BIOCHEMICAL CONTENTS OF MULBERRY FRUITS

Ionela TÎRZIU[1], A. LĂUTARU[1], Andreea Giorgiana RĂBONȚU[2], Georgeta Sofia POPESCU[1*], Anișoara IENCIU[2], D. MANEA[2]

[1]Faculty of Food Engineering, [2]Faculty of Agriculture, Banat's University of Agricultural Sciences and Veterinary Medicine "King Michael I of Romania"
Corresponding author: sofia.pintilie@gmail.com

Abstract. *The purpose of the present study is to establish the biochemical content of white and black mulberry fruits grown in the South West and West Region of Romania (Gorj County and Timis County). The mulberry belongs to the Morus genus of the Moraceae family. Knowing the composition of mulberry fruits is an useful task, especially to find new sources of natural antioxidants. Berry fruits are rich source in bioactive compounds with health human body benefits. Mulberries have recently gained an important position in the food industry due to the presence of many bioactive componentsThis study investigated fruit weight, total soluble solids content, total antioxidant capacity (TAC), and total polyphenols content (TPC). In black mulberry fruits (Morus nigra) were observed the highest value of the total antioxidant capacity and total phenolic content. Antioxidant capacity can be an effect of the interaction between the colour and the location (place of origin) of fruits. The total antioxidant capacity (TAC) and the total polyphenols content (TPC) were analysed by using the spectrophotometric method. Total antioxidant capacity was determinated used CUPRAC method. Folin Ciocalteu method was used for determination total polyphenols content.From our study, total soluble solids (TSS) values were of 15 % (Morus nigra) to 21 %* (*Morus alba*)*, mulberries are a rich source of phenolics, with high levels in Morus nigra (0.78 mM GAE/100 g) and low content in Morus alba (0.165 mM GAE/100 g). Differences from content of phenolic content in the fruits depend on many factors, such as genetic differences, the maturity degree at harvest, and environmental conditions during fruit development.Our results indicate that the studied mulberry fruits are valuable products due to their rich content in different compounds with antioxidant activity. Therefore, these fruits can be useful in a balanced diet. This study also brings many arguments for the use of these fruits as potentially healthy foods and their use in the food and pharmaceutical industry.*

Keywords: *mulberry, antioxidant, CUPRAC method, total polyphenols*

INTRODUCTION

The mulberry belongs to the Morus genus of the Moraceae family. There is a wide range conditions for the Morus genus can grow (like as climatic, topographical and soil conditions). The fruit can be consumed fresh or processed. Mulberry fruit can be used in different forms such as marmalades, jams, syrup, ice-creams, concentrate, vinegars, juices, alcohol, wine, and several other products (KAMILOGLU et al, 2013). The mulberry fruits are used in folk medicine, as a warming agent, as a remedy for dysentery, and as a laxative, anthelmintic, hypoglycaemic, expectorant, etc. (POPESCU et al., 2015; ISSA and ADD-ALJABAR, 2013; ERCISLI and ORHAN, 2007). The biochemical composition and nutritional status of plants are affected by these various conditions. Morus species are found in Asia (East,West and South East), South Europe, America (South of North America, Northwest of South America) and some parts of Africa (LEE et al., 2004; LIN and TANG, 2007; HUSSAINET al., 2008; NATIC, 2015).

Berry fruits are rich source in bioactive compounds with health human body benefits. Mulberries have recently gained an important position in the food industry due to the presence of many bioactive components, such as anthocyanins (OZGEN et al., 2009; SONG et al., 2009), carotenoids and flavonoids (HASSIMOTTO, 2007, LIN and TANG, 2007; HUSSAIN et al., 2008),

alkaloids (ASANO, 2008), vitamins, fats, sugars (fructose and glucose) and minerals (ERCISLI and ORHAN, 2007, IMRAN et al., 2010).

Knowing the phytochemical compounds of mulberry fruits is useful and an interesting task, especially to find promising new sources of natural antioxidants. Our work was undertaken for investigating the nutritional profile and antioxidant potentials of various *Morus* species fruits (white and black mulberry) originating from the Gorj and Timiș counties (South West Region and West Region of Romania).

MATERIAL AND METHODS

Reagents and chemicals.

