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PHYTOCHEMICAL CHARACTERIZATION OF FRUITS IN SOME SPECIES OF THE *CUCURBITACEAE* FAMILY

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ABSTRACT

Cucurbitaceae fruits are known for their low fat and calorie content and high water content. However, they are rich in phytochemical compounds. Understanding their nutritional value is necessary for better utilization and maximizing nutrient intake. In addition, fruits can be harvested in stages, thus ensuring the availability and continuous access to food, an important dimension of food security. This study aims to evaluate the nutritional and phytochemical properties of some Cucurbitaceae species: cucumber (Cucumis sativus), horned cucumber or kiwano (Cucumis metuliferus) and bitter cucumber (Momordica charantia) grown in southwestern Romania. For this, the fruits of the three species were harvested at the green stage. The results showed higher concentrations of TSS in Cucumis sativus (4.5 %) and Cucumis metuliferus (4.6 %), of reducing sugar in Cucumis sativus (2.037 %) and of vitamin C and total phenols in Momordica charantia fruits (11.41 mg/100g ascorbic acid and 104.5 mg GAE/100g, respectively).

INTRODUCTION

The *Cucurbitaceae* family includes commonly consumed species such as pumpkin, watermelon, cantaloupe, horned melon and cucumber, which are valued for their rich nutritional composition and beneficial health properties. These species provide essential macronutrients, minerals and bioactive compounds that contribute to their dietary and therapeutic significance (Borecka and Karaś, 2025).

One of the well-known genera in the *Cucurbitaceae* family is *Cucumis* L. The fruits of *Cucumis* species exhibit a wide range of characteristics, including textures that vary from spiny to smooth and colors that shift at maturity to shades of yellow, green, or orange (Silva et al. 2025). Recent studies have shown that plants in the genus *Cucumis* have exhibited some pharmacological activities, such as antimicrobial, antioxidant, anti-inflammatory, antidiabetic and anticancer activity and cosmetic potential (Insanu et al. 2022). *Cucumis* L. is a valuable source of income for farmers because its fruits can be used not only for fresh consumption, but also in the production of canned goods, pickles and juices (Silva et al. 2025).

Cucumis sativus L., is an important species of the *Cucurbitaceae* family, being widely cultivated in both temperate and tropical regions. Cucumber fruits are consumed worldwide as fresh or processed vegetables, due to their pleasant and refreshing taste and content of essential nutrients and antioxidant-rich phytochemicals (Soare et al.

2023). The nutrient content positions cucumbers as a functional food that supports cardiovascular health, immune function and the prevention of chronic diseases. Despite their low calorie and fiber content, cucumbers offer significant benefits when included as part of a balanced diet (Saini, 2025).

Cucumis metuliferus E. Mey. Ex. Naudin is an annual species of the Cucurbitaceae family known as horned melon or kiwano. This species was recently introduced to Romania, in 1996, within the Plant Breeding Laboratory, at SCDL Buzau (Vînătoru et al. 2019) and could represent an excellent source of income for small farmers (Barcanu et al. 2022). In Kenya, New Zealand, France, Australia, the USA and Israel, the fruits of improved varieties are cultivated and marketed for export. The fruits are rich in vitamins, minerals and phytochemicals that can contribute to improving human health. They can be consumed in three stages of consumption: immature stage (green), intermediate stage (white-yellow) or mature stage (yellow-orange), depending on consumer preferences. Kiwano fruits in immature stages have the appearance and taste of cucumbers, and mature ones can have a melon-like taste with aromatic notes of banana and lemon (Lim, 2012; Soare et al. 2024). It can be consumed in salads, in fish and seafood dishes or used in pharmaceutical preparations due to its valuable biochemical composition.

