ANNALS OF THE UNIVERSITY OF CRAIOVA

Series: ✓*Biology*
✓*Horticulture*
✓*Food products processing technology*
✓*Environmental engineering*

Vol. XXIX (LXV) - 2024

ANTIOXIDANT ACTIVITY IN EXTRACTS FROM VARIOUS ORGANS BITTER GOURD (*MOMORDICA CHARANTIA* L.)

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Keywords*: Momordica charantia, fruits, flowers, vegetative organs, antioxidant activity*

ABSTRACT

Bitter gourd (Brâncuși cultivar) stems, tendrils and leaves from plants locally grown at the „Ovidius" University, Constanța, were extracted in 70% ethanol solution and analyzed for antioxidant activity.

The highest antioxidant activity was found in tendrils (53.08%), flowers (51.53%) and fruit pulp (49.64%). Lowest values of IC50 were found in flower (34.46 mg/L) and fruit pulp (39.47 mg/L) extracts. These values are high when compared to other known Cucurbitaceae, especially in regard to vegetative organs. Considering the known contents of bioactive compounds in M. Charantia organs, the antioxidant activity cannot be directly correlated to total phenolic concentrations, those of flavonoids or ascorbic acid.

INTRODUCTION

The bitter gourd *Momordica charantia* L. (also called bitter cucumber, bitter melon, or balsam pear) belongs to Cucurbitaceae family. Originary from Africa, it is now widely grown in South Asia, Caribbean countries and Australia. Although a crop rather specific to warm regions, it is becoming popular in other areas too. In Romania it was first introduced in the 1990's. Since then, new varieties were developed. It is currently considered as the most profitable crop in Romania.

A perennial, herbaceous vine, it has climbing stems that grow up to 5 m. Leaves reach 5 cm in length, with long, pubescent petioles. Spiral-shaped tendrils a ensure climbing. It is a monoecious plant, with yellow solitary flowers, long-pedunculated, with 10-20 cm long petals. Male flowers outnumber female ones by 20:1. The fruit is a pepo, growing up to 20 cm, cylindical, featuring proeminent ridges and warts. Ripe fruits are yellow-orange, with a bright yellow pulp filled with multiple seeds covered by red arils. Bitter gourd fruits are known for various nutraceutical properties, being used as hypoglycemic, hepatoprotective, antibiotic, antimalaria, anti-obesity and immuno-modulatory (Șesan 2020).

While grown for a long time around the world, it was only during the last decade that this pant was studied for its bioactive content and antioxidant potential. In a study from 2021 (Perumal et al. 2021), the lack of knowledge on this species was pointed out. Of the existing studies, all are obviously focused on the most important part, namely the fruit. Furthermore, few studies were conducted on Romanian cultivars. Brâncuși bitter gourd cultivar was only recently developed thorough repeated individual selection at SCDL Buzău. It is characterized by its high

yield (up to 9.2 kg/plant) and the white colour of its fruits when unripe. Some studies were already conducted concerning its nutritional composition (Vînătoru et al. 2022), bioactive contents in fruits (Popoviciu et al. 2023) and vegetative organs (Pricop et al. 2023).

Figure 1. *Momordica charantia* L. Brâncuși cultivar

The objective of this paper was to expand the knowledge on this cultivar and species, by determining the antioxidant activity of extracts made using not only fruits, but also vegetative organs of the plant.

MATERIAL AND METHODS

Bitter gourds (belonging to Brâncuși cultivar) were grown in the greenhouse of the experimental farm of the "Ovidius" University of Constanța, from seeds acquired in local commerce. Cultivation was done biologically. Collected organs were stems (lateral branches), tendrils, leaves, flowers and fruits. Fruits were separated into peel (epicarp) and pulp (meso- and endocarp). Samples were dried and ground prior to analysis.

Plant material was extracted in 70% ethanol, at a 10% concentration. For determining antioxidant activity of resulting extracts, each sample extract was diluted 10-fold. 0.1 mL were incubated with 2.9 mL 2,2-diphenyl-1-picrylhydrazyl (DPPH) for 60 minutes at dark. Spectrophotometric absorbance was read at 517 nm using a Cecil 2021 spectrophotometer. A calibration curve was previously made using gallic acid. Results were expressed percentage of DPPH radical scavenging (Brand-Williams et al. 1995).

RESULTS AND DISCUSSIONS

The percentual antioxidant activity of extracts is shown in Figure 2, while Table 1 shows the average half maximal inhibitory concentrations of these extracts against free radicals.

The highest antioxidant activity was found in tendrils (53.08%), flowers (51.53%) and fruit pulp (49.64%). This can be only partially related to the distribution of total phenolic compounds in various organs of the plant, as shown in previous studies: 18,598 mg/kg DW in fruit pulp, 7,107 mg/kg in tendrils compared to 13,527 mg/kg in fruit peel, 9,657 mg/kg in stems, 6,283 mg/kg in leaves. Concerning the dominant and most strongly antioxidant fraction, flavonoids, these were 14,545

mg/kg in pulp, 8,763 mg/kg in peel, 6,766 mg/kg in stems and just 4,489 mg/kg in tendrils and 3,158 mg/kg in leaves. As for the concentration of ascorbic acid, it was higher in peel (14,689 mg/kg) than in pulp (12,847 mg/kg), and both much higher than in other organs (2,691 mg/kg in tendrils, 2,336 mg/kg in stems and 1,713 mg/kg in leaves; Popoviciu et al. 2023; Pricop et al. 2023).