All reagents employed in this study were of analytical grade and were purchased from Merck (Germany), Sigma–Aldrich (Germany) and Fluka.

Collection and preparation of mulberry fruit samples

The fruits of black mulberry (*M. nigra*) and white mulberry (*M. alba*) were collected from Gorj and Timiș Counties in July 2018. The fruits were picked at the ripe stage. For each species *Morus nigra L*. (black mulberry) and (*Morus alba L* (white mulberry) two genotypes were taken into analysis (2 trees). Each genotype was represented by one tree, and each sample was taken from one individual plant. The visible dirt and insect parts were removed from the fruit. The samples were transferred to our laboratory, after harvest. The fruit were selected according to uniformity of color and shape, and then stored at −20 °C in polyethylene bags (up to 1 month) until analysis.

Determination of fruit weight and total soluble solids of mulberry fruits

Fruit weight was measured by using a digital balance with a sensitivity of 0.001 g. Total soluble solid contents (TSS) were determined by extracting and mixing one drop of juice from each fruit into a digital refractometer (Model KRÜSS) at 22 °C. Twenty fruits from each clone (10 fruits per tree) of each species were used for analysis.

Determination of total phenolic contents and total antioxidant capacity in mulberry fruits

Total polyphenol and total antioxidant content were made by absorption determination using the spectrophotometer SPECORD 205 from Analytik Jena. CUPRAC method was used for total antioxidant capacity –TAC (OZYUREK et al., 2011; POPESCU et al., 2014; POPESCU et al., 2015). For determination of total polyphenols content (TPC) was used Folin Ciocalteu method (POPESCU et al., 2015).

RESULTS AND DISCUSSIONS

Fruit weight and total soluble solids of mulberry fruits

The fruit weight and, total soluble solids (TSS) of mulberry species are given in Figure 1 and 2. We note our samples with MN – black mulberry fruit and with MA- white mulberry fruit. We used index **1** for the samples from Gorj County and index **2** for the samples from Timiș County.

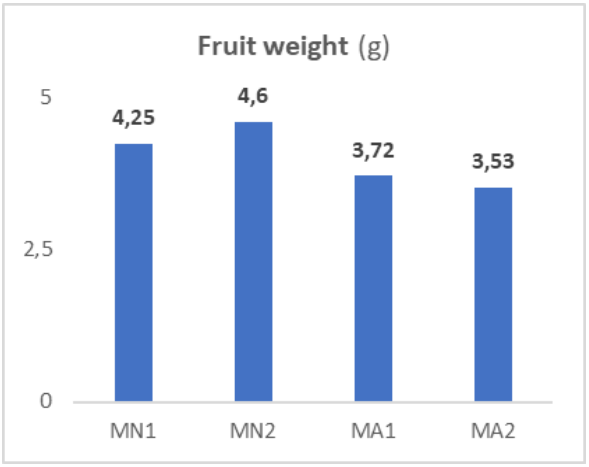

Figure 1. Mulberry fruit weight

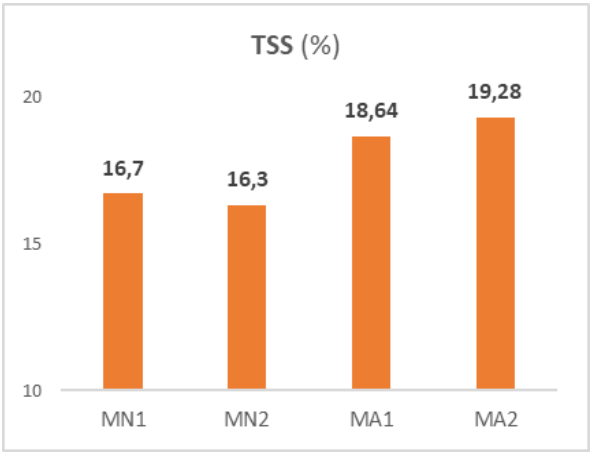

Figure 2. Total soluble solids content in mulberry fruit

Fruit weight of mulberry species ranged between 2 g and 6 g, with black mulberry having the biggest fruit. TSS values were of 15 % (*M. nigra*) to 21 % (*M. alba*). According to these results, black mulberry may be recommended for fresh fruit production, since it has attractive bigger fruits and white mulberry fruit may be recommended for processing, due to higher TSS contents.