Cucumis metuliferus, by its growth habit as a climbing vine and its orange fruits and prominent thorns, also has ornamental value. Its fruits are rich in vitamins, potassium and iron, and antioxidants (Vieira et al. 2021; Soare et al. 2024). Its concentrations of essential vitamins, including B complex, A and C, are four times higher than those found in lemons (Mutetwa et al. 2025). They possess anti-inflammatory (i.e. anti-lipoxygenase and anti-proteinase) and antidiabetic (having α-amylase and β-glucosinase activity) properties (Busuioc et al. 2023).

Momordica charantia L., (bitter cucumber; bitter gourd) is an annual, climbing species of the *Cucurbitaceae* family and cultivated for its edible fruits, with a pronounced (accentuated) bitter taste and numerous nutritional qualities. It is also considered an important medicinal species that has been cultivated and acclimatized in Romania, for the importance of its use as raw materials in phytopharmaceutical preparations (Cozea and Stelica, 2011).

This species can be considered a plant of the future, for food, nutritional and health security, with extensive benefits in fields such as: botany, horticulture, phytochemistry, medicine (Şesan, 2020).The species adapts well to the pedoclimatic conditions in Romania, obtaining profitable yields of unripe fruits, which can be used in the production of therapeutic extracts. Recent research has demonstrated that formulations based on extracts from this fruits can help in the management of diabetes, as it contains certain phytochemicals with antioxidant and blood sugar and cholesterol-lowering properties. Zhang et al. (2024) suggest that supplementation with Momordica charantia can be a relatively safe and effective strategy for the management of hyperglycemia in patients with type 2 diabetes mellitus (T2DM), and the fruit juice is useful in the treatment of many conditions, such as relieving joint pain, against chronic fever, liver diseases or digestive disorders (Singh et al. 2023).

The fundamental factor in improving the quality of cultivated plants is the value and diversity of biological material, which must be rich in quality genes or genotypes (Păniță et al. 2020). The fruits of *Cucurbitaceae* species are a rich source of vitamins, minerals and also have good antioxidant and nutraceutical potential. Cucumbers are an important fruit vegetable consumed as a salad or cooked in the world (Diouf et al. 2023).

This study aimed to evaluate the nutritional and phytochemical characteristics of some *Cucurbitaceae* species: cucumber (*Cucumis sativus*), horned cucumber (*Cucumis metuliferus*) known as kiwano and bitter cucumber (*Momordica charantia*) grown in the pedoclimatic conditions of southwestern Romania.

MATERIAL AND METHODS

The fruits of *Cucumis sativus* and *Cucumis metulif*erus and *Momordica charantia* were obtained in cultivation, in the teaching field of the Faculty of Horticulture, University of Craiova, in the southwestern area of Romania, on a reddish-brown preluvosol, in 2024.

An important role in the growing season of crops is played by climatic conditions, especially temperature and humidity, which can influence fruits quality. In South-West Romania, the climate is continental, forest-steppe or steppe type, and is characterized by very high temperatures in the warm season and fluctuating, uneven and decreasing precipitation. Table 1 illustrates the climatic conditions during the growing season of *Cucurbitaceae* species.

Table 1.

The climatic conditions of the area of South-west Romania, 2024*

Month	Temperature (^{0}C)			The relative humidity of the air (%)	Rainfall (mm)
	Minimum	maximum	medium		
May	7.9	+26.8	16.7	66	24
June	13.5	+36.3	+25.4	53	47
July	14	+39.6	+27.4	48	18
August	16.2	+38.2	+27.0	43	10
September	7.4	+34.4	+20.3	55	30
October	1.9	+26.4	+13.5	65	14

* https://rp5.ru/Weather_in_Craiova_(airport)

Biochemical analysis.

Three fruits, in the green stage, were harvested from each species and average samples were prepared for analysis.

The TSS content (%) was determined using a digital refractometer (Kruss Optronic DR 301-95) at 20 °C and expressed as %.

The titratable acid (%) content was determined by titration with 0.1N sodium hydroxide (NaOH), using phenolphthalein as indicator and expressed as % malic acid.

