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EVALUATION OF NUTRIENT, ANTI-NUTRIENT AND ACIDS COMPOSITIONS OF CITRUS PEELS.

Chuku, E. C.; Agbagwa, S. S.; Wekhe, O. E. And Chuku, O. S.

Department Of Plant Science And Biotechnology, Rivers State University.

Email:samuelagbagwa@gmail.com;

Abstract

Research studies on the nutrient, anti-nutrient and acid compositions of five citrus peels were carried out in the Department of Plant Science and Biotechnology, Rivers State University. The different citrus peels used for the study were those of sweet orange, lime, grape, rough lemon and tangerine. Investigations on the proximate composition revealed that highest values for carbohydrate (11.95±0.03) and protein (15.5±0.25) were found in rough lemon while highest concentrations of ash and lipid were recorded for sweet orange peels. Lime and tangerine peels had values for moisture (75.85±0.33) and fibre (2.5±0.004) respectively. Mineral content determination showed that lime peels had highest calcium (15.1±0.11) and phosphorus (18.0±0.00). However, highest values for potassium and iron were recorded for grape peels. Rough lemon and tangerine had highest values for sodium (10.1±0.05) and magnesium (53.1±0.022) respectively. Anti-nutrient assessment revealed that the peels of sweet orange had highest concentrations of flavonoid (6.8±0.01) and oxalate (0.11±0.00) respectively. Highest values for polyphenol and phytate were recorded for grape peels. Rough lemon and lime peels had highest values for saponin and tannin respectively. Three acids were found namely citric, malic and tartaric. The peels of grape fruits recorded the highest concentrations of citric (1.5±0.00) and malic (2.4±0.16) acids while lime peels had the highest value for tartaric acid. In addition, the peels of these five citrus plants possessed appreciable amounts Vitamins A and C. The peels of citrus could be utilized for manure and can be treated for extraction of vital metabolites and oils.

Key words: Citrus peels, acids and nutrient composition

INTRODUCTION

The *Citrus* genus is a well-known and cherished taxon that belongs to the Rutaceae family (Garcia, Gomez-Caravaca, Arraez-Roman, Segura-Carretero, Guerra-Hernandez, Garcia-Villanova & Segura-Gutierrez, 2013). The genus was implicated by early literature to have its origin from the South Eastern Asia (Peertson, Beecher, Bhagwat, Dwyer, Gebhard, Haytowitz, & Holden, 2006). The cultivation of citrus

have been reported to be over 400 years and the genus is grown in every part of the world (Morton, 1987).

Citrus genus contains several species that are uniquely characterized and early researchers have been able to classify them through chemotaxonomy using their flavonoid content as morphological characters were of limited use (Liu, Liu, Wang, Jong, Zha, Lu & Lu, 2012). Examples of citrus species include *C. sinensis* (Sweet orange), *C. reticulata* (Mandarins), *C. paradisi* (Grape), *C. limon* (Lemon), *C. aurantifolia* (Lime) and many others. These species are perennial plants that are mostly cherished for their fruits (Ortiz, 2002).

The fruit of citrus species are nutritionally important as they serve as sources of fibre, carbohydrate, protein, ash, moisture, calcium, potassium, phosphorus, iron, magnesium, sodium, Vitamins A and C (Moufida & Marzouk, 2003). More so, fruits of citrus species also contain phytochemicals and organic acids (Croak & Corredig, 2006).

Economically, citrus fruits are very important as they do not only serve as food but are further utilized in beverage, cosmetics and spice production (Kelebek & Selli, 2011). Furthermore, they are also vital in the pharmaceutical and industrial sectors as they serve as source of oils and medicine (Braddock, 1999; Buccellato, 2002; Ohiokpehai, 2003).

Citrus cultivation and production in Nigeria cannot be overlooked as over 3,900000 tonnes have been recorded to be produced and its cultivation has also serviced the fruits and juice markets (Peter, 2015). Literature has shown that even the peels of citrus fruits are also of economic value (Wright, 2004).