Total phenolic contents and total antioxidant capacity in mulberry fruits

The determination of the TAC (antioxidant activity) and TPC were accomplished by the spectrophotometric methods using mulberry extracts. The total phenolic content of mulberry species is given in Figure 3. In Figure 4 is showed total antioxidant content of mulberry species.

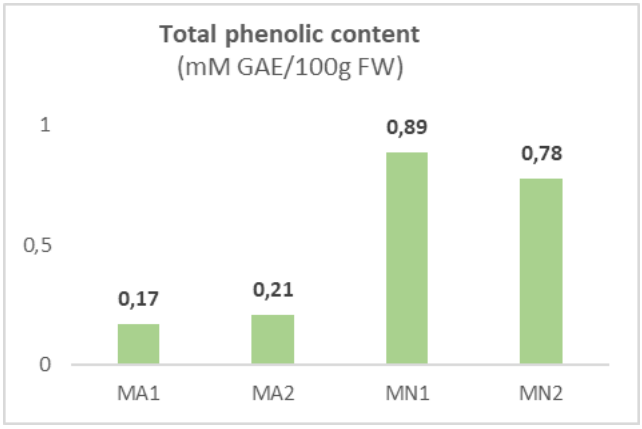

Figure 3. Total phenolic content of mulberry species

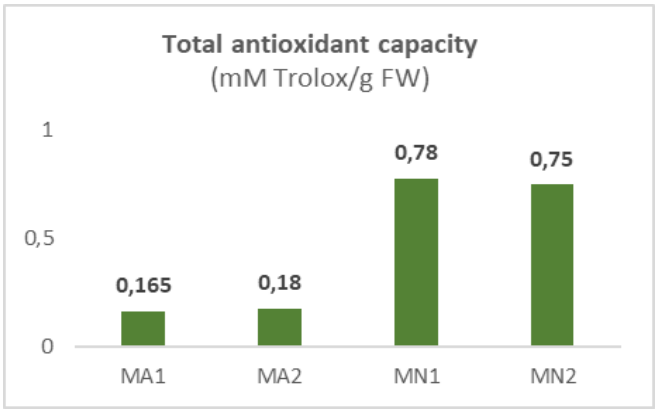

Figure 4. Total antioxidant capacity of mulberry species (by CUPRAC method)

When analysing these data, one may conclude that mulberries are a rich source of antioxidants, with TAC high levels in *M. nigra* (0.78 mM Trolox/g) and low content in *M. alba* (0.165 mM Trolox/g). The total polyphenolic content obtained from the white mulberries was several times lower (0.17 respectively 0.21 mM GAE/100g FW) than the content of phenolics found in the black mulberries (0.89 respectively 0.78 mM GAE/100g FW). Black mulberry fruits contain the highest amount of total phenols, which was in agreement with the results obtained by POPESCU et al. (2015), KAMILOGLU et al. (2013), ERCISLI AND ORHAN (2007), where they reported that black mulberry fruits were rich in phenols. The phenolic acids levels in black mulberries explain their sour, astringent taste. By comparing our results with NATIC et al. (2015), *Morus alba* mulberry samples contained a similar amount of TPC.

Differences of phenolic content in the fruits depend on many factors (genetic differences, the maturity degree at harvest, and environmental conditions during fruit development).

The overall results show that the selected *Morus* species could be the potential sources of natural phenols and antioxidants.

CONCLUSIONS

In the present study, analytical investigations have been undertaken in order to reveal the biochemical composition, nutritional values and antioxidant potentials of the *Morus* species in Romania.

Our results indicate that studied mulberry fruits are valuable products, based on their rich and beneficial nutrient composition and may be useful in a balanced diet. Their nutritive and phytomedically potentials are increased by their higher phenolic contents and antioxidant activity. The current paper can serve as a source for new reference data and leads to an increase in public awareness of the possibility of consuming these unconventional fruits. This study also brings many arguments for the use of these fruits as potentially healthy foods and their use in the food and pharmaceutical industry.