Reducing sugars content (%) were extracted in distilled water (1:40 g:mL), 60 minutes at 60 °C and assayed colorimetric at 540 nm with 3,5 dinitrosalicylic acid reagent using glucose as standard. The results were expressed in % fresh weight basis (Soare et., 2018).

The vitamin C was determined by iodometric method, and expressed in mg/100g.

Determination of total phenolic content (TPC). Each extract was mixed with Folin-Ciocalteu reagent and saturated sodium carbonate (Na_2CO_3) solution. The mixture was allowed to stand at room temperature for 60 min and then the absorbance was recorded at 765 nm. The total phenolic content (TPC) was

calculated using a standard curve prepared using gallic acid and expressed as mg of gallic acid equivalents (GAE) per 100 gram f.w.

Statistical calculation: For the analysis of variance (ANOVA) the MS Excel software and the means were differentiated with the significance level at $p< 0.05$.

RESULTS AND DISCUSSIONS

The taste of fruits can be influenced by cultivar, total soluble solids (TSS), acidity, aroma and pedoclimatic conditions. The analysis of quality parameters in fruits of the *Cucurbitaceae* species analyzed showed significant differences between them. Thus, the level of total soluble substance (TSS) in the studied species recorded values in descending order of 4.6 % in *Cucumis sativus*, 4.5 % in *Cucumis metuliferus* and only 2.7 % in *Momordica charantia* (Table 2). Higher TSS levels are associated with improved fruit quality and aroma, a fact also supported by Mutetwa et al. (2025).

The total soluble solids (TSS) can influence the shelf life of fruits, the higher their content at harvest, the longer the shelf life (Valverde et al. 2021).

Sugars in the fruits are involved in regulating metabolism and maintaining the body's energy balance. In this study, reducing sugar was higher in *Cucumis sativus* species of 2.037% and lower in *Momordica charantia* of only 1.45 %. A significant difference was also recorded in terms of acidity in *Cucumis* fruits. A higher acidity content was recorded in *Cucumis sativus* fruits, of 1.563 %, and lower in *Momordica charantia* fruits, of 0.087 %.

Table 2

The content in TSS, reducing carbohydrates and titratable acidity

Species	TSS (%)	Reducing sugar (%)	Total acidity (%)
Cucumis metuliferus	4.5a	1.904^{a}	0.683^{b}
Momordica charantia	2.7b	1.450^{b}	0.087^{c}
Cucumis sativus	4.6a	2.037^{a}	1.563^{a}
LSD 5 %	0.96	0.14	0.27

Values are expressed as mean; different superscripts within a row indicate significant differences at $p < 0.05$.

Ascorbic acid, also known as vitamin C, is one of the most important water-soluble vitamins, naturally present in fruits and vegetables (Soare et al. 2024). Vitamin C protects cells from oxidative stress, improves the immune system and contributes to maintaining general health. Ascorbic acid also plays an important role in plant cellular metabolism, acting as a vital antioxidant (Hancock and Viola, 2005).

Analysis of vitamin C content, expressed as ascorbic acid, was the dominant compound in the fruits, with a higher content in *Momordica charantia* fruits, of 11.41 mg/100g ascorbic acid, followed by Cucumis metuliferus of 3.98 mg/100g ascorbic acid and in last place *Cucumis sativus*, with 2.11 mg/100g ascorbic acid (Table 3). According to Looregipoor et al. (2023) *Momordica* fruits are a good source of carbohydrates, proteins, vitamins and minerals, having the highest nutritional value among plants in the *Cucurbitaceae* family.

Table 3.

The content in Vitamin C and total phenols

Species	Vitamin C (mg/100g)	Total phenols (mg GAE/100g)
Cucumis metuliferus	3.98^{b}	71.82^{b}
Momordica charantia	11.41^{a}	104.5^{a}
Cucumis sativus	2.11^{c}	14.89^{c}
LSD 5 %	1.45	13.15

Values are expressed as mean; different superscripts within a row indicate significant differences at $p < 0.05$.

The significant levels of vitamin C content in these fruits support their potential as a functional food.

