Annals of Science and Allied Research Vol. 2 (2) December, 2024: 47-51.
https://doi.org/10.5281/zenodo. 14677492
ISSN – 2584-2307 (Online)

UNLOCKING THE NUTRITIONAL AND ELEMENTAL RICHNESS OF *CITRUS SINENSIS* PEEL

Amanpreet Kaur[1*], Abha Shukla[2], Neha Bhatt[3], Sarika Arora[4], Pawan Kumar Shukla[5], Shuhangee Agarwal[6]

[1,4,5,6]*Department of Chemistry, School of Sciences, IFTM University, Moradabad (244102)*
[2]*Department of Chemistry, Kanya Gurukula Campus, Gurukula Kangri Vishwavidyalaya, Haridwar-249404, Uttarakhand, India;* [3]*Department of Chemistry, Pt. L.M.S., Rishikesh Campus, SDS University, Tehri Garhwal-249145, Uttarakhand, India;* *Corresponding Author Email: amanpreet.kaur@iftmuniversity.ac.in

(Received on November 14, 2024; Revised on December 19, 2024; Accepted on December 29, 2024)

ABSTRACT

The Middle East has seen a fall in interest in wild plant food sources as a result of urbanization and the degradation of natural landscapes occurring in the region. Nevertheless, it is of the utmost importance to do study on wild plants that may be consumed, since these plants have the potential to be significant resources for both food and medicine. *Citrus sinensis* peel, for example, has been the subject of research that has shed light on its nutritional composition. These studies have shown that it contains significant amounts of protein, carbs, and lipids, and that it has an energy value of 364.36 kcal per 100g of fresh weight. In addition, the mineral analysis reveals that there is a significant amount of potassium, calcium, magnesium, and sodium, while there is only a trace amount of harmful elements like lead, cadmium, and arsenic. Putting an emphasis on quality rather than quantity, the results show that the nutritional and therapeutic advantages of these wild plants may come out to be greater than those of plants that are grown in standard cultivation methods.

Keywords: *Citrus sinensis*, proximate analysis, nutritive value, elemental analysis, ICP-OES

INTRODUCTION

Plants provide valuable advantages, including the provision of oxygen and the provision of nutrients via the consumption of food and therapeutic plants. There has been a substantial increase in ethnobotanical research on a national and worldwide scale, which has brought to light the contradiction that exists between traditional therapeutic practices and scientific confirmation. In order to improve health, herbal medicines, which are highly regarded for the nutritional and pharmacological features they provide, are increasingly being used (1). The immense variety of plants found around the globe presents a significant opportunity for usage as sources of nourishment. The therapeutic applications of these plants, which may take the form of extracts, entire plants, pastes, and infusions, have been impacted by historical, cultural, and geographical differences (2).

Across the world, herbal treatments are becoming more popular as a result of their natural origins and reduced levels of toxicity. The phytonutrients, vitamins, minerals, and enzymes that are found in plants and herbs are very abundant, and they play an important part in the process of promoting health and well-being. The operations of the body are supported by phytonutrients, which contain minerals such as sodium, calcium, potassium, and magnesium that are necessary mineral components. In general, the body is able to absorb and make better use of organically generated minerals, despite the fact that synthetic minerals are often more affordable.

Magnesium, calcium, sodium, and potassium are some of the fundamental minerals that may be obtained from medicinal plants. These natural sources provide us with the opportunity to get nutrients that are beneficial to our health and also feed us (3). When it comes to understanding the nutritional advantages of medicinal plants, it is vital to do a nutrient analysis and a proximate study of the leaves. As a result, it is essential to conduct an analysis of specific plant species to determine the nutritional content and mineral composition of these plants in order to evaluate the health advantages they provide (4).

MATERIALS AND METHODS

Proximate analysis:

Ash Content

The ash content was determined by weighing five grams of each leaf sample and then heating it in a silica crucible inside of a muffle furnace at a temperature of 500 degrees Celsius for around five to six hours, until the ash became white or grayish-white. Following the cooling process, the samples were reweighed over and over again until the weight stayed the same, which indicated the final ash weight (5).