Nevertheless, there is dearth of information on the nutrient, antinutrient and acid contents of citrus peels. Hence, this research was embarked to assess these parameters in five citrus species found in Port Harcourt.

MATERIALS AND METHODS

Sample Collection

Five species of citrus (C. *aurantifolia*, C. *limon*, C. *sinensis*, C. *reticulata* and C. *paradisi*) were obtained from Mile III Market, Port Harcourt. Samples bought were transported to the Department of Plant Science and Biotechnology, Rivers State University for further studies.

Nutrient Composition Studies

The determination of proximate, mineral, vitamin and anti-nutrient contents of the five species of citrus were done using the atomic absorption spectrophotometry methods earlier described by AOAC, (2005). Data obtained were subjected to statistical analysis using the Microsoft Excel version 2019 16.0.6742.2048.

RESULTS AND DISCUSSION

Table 1: Proximate composition of five species of citrus (%)

Citrus species	Moisture	Ash	Lipid	Carbohydrate	Protein	Fibre
C. aurantifolia	75.85±0.33	2.5±0.02	4.5±0.01	4.95±0.03	11.0±0.04	1.2±0.01
C. limon	65.5±0.01	1.6±0.01	3.4±0.00	11.95±0.03	15.5±0.25	2.05±0.05
C. sinensis	72.5±0.02	3.56±0.03	5.60±0.03	5.5±0.04	12.3±0.02	1.5±0.01
C. reticulata	73.0±0.04	2.4±0.01	5.5±0.11	4.1±0.03	12.5±0.02	2.5±0.04
C. paradise	70.0±0.03	1.8±0.05	3.2±0.12	8.45±0.02	14.4±0.03	2.15±0.02

Table 2: Mineral and compositions of five species of citrus (mg/100g)

Citrus species	Ca	K	Na	P	Fe	Mg
C. aurantifolia	15.1±0.11	12.0±0.01	9.1±0.04	18.0±0.00	4.2±0.03	32.1±0.04
C. limon	11.5±0.02	11.2±0.03	10.1±0.05	16.2±0.03	4.0±0.02	35.0±0.05
C. sinensis	14.2±0.01	13.8±0.03	2.0±0.02	14.1±0.02	4.0±0.01	2.9±0.01
C. reticulata	10.1±0.02	13.6±0.01	7.0±0.03	5.91±0.04	3.5±0.06	53.1±0.02 2
C. paradise	15.0±0.03	14.0±0.12	8.9±0.04	14.±0.12	14.1±0.01	42.0±0.21

Table 3: Acid and vitamin composition of five species of citrus (mg/100g)

Citrus species	Citric acid	Malic acid	Tartaric acid	Vit. A	Vit. C
C. aurantifolia	0.65±0.00	1.28±0.03	3.4± 0.01	20.5±0.02	9.9±0.02
C. limon	1.2±0.01	2.0±0.04	3.0±0.03	25.1±0.03	10.15±0.03
C. sinensis	0.58±0.02	1.44±0.01	2.80±0.12	26.0±0.01	6.6±0.01
C. reticulata	0.71±0.05	1.50±0.	2.41±0.04	21.0±0.05	7.01±0.13
C. paradise	1.5±0.00	2.4±0.16	3.05±0.12	7.5±0.02	10.5±0.05

Table 4: Phytochemical composition of five species of citrus (%)

Citrus species	Phytate	Oxalate	Saponin	Tannin	Carotenoid	Polyphenol	Flavonoid
C. aurantifolia	0.08±0.02	0.05±0.04	0.05±0.02	1.3±0.05	3.8±0.01	2.0±0.03	4.7±0.10
C. limon	0.01±0.20	0.02±0.03	0.01±0.01	1.56±0.02	4.01±0.12	2.15±0.05	4.6±0.01
C. sinensis	0.09±0.03	0.11±0.00	0.03±0.05	1.04±0.4	4.3±0.02	4.5±0.05	6.8±0.01
C. reticulate	0.11±0.01	0.10±0.02	0.01±0.1	1.12±0.01	4.1±0.3	4.6±0.13	6.6±0.01
C. paradise	0.13±0.03	0.08±0.04	0.02±0.03	1.40±0.01	4.6±0.11	4.7±0.05	6.5±0.02