Under stress conditions, the body's defense systems can be overtaxed, which determines the need to supplement it with dietary antioxidants, of which phenols represent one of the main classes of antioxidants contained in plants. (Mazilu et al. 2022). Phenols play an important role in the prevention of incurable diseases and other diseases, as they have a strong activity in capturing free radicals. They are second only to carbohydrates in abundance in higher plants and present a wide variety of structures, ranging from simple phenol derivatives to complex polymeric materials (Subedi et al. 2014).

This study also determined the content of total phenols, recording higher values in green fruits of *Momordica charantia* of 104.5 mg GAE/100g and lower values in *Cucumis sativus*, of only 14.89 mg GAE/100g (Table 3). Higher values in total phenolics were also identified in other fruits harvested at the immature (green) stage compared to those harvested late, after ripening, due to the different metabolites released by plants at different growth stages, in green walnuts (Cosmulescu et al. 2010) or in mango fruit (Supriya et al. 2020).

Looreregipoor et al. (2023) said that *Momordica* contains significant amounts of phenolic compounds, which confirms the medicinal use of this species and can be a key indication for extracting secondary medicinal compounds by examining its medicinal effects. Therefore, the values obtained in this study can contribute to supporting the promotion of the consumption of these fruits for marketing.

Fruit quality can be influenced by numerous factors, such as species, environmental conditions, applied technology, establishment period or harvest time. Therefore, the values obtained in this study can contribute to supporting the promotion of fruit consumption, but also their commercialization.

CONCLUSIONS

Qualitative phytochemical analysis indicated that the fruits of the three species studied are sources of essential nutrients, highlighting the Momordica charantia species by its content in total polyphenols and vitamin C, followed by Cucumis metuliferus also by its content in total polyphenols and vitamin C, but not least Cucumis sativus with a remarkable content of TSS, reducing sugar and total acidity superior to the other two species.

In Romania, *Momordica charantia* and *Cucumis metuliferus* crops are not well known or cultivated among farmers, despite the numerous agronomic, nutritional and medicinal advantages they offer. The varied content of bioactive

compounds present in the fruits of these species can significantly contribute to the prevention of diseases and the development of general health through the intake of phytonutrients and for this reason they should be more promoted to be cultivated.

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REFERENCES

Barcanu E., Agapie O. L., Gherase I., Tanase B., Dobre G. and Vînătoru C., 2022. "Consumer Preferences for Kiwano Fruit, a Newly Introduced Crop in Romania." Scientific Papers. Series B, Horticulture 1, 2285–5653.

Borecka M., Karaś M. 2025. Comprehensive Review of the Nutritional and Health-Promoting Properties of Edible Parts of Selected *Cucurbitaceae* Plants. Foods, 14(7),1200.

Busuioc A.C., Costea G.V., Botezatu A.V.D., Furdui B and Dinica R.M. 2023. "*Cucumis metuliferus* L. Fruits Extract with Antioxidant, Anti-Inflammatory, and Antidiabetic Properties as Source of Ursolic Acid." Separations 10, 274.

Cosmulescu S. N., Trandafir I., Achim G., Botu M., Baciu A., & Gruia M. (2010). Phenolics of Green Husk in Mature Walnut Fruits. Notulae Botanicae Horti Agrobotanici Cluj-Napoca, 38(1), 53-56.

Cozea A., Stelica C., 2011. Aspects regarding pathogen-enzymatic system interrelation at *Momordica charantia* naturalized in Romania. Romanian Biotechnological Lette, vol 11(5), 6668- 6672.

Diouf S., Sambou A., Alpha C., 2023. Agro-morphological characterization of four varieties of cucumber from *Cucumis sativus* L. and *Cucumis metuliferus* E. Mey. Ex Naudin in Senegal. Journal Of Horticulture and Postharvest Research, 6(2), 131-144.

Hancock R.D., Viola R. 2005. Biosynthesis and catabolism of L-ascorbic acid in plants. Critical Reviews in Plant Sciences, 24, 167–188.