Moisture Content

Each sample was put in a plate with a flat bottom, and then it was dried in an air oven at a temperature between 100 and 110 degrees Celsius for a whole 24 hours. The moisture content was determined by documenting the change in weight that occurred after drying (6).

Crude fat content

Around six to eight hours were spent using a Soxhlet apparatus to extract two grams of each dried sample with petroleum ether at temperatures ranging from sixty to eighty degrees Celsius. For the purpose of determining the amount of crude fat present, the residual petrol was filtered using Whatman No. 40 filter paper, and the filtrate was then evaporated in a beaker that had been pre-weighed (7).

Unprocessed Fiber content

For each fat-free sample, two grams were treated with 200 milliliters of 1.25% hydrochloric acid. After the residue had been filtered and washed, it was treated with 1.25 percent sodium hydroxide, rinsed with hot water and a solution of one percent hydrogen nitrate, and then dried in an oven at 130 degrees Celsius until it reached a consistent weight. After reweighing the residue after being ashed at 550 degrees Celsius for two hours, the fiber content was determined (8).

Crude Protein Content

The micro Kjeldahl technique was used in order to determine the amount of crude protein, and the AOAC method was utilized in order to determine the total protein content by multiplying the nitrogen content by 6.25 (9).

Composition of Carbohydrates

Carbohydrates were determined by removing th=ie percentages of ash, fat, protein, and fiber from 100. The remaining % was then used to compute carbohydrates (10).

Nutritive Value

A calculation was made to determine the nutritive value, also known as the caloric content, of each sample by multiplying the values of the protein, fat, and carbohydrates by the appropriate caloric factors (4, 9, and 4), and then adding the findings together (11).

Minerals and Heavy Metals

Sodium and potassium were among the minerals that were ascertained via the use of flame photometry, whilst calcium and magnesium were evaluated through the utilization of titrimetric techniques. ICP-OES, which stands for inductively coupled plasma-optical emission spectroscopy, was used in order to evaluate heavy metals including lead, arsenic, and cadmium (12).

Statistics

In order to ensure accuracy, every measurement was performed three times. The data were given as the mean plus or minus the standard deviation, with a significance threshold of $p < 0.05$.

DISCUSSION

Based on the proximate analysis of the peel of *Citrus sinensis*, it was found that the moisture content of the peel was 9.64±0.10%, which is within a safe range that may effectively limit the development of microorganisms (13). The enzymatic hydrolysis of components is also restricted when there is a low moisture level, which helps to preserve the active components of the plant source. The peel was discovered to have a crude protein content of 3.58±0.15%, which indicates that it is a substantial source of protein that has the potential to facilitate the development of antibodies. The recording of the fat content was found to be 4.38±0.27%, whereas the total ash content was recorded as 14.14±0.33%, which indicates the existence of inorganic compounds. Additionally, the peel exhibited a fiber content of 0.72±0.01% and a high carbohydrate concentration of 76.61±0.22%. Carbohydrates are an important component that plays a significant role in the maintenance of plant and animal life (14).

Annals of Science and Allied Research Vol. 2 (2) December, 2024: 47-51.
https://doi.org/10.5281/zenodo. 14677492
ISSN – 2584-2307 (Online)

It was determined that the peel has a nutritional value of 364.36 kilocalories per 100 milligrams, which indicates that it has the potential to be an advantageous dietary supplement. The high nutritional and carbohydrate content of the plant demonstrates that it is suitable for use as animal feed and fodder, and that it may also be used into a variety of dietary formulas (15).