BIBLIOGRAPHY

ASANO N., YAMASHITA T., YASUDA K., IKEDA K., KIZU H., KAMEDA Y., KATO A., NASH R., LEE H., RYU K.S., 2001–Polyhydroxylated alkaloids isolated from mulberry trees (Morus alba L.) and silkworms (Bombyx mori L.). Journal of Agricultural and Food Chemistry, 49 (9): 4208-4213, United State.

ERCISLI S., ORHAN E., 2007 –Chemical composition of white (Morus alba), red (Morus rubra) and black (Morus nigra) mulberry fruits, Food Chemistry, 103, 1380–1384,The Netherlands.

HASSIMOTTO N.M.A., GENOVESE M.I., LAJOLO, F.M., 2007 – Identification and characterization of anthocyanins from wild mulberry (Morus nigra L.) growing in Brazil, Food Science and Technology International, 13, 17–25, United State.

HUSSAIN I., KHAN L., MARWAT, G.A., AHMED N., SALEEM M., 2008 – Comparative study of vitamin C contents in fruits and medicinal plants. *J. Chem. Soc. Pak.*, 30(3), 406-409, Pakistan.

IMRAN M., KHAN H., SHAH M., KHAN R., KHAN F., 2010 – Chemical composition and antioxidant activity of certain *Morus* species, J Zhejiang Univ-Sci B (Biomed & Biotechnol), 11(12), 973-980, China.

ISSA N.K., ADD-ALJABAR R.S., 2013 – Evaluation of Antioxidant Properties of Morus nigra L. Fruit Extracts [II], Journal of Biological Sciences, 6/4, 258-263, Jordan.

KAMILOGLU S., SERALI O., UNAL N., CAPANOGLU E., 2013 – Antyoxidant activity and polyphenol composition of black mulberry (Morus Nigra L.) products, Journal of Berry Research, 3, 41-51, The Netherlands.

LEE, J.Y., MOON S.O., KWON Y.J., RHEE S.J., PARK H.R., CHOI S.W., 2004 – Identification and quantification of anthocyanins and flavonoids in mulberry (Morus sp.) cultivars. Food Science and Biotechnology., 13: 176-184, Korea.

LIN J.Y., TANG C.Y., 2007 – Determination of total phenolic and flavonoid contents in selected fruits and vegetables, as well as their stimulatory effects on mouse splenocyte proliferation. Food Chemistry, 101(1):140-147, United State.

NATIC M.M, DABIC D.C, PAPETTI A., FOTIRIC AKŠIC M.M, OGNJANOV V., LJUBOJEVIC M., TESIC Z.L, 2015 – Analysis and characterisation of phytochemicals in mulberry (Morus alba L.) fruits grown in Vojvodina, North Serbia, Food Chemistry, 171, 128–136, United State.

OZGEN M., SERC S., KAYA C., 2009 – Phytochemical and antioxidant properties of anthocyanin-rich Morus nigra and Morus rubra fruits, Scientia Horticulturae, 119, 275–279, The Netherlands.

OZYUREK M., GUCLU K., TUTEM E, BASKAN KS, ERCAG E., CELIK S.E., BAKI S., YILDIZ L., KARAMAN S., APAK R., 2011 – A comprehensive review of CUPRAC methodology, Analitical Methods**,** 3**,** 2439-2453, United Kingdom.

POPESCU S., VELCIOV A., IENCIU A., COZMA A., MANEA D. Chemical and biochemical components in mulberry fruits, pp. 327-334 in 15th International Multidisciplinary Scientific Geoconference – Micro and nano technologies. Advances in Biotechnology Section, vol. I, Albena, Bulgaria, 2015.

POPESCU (PINTILIE) G.S., VELCIOV A.B., COSTESCU C.I., GOGOASA I., GRAVILA C., PETOLESCU C., 2014 – Chemical characterization of white (Morus alba), and black (Morus nigra) mulberry fruits, Journal of Horticulture, Forestry and Biotechnology, 18(3), 133- 135, Romania.

SONG W., WANG H.J., BUCHELI P., ZHANG P.F., WEI D.Z., LU Y.H., 2009 – Phytochemical profiles of different mulberry (Morus sp.) species from China, Journal of Agricultural and Food Chemistry, 57, 9133–9140, United State.