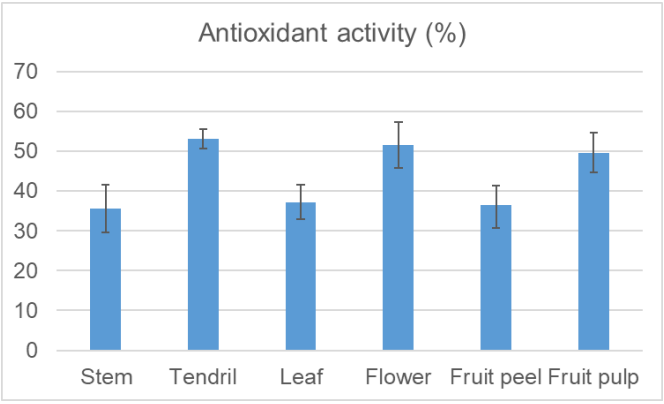

Figure 1. Antioxidant activity in 10% hydroalcoholic extracts of *Momordica charantia* organs (%).

Table 1.
Average IC50 of *Momordica charantia* organs 10% hydroalcoholic extracts against free radicals (mg/L)

Organ	Stem	Tendril	Leaf	Flower	Fruit peel	Fruit pulp
IC50 (mg/mL)	61.66	48.64	63.14	34.46	62.35	39.47

Values obtained for fruits (equivalent to an IC 50 of 394.70 mg fruit tissue/L) are higher than the 170-210 mg/L obtained from two Malaysian varieties by Choo et al. (2014), suggesting a high variability of this parameter among cultivars.

For comparison, antioxidant activities below 10% were found in 4% extracts of *Citrullus colocynthis* leaves (Saleem et al. 2014). IC50 of 64-65 mg/L were determined in aqueous and ethanolic extracts of *Momordica foetida* leaves (Molehin & Adefegha 2014). Values between 60-122 mg/L were determined in leaves and other aerial organs of *Echinocystis lobata* (Ielciu et al. 2017). Extracts from fruits of *Coccinia grandis* had an IC50 of 11-12 mg/L; *Trichosanthes cucumerina*, 13-15 mg/L and *Cucurbita moschata*, 21-22 mg/L, all with minor differences between peel and pulp (Akhter et al. 2022).

CONCLUSIONS

Extracts from *M. charantia* organs were found to have a high antioxidant activity. The highest antioxidant activity was found in tendrils (53.08%), flowers (51.53%) and fruit pulp (49.64%). Lowest values of IC50 were found in flower (34.46 mg/L) and fruit pulp (39.47 mg/L) extracts.

These values are high when compared to other known Cucurbitaceae, especially in regard to vegetative organs. Considering the known contents of bioactive compounds in *M. charantia* organs, the antioxidant activity cannot be directly correlated to total phenolic concentrations, those of flavonoids or ascorbic acid.

REFERENCES

Akhter K., Bibi A., Rasheed A., ur Rehman S., Shafique U., Habib T. 2022. Indigenous vegetables of family Cucurbitaceae of Azad Kashmir: A key emphasis on their pharmacological potential. PloS One, 17(6), doi: 10.1371/journal.pone.0269444.

Brand-Williams W., Cuvelier M.E., Berset C. 1995. Use of a free radical method to evaluate antioxidant activity. LWT - Food Science & Technology, 28, 25-30.

Choo W.S., Yap J.Y., Chan S.Y. 2014. Antioxidant properties of two varieties of bitter gourd (*Momordica charantia*) and the effect of blanching and boiling on them. Pertanika J. Trop. Agric. Sci., 37(1): 121-131.

Ielciu I., Vlase L., Frédérich M., Hanganu D., Păltinean R., Cieckiewicz E, Olah N.K., Gheldiu A.M., Crişan G. 2017. Polyphenolic profile and biological activities of the leaves and aerial parts of *Echinocystis lobata* (Michx.) Torr. et A. Gray (Cucurbitaceae). Farmacia, 65(2): 179-183.

Molehin O.R., Adefegha S.A. 2014. Comparative study of the aqueous and ethanolic extract of *Momordica foetida* on the phenolic content and antioxidant properties. Int. Food Res. J., 21(1): 401-405.

Perumal V., Khatib A., Uddin Ahmed Q., Fathamah Uzir B., Abas F., Murugesu S., Zuwairi Saiman M., Primaharinastiti R., El-Seedi H. 2021. Antioxidants profile of Momordica charantia fruit extract analyzed using LC-MS-QTOF-based metabolomics. Food Chem (Oxf). 26(2), doi: 10.1016/j.fochms.2021.100012.

Popoviciu D.R., Pricop S.M., Radu M.D. 2023. Quantitative analysis of nutritional and bioactive compounds in bitter gourd (*Momordica charantia* L.) fruits. Ann. Univ. Craiova, Ser. Biol. Hortic. Food Prod. Process. Environ. Eng., 28(64): 21-26.

Pricop S.M., Popoviciu D.R., Radu M.D. 2023. Quantitative analysis of antioxidant compound classes in vegetative organs of bitter gourd (*Momordica charantia* L.). Ann. Univ. Craiova, Ser. Biol. Hortic. Food Prod. Process. Environ. Eng., 28(64): 193-198.

Saleem A., Ahotupa M., Pihlaja K. 2014. Total phenolics concentration and antioxidant potential of extracts of medicinal plants of Pakistan. Z. Naturforsch. C, 56, 973-978.

Șesan T.E. 2020. *Momordica charantia* L. – New aclimatized plant in Romania. Botanical characters (review 1). J. Plant Develop., 27: 83-93.

Vînătoru C., Mușat, B., Bratu C., Negoșanu G., Popescu M., Șomoiag C. 2022. Phenotypic and biochemical characterisation of the newly developed cultivar of *Momordica charantia* – Brâncuşi. Bulletin of University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca. Horticulture. 79(1): 14-17.