

Volume 22, Issue 1/2022

PRINT ISSN 2284-7995

E-ISSN 2285-3952



SCIENTIFIC PAPERS

**SERIES “MANAGEMENT, ECONOMIC
ENGINEERING IN AGRICULTURE AND RURAL
DEVELOPMENT”**

Publishers:

University of Agronomic Sciences and Veterinary Medicine of Bucharest, Romania. Address: 59 Marasti Blvd., District 1, 011464 Bucharest, Romania, Phone: + 40213182564, Fax: +40213182888, www.managusamv.ro

Ceres Publishing House, Address: 29 Oastei Street, District 1, Bucharest, 013701, Phone/Fax: +40213179023, Email: edituraceres@yahoo.com
All rights reserved

The publishers are not responsible for the content of the scientific papers and opinions published in the Volume. They represent the authors' point of view.

EDITORIAL BOARD

Editor in Chief: Prof. Ph. D. Toma Adrian DINU

Executive Editor: Prof. Ph. D. Agatha POPESCU

Members:

Prof. Ph.D. H.C. Miguel Moreno MILLAN, University of Cordoba, Spain
Prof. Ph.D. Doc. Svend RASMUSSEN