Table 1 Proximate analysis of peel of *Citrus sinensis*

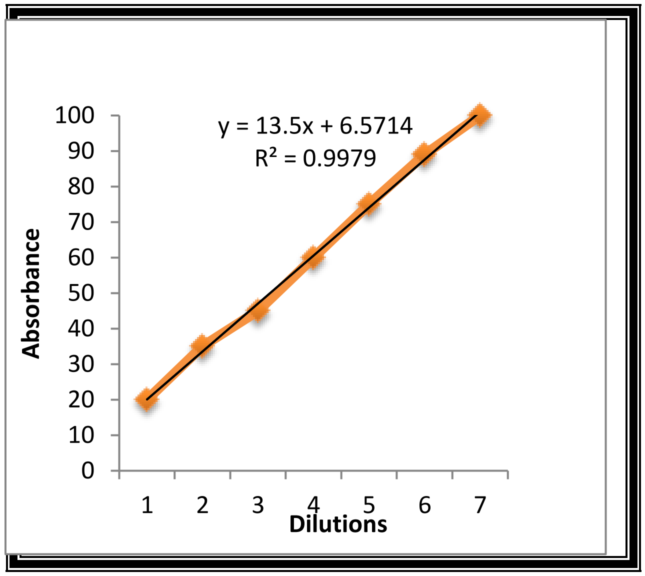
Parameters	Part	Result
Moisture	Peel	9.64±0.10
Crude protein	Peel	3.581±0.15
Fat	Peel	4.38±0.27
Ash	Peel	14.14±0.33
Crude fiber	Peel	0.72±0.01
Total carbohydrate	Peel	76.61±0.22

Table 2 Nutritive value of peel of *Citrus sinensis*

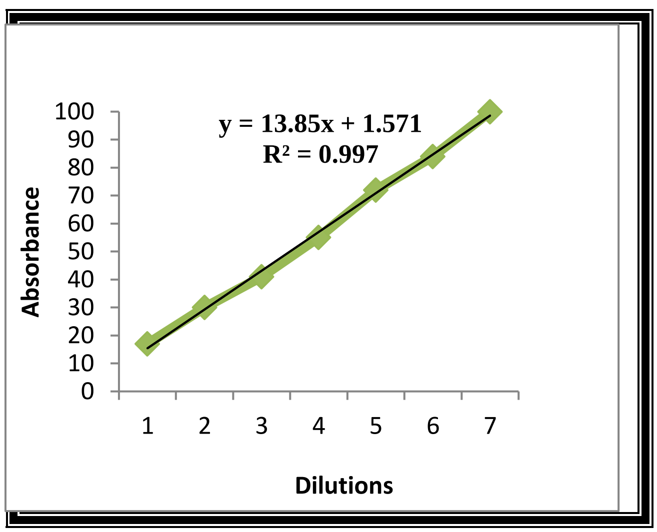
Plant	Part	Nutritive value result (Kcal/100gm)
Citrus sinensis R.Br	Peel	364.36

In accordance with the information shown in Table 3, it is evident that *Citrus sinensis* has very high concentrations of vital minerals including sodium, potassium, magnesium, and calcium. Additional illustrations of the concentration levels are provided by the calibration curves for sodium and potassium, which are shown in Graphs 1 and 2. According to the results of the mineral content study, these elements are present in significant quantities, which suggests that *Citrus sinensis* might be a potentially beneficial source of these critical nutrients (16).

Graph 1- Calibration curve for Sodium from flamephotometer



Graph 2- Calibration curve for Potassium from flamephotometer



The examination of the mineral composition of the peel of *Citrus sinensis* showed that it contains considerable amounts of sodium (538 ppm), potassium (318 ppm), calcium (480.96 ppm), and magnesium (53.60 ppm). In addition to their roles as necessary blood electrolytes, sodium and potassium play an important role in the maintenance of the ionic equilibrium in the human body (17). They also play a role in the contraction of muscles and the excitability of tissues. In addition, potassium is essential for the proper functioning of the heart, the transmission of nerve impulses, and the management of disorders such as low blood sugar and sleeplessness. Calcium, which is renowned for maintaining healthy bones and teeth, as well as blood and nerve function, is much greater in the peel sample than it is in the leaves, which suggests that it may be used to treat calcium shortages (18).