Insanu M., Defri R., Velina S., Irda F., 2022. Chemical Compounds and Pharmacological Activities of *Cucumis* genus. Biointerface Research in Applied Chemistry, 1324-1334.

Lim T.K. 2012. Edible Medicinal and Non-Medicinal Plants. Volume 2. Springer; Dordrecht, The Netherlands: *Cucumis Metuliferus*; pp. 235–238.

Looregipoor F., Najmeh H., Abdolali S., 2023. Study on Quantitative and Qualitative Traits Diversity in Some *Momordica charantia* L. Genotypes. Agrotechniques in Industrial Crops, 3(4),211-222.

Mazilu I.E., Vîja L.E., Cosmulescu S., 2022. The Influence of Harvest Moment and Cultivar on Variability of Some Chemical Constituents and Antiradical Activity of Dehydrated Chokeberry Pomace. Horticulturae, 8, 544.

Mutetwa M., Manjeru P., Chaibva P., Makaure B., Chandiposha M., Madanzi T., Makuvaro V., & Muziri T., 2025. Optimizing nitrogen fertilizer levels for improved growth, yield, and fruit quality in horned melon (*Cucumis metuliferus)* E. Mey. ex Naudin). Eureka: Life Sciences, (2), 3-13.

Păniță O., Iancu P., Soare M., 2020. Environmental Conditions and Genotype Influence Upon Some Correlations Value to Few Lines of Winter Wheat. Agricultural Science, 2, (1), 252-262.

Șesan T. E., 2020. *Momordica Charantia* L. – New aclimatized plant in Romania. Botanical characters. Journal of Plant Development, 2, 83-93.

Silva, C.E.D, Clerici M.T.P.S., 2025. Contributions of *Cucumis* L. Genetic diversity to phytochemical bioavailability and its impact on human health: A review. Food Science and Technology, 1-13, Campinas, 45, e491.

Singh P., Pandey P., Singh PK., Tripathi M., Singh RP., Shukla S., Pathak N., Singh RL. 2023. A comprehensive review on phytochemistry, nutritional and pharmacological properties of *Momordica charantia*. IP International Journal of Comprehensive and Advanced Pharmacology, 8(2), 73-79.

Soare R., Dinu M., Băbeanu C., 2023. Evaluation of some cucumber hybrids (*Cucumis sativus* l.) For quality traits. Annals of the University of Craiova-Agriculture Montanology Cadastre Series, 53 (1), 284-290.

Soare R., Dinu M., Băbeanu C., Modran M.G. 2018. Production of some colored potato genotypes in organic culture. Bulletin of the University of Agricultural Sciences and Veterinary Medicine ClujNapoca. Horticulture, 75, 90-94.

Soare R., Dinu M., Băbeanu C., Niculescu M., Soare M., Botu M., 2024. Quantitative and Qualitative Production of Species *Cucumis metuliferus* and the Potential for Adaptation in the Context of Current Climate Change. Plants, 13(13),1854.

Subedi L., Timalsena S., Duwadi P., Thapa R., Paudel A., Parajuli K., 2014. Antioxidant activity and phenol and flavonoid contents of eight medicinal plants from Western Nepal. Journal of Traditional Chinese Medicine, 34,584–590.

Valverde-M., Daniel and Diaz-P., Manuel and G.-G., Marta C.-F., Angel J., 2021. Total Soluble Solids and Dry Matter of Cucumber as Indicators of Shelf Life. Postharvest Biology and Technology 180, 2-10.

Vieira E.F., Grosso C., Rodrigues F., Moreira M.M., Fernandes V.C., Delerue-Matos, C. 2021. Bioactive Compounds of Horned Melon (*Cucumis metuliferus* E. Meyer ex Naudin). In *Bioactive Compounds in Underutilized Vegetables and Legumes*; Reference Series in Phytochemistry; Murthy, H.N., Paek, K.Y., Eds.; Springer: Cham, Switzerland.