proximate composition of *Citrus tangerina* fruit extracts per 100g of edible portion.

Components	Values (%)
Moisture	69.30 ± 0.2
Ash	0.49 ± 0.1
Protein	1.2 ± 0.2
Carbohydrate	10.1 ± 0.1
Fiber	2.63 ± 0.2
Total fat	0.13 ± 0.2
Saturated fat	0.03 ± 0.1

Table 4: Proximate composition of *Citrus sinensis* of fruit extracts per 100g of edible portion.

Constituents	Concentration
Retinol (Vit.A)	95 μg ± 0.1
Thiamine (Vit.B_1)	0.21 ± 0.1
Riboflavin (Vit.B_2)	0.08 ± 0.1
Pyridoxine (Vit.B_6)	0.63 ± 0.1
Ascorbic Acid (Vit.C)	46.2 ± 0.2
Tocopherol (Vit.E)	0.4 ± 0.1
Nicotinic Acid (Niacin)	0.3 ± 0.1
Folate	24.1 μg ± 0.1

Table 5: Vitamin content of *Citrus tangerina* fruit extracts (Mg/100g).

Constituents	Concentration
Retinol (Vit.A)	23 μg ± 0.1
Thiamine (Vit.B_1)	0.08 ± 0.1
Riboflavin (Vit.B_2)	0.06 ± 0.1
Pyridoxine (Vit.B_6)	0.08 ± 0.1
Ascorbic Acid (Vit.C)	38.1 ± 0.2
Tocopherol (Vit.E)	0.2 ± 0.1
Nicotinic Acid (Niacin)	0.6 ± 0.1
Folate	31.2 μg ± 0.1

Table 6: Vitamin content of *Citrus sinensis* fruit extracts (Mg/100g).

Components	Values (Mg)
Calcium	36 ± 0.2
Phosphorous	12 ± 0.2
Magnesium	14 ± 0.2
Potassium	161 ± 0.3
Zinc	0.3 ± 0.1
Sodium	1.2 ± 0.2
Iron	0.2 ± 0.2

Table 7: Mineral content of *Citrus tangerina* fruit extracts per 100g of edible portion.

Components	Values (Mg)
Calcium	42 ± 0.1
Phosphorous	16 ± 0.1
Magnesium	11 ± 0.2
Potassium	188 ± 0.2
Zinc	0.07 ± 0.1
Sodium	1.01 ± 0.2
Iron	0.2 ± 0.1

Table 8: Mineral contents of *Citrus sinensis* fruit extract per 100g of edible portion.

Discussion

C. tangerina and *C. sinensis* fruit extracts have been found to contain many phytochemicals, proximates, minerals and vitamins. The presence of these constituents has supported their use in the prevention and treatment of many illnesses including hypertension, intestinal atony, chronic constipation, gastrointestinal tract inflammation, dyspepsia, stomach pain, cancer, scurvy, diabetes, dysentery and stroke. These fruits have high K and low Na and this has demonstrated why they were used in many cultures in the treatment and prevention of arterial hypertension, arrhythmia, stroke and cancer. Magnesium (Mg) a mineral found in these fruits inhibits the progression of arteriosclerosis and prevents heart attack.

These fruits are very rich in pectin: a type of vegetable fibre known for its anti-cholesterol and anti-carcinogenic properties which is a natural inhibitor of prostate cancer in laboratory rats [7,15]. The presence of vitamins A, C and E has demonstrated their use in ulcer management as they help to regenerate arterial walls, although vitamin is consumed in small as high dose may aggravate the ulcer. They also act as vermifuge to expel intestinal parasites. The presence of high K and low Na has demonstrated their use in the treatment of cardiovascular diseases. These findings were in per with [2,3,6-8,15-20] and were ascribed to a high tryptophan and carbohydrate content which increase the serotonin levels and give serotonin mediated natriuretic effect. The presence of folic acid has laid credence to their use during foetal nervous system development and as anti- oxidants for proper functioning of the defensive system. The presence of organic acids potentiates the activity of vitamin C and aids the elimination of toxic residues like uric acid from the body. The fruits also contain four very important and highly effective anti-oxidants - vitamin C, quercetin, provitamin A and folic acid. The vitamin C is anti-carcinogenic, and with its carotenoids help in the prevention of ocular degeneration of the retina which causes blindness in the aged. Presence of rutin is helpful in the prevention of recurrent bleeding that arise from weakened blood vessels and can help in treatment of haemorrhoids and help prevent the walls of blood vessels from becoming fragile and hence prevents tearing.

These important fruits also contain limonoids that are responsible for the fruits aroma which forms part of its essence. Chemically these are terpenes, and the most found is d- limonene. These important bioactive ingredients aid in the prevention of tumours. The fruits also contain very important major minerals including Ca, P, Mg, K, Na and Fe.

This high potentiative nature of *C. tangerina* and *C. sinensis* may be as a result of the phytochemicals - flavonoids, alkaloids, saponins, tannins, oxalates, phenols, limonoids, carotenoids, minerals, vitamins and proximates embedded in these plants' fruits. The nutritive and non - nutritive components found in these plants' fruits can be exploited in the production of cheap and readily available herbal drugs which will aid in the treatment and prevention of numerous illnesses ascribed to them considering the cost implication involved in the management these diseases [21-32].

Conclusion

The isolations and characterization of the active ingredients in these plants' fruit fractions followed by further pharmacological and clinical research would aid in the manufacture of good herbal drugs for the management of hypertension, cellular aging, cancer and other cardiovascular diseases which will be affordable and readily available as an alternative therapies to the conventional drugs.

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