The peel samples of *Citrus sinensis* exhibited minimal levels of hazardous metals such as lead, cadmium, and arsenic. Heavy metals, which may have a deleterious influence on biological systems if they accumulate, were found to be present in the absence of any significant amounts. The fact that all of the heavy metal concentrations were below the detectable limits [ND (DL-0.1 ppm)] indicates that the peel is safe for eating in terms of the heavy metal content (19).

Because it does not play any vital biochemical or physiological function in the body, lead is considered to be a contaminant that is dangerous to the environment. Because of its toxicity, it may cause major health problems, such as damage to the kidneys, high blood pressure, damage to the brain, miscarriages, decreased cognitive capacities in children, and disturbance of the nervous system (20).

The peel of the *Citrus sinensis* tree did not contain any traces of cadmium. The toxicity of this heavy metal has been connected to higher blood pressure and kidney illnesses. Additionally, the buildup of this heavy metal may cause damage to nerve cells, which can result in greater activity within the nervous system (21). A wide variety of detrimental effects on several systems may be brought about by arsenic when it is present in excessive amounts. These consequences include damage to the skin, vascular illnesses, neurological problems, and damage to the liver and kidneys (22).

Table 3 Elemental analysis of Peel material of *Citrus sinensis*

S. no.	Metal	Technique used	Peel Concentration (ppm)	RDA/Day
1.	Sodium	Flame photometer	538	2.4 g
2.	Potassium	Flame photometer	318	3.6 g
3.	Calcium	Titrimetry	480.96	1.3 g
4.	Magnesium	Titrimetry	53.60	0.4 g
5.	Arsenic	ICP-OES	ND(DL-0.1 ppm)	3.00 ppm
6.	Cadmium	ICP-OES	ND(DL-0.1 ppm)	0.30 ppm
7.	Lead	ICP-OES	ND(DL-0.1 ppm)	10.00 ppm

***RDA (recommended dietary allowance), ND (Not detected)**

CONCLUSION

The peel of the *Citrus sinensis* tree has been shown to have great proximate and nutritional value, according to the findings of the present research. In terms of the minerals that are considered safe for human consumption, the levels of sodium (Na), potassium (K), calcium (Ca), magnesium (Mg), cadmium (Cd), lead (Pb), and arsenic (As) were found to be within acceptable ranges. Consequently, the peel that was examined is regarded as safe since it contains a greater quantity of minerals and has a small amount of heavy metals. This highlights the significance of *Citrus sinensis R. Br*. in the field of nutraceuticals. It would be prudent to do more study in order to verify the clinical safety of its extracts and determine the right concentrations in order to protect the health of consumers.

REFERENCES

1. Totelin L (2015). When foods become remedies in ancient Greece: the curious case of garlic and other substances. J Ethnopharmacol. 167:30-37.

Annals of Science and Allied Research **Vol. 2 (2) December, 2024: 47-51.**
https://doi.org/10.5281/zenodo. 14677492
ISSN – 2584-2307 (Online)