The result of proximate composition presented in Table 1 revealed the presence of moisture, ash, lipid, fibre, carbohydrate and protein. Highest values of 3.56±0.03 and 5.60±0.03 were recorded for ash and lipid in C. *sinensis* while C. *limon* recorded highest concentrations of carbohydrate (11.95±0.03) and protein (15.5±0.25). However, C. *aurantifolia* and C. *reticulata* had highest values for moisture (75.85±0.33) and fibre (2.5±0.04) respectively. The findings of this current study is in line with earlier works as they reported similar in citrus fruits (Forsyth, 2003). Although, the proximate composition in this study are higher than those reported

by Kolawole, Obuch & Emokpae, (2017). Morton, (1987) also reported lower proximate values than those found in this study. Several researchers have implicated different waste materials to possess qualities that could be useful for production of some agricultural produce (Agbagwa, Chuku & Emiri, 2020).

The result of mineral composition shown in Table 2 reveals the presence of calcium, potassium, phosphorus, iron, sodium and magnesium in all tested citrus peels. Highest contents of calcium (15.1±0.11) and phosphorus (18.0±0.00) were recorded for C. aurantifolia while C. paradisi had highest values for potassium (14.0±0.12) and iron (14.1±0.01). Furthermore, highest concentrations of sodium (10.1±0.05) and magnesium (53.1±0.022) were seen for C. limon and C. reticulata respectively. The present study has shown that the peels of the assessed citrus contain appreciable mineral contents and in line with the report of Benyahia, El-Khlifi, Talha & Benkirane, (2015). However, the mineral values in this study are higher than those reported by Kolawole *et al*., (2017) and Morton, (1987). Literature has shown the occurrence of these same minerals in other agro wastes and that they play a corresponding role in nutrient quality of produce when utilized for other forms of production (Udeozo, Okafor, Ike, & Eze, 2018; Agbagwa, Chuku & Worlu, 2020).

The result of acids and vitamins presented in Table 3 showed the occurrence of citric acid, malic acid, tartaric acid, vitamins A and C. Acid investigation revealed that C. paradise had highest contents of citric (1.5±0.00) and malic (2.4±0.16) acids whereas C. aurantifolia recorded highest concentration of tartaric acid. However, vitamin assessment showed that highest values of vitamin A (26.0±0.01) and vitamin C (10.5±0.05) were found in C. sinensis and C. paradise respectively. The vitamin data in this study is in agreement with earlier findings reported by previous researchers (Kimball, 1991; Fellers, Nikdel & Lee, 1990). Furthermore, the acids profiled in this study are in conformity with those reported by Mahato, Sinha, Sharma, Koteswararao, & Cho, (2019). Literature has also shown the peels of citrus to possess other vital components like oil (Kamal, Anwar, Hussian & Ashraf, 2011).

The antinutrient result presented in Table 4 revealed the availability of phytate, oxalate, saponin, tannin, flavonoid, polyphenol and carotenoids to be present in all assessed citrus peels in appreciable amounts. Earlier researchers have also implicated same anti nutrients to be associated with Citrus genus (Gupta, Kohli, Ghaiye, Bansal & Lather, 2011). More so, these anti nutrient parameters have been shown to have antimicrobial and anti-inflamatory properties (Lucia, Maria, Virginia, Maria, Isidro, Maria, Joaquin, Maria & Maria del Mar, 2016).

CONCLUSION

The various citrus peels assessed in this study have shown to contain some appreciable amounts of proximate, mineral, organic acids, vitamins and antinutrients. The availability of these constituents make these peels useful for other production process. Hence, farmers and industries should utilize this waste peels for manure and metabolite extraction respectively.

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