2. Towns AM and Van AT. (2016). Wild plants, pregnancy, and the foodmedicine continuum in the southern regions of Ghana and Benin. J Ethnopharmacol. 179:375-382.
3. Mustafa H. Al-Musawi, Kadhim M. Ibrahim, Salim Albukhaty. (2022). Phytochemical Analysis, and Anti-Microbial Activities of Ethanol Extract of Cordia myxa Fruit: In vitro Study. Research Journal of Pharmacy and Technology. 15(7):2871-6.
4. Mamun-or-Rashid AN, Hossain MS, Naim HB, Kumar DM, Sapon A and Sen MK. (2014). A review on medicinal plants with antidiabetic activity. Journal of Pharmacognosy Phytochemistrty.;3(4):149-159.
5. Bonjour JP, Kraenzlin M, Levasseur R, Warren M and Whiting S. (2013). Dairy in adulthood: from foods to nutrient interactions on bone and skeletal muscle health. Journal of American College of Nutrition.;32:251-63.
6. Shukla A, Kaur A, Shukla RK, Anchal. (2019). Comparative Evaluation of Antioxidant capacity, Total flavonoid and Phenolic content of *Citrus sinensis R. Br.* fruit. Research Journal of Pharmacy and Technology.;12(4):1811-1816.
7. Slavin J and Carlson J. (2014). Carbohydrates. Advances in Nutrition.;5(6):760–761.
   Fairweather-Tait SJ and Cashman K. . (2015). Minerals and Trace Elements. Nutrition and Health;111:45–52.
8. Beto JA. (2015). ;The Role of Calcium in Human Aging. Clinical Nutrition Research. 4:1- Farquhar WB, Edwards DG, Jurkovitz CT and Weintraub WS. Dietary Sodium and Health. Journal of the American College of Cardiology. 2015;65(10):1042–1050.
9. Hong Y-S, Song K-H and Chung J-Y. (2014). Health Effects of Chronic Arsenic Exposure. Journal of Preventive Medicine and Public Health.;47:245-252.
10. Faryadi Q. (2012). The Magnificent Effect of Magnesium to Human Health: A Critical Review. International Journal of Applied Science and Technology.;2(3):118-126.
11. Gafar MK, Itodo AU. (2011). Proximate and mineral composition of hairy indigo leves. Research Journal of Pharmaceutical and Biological Chemical Sciences.;2(1): 669-681.
12. Shukla RK, Nandan K, Shukla A, Kaur A, Rana D. . (2020). Review on Traditional uses, Biological activities, Phytoconstituents of Bombax ceiba Linn. Research Journal of Pharmacy and Technology;13(11): 5607-5612.
13. Gopalakrishnanb L, Doriyaa K, Kumar DS. (2016). *Moringa oleifera*: A review on nutritive importance and its medicinal application. Food Science and Human Wellness.;5:49–56.
14. Magomya AM, Kubmarawa D, Ndahi JA, Yebpella GG (2014). Determination Of Plant Proteins Via The Kjeldahl Method And Amino Acid Analysis: A Comparative Study. International Journal of Scientific and Technology Research.;3(4):68-72.
15. Shukla A, Pokhriyal P. (2022). A desirability approach for Antidiabetic and anti-inflammatory efficacy of Fiscus subincisa peel. Research Journal of Pharmacy and Technology. 15(4):1732-1736.
16. Pasiakos SM, Agarwal S, Lieberman HR, Fulgoni VL (2015). Sources and Amounts of Animal, Dairy, and Plant Protein Intake of US Adults in 2007–2010, Nutrients 7(8):7058–7069.
17. Prasada AR, Raob ASN. (2016). Trace Elemental Analysis of Some Anti-Diabetic Medicinal Plants Using Particle Induced X-ray Emission [PIXE]. Materials Today: Proceedings.;3:3930–3934.
18. Ramdhonee A, Jeetah P (2017). Production of wrapping paper from banana fibres, Journal of Environmental Chemical Engineeringhttp://dx.doi.org/10.1016/ j.jece.2017.08.011
19. Rihawy MS, Bakraji EH, Aref S and Shaban R. (2010). Elemental investigation of Syrian medicinal plants using PIXE analysis, Nuclear Instruments and Methods in Physics Research B 268:2790–2793.
20. Shukla A, Vats S and Shukla RK. (2015). Phytochemical Screening, Proximate Analysis and Antioxidant Activity of *Dracaena reflexa* Lam. Leaves. Indian Journal of Pharmaceutical Sciences. 77(5):640-644.
21. Velmurugan R, Incharoensakdi A, (2018). Nanoparticles and Organic Matter in Nanomaterials in Plants, Algae, and Microorganisms,.
22. Shukla A, Anchal, Shukla RK, Kaur A. (2021). Isolation and Identification of to triterpenoids from ehthyl acetate extract of peel of *Boehmeria regulosa*. Research Journal of Pharmacy and Technology 14(6) :2919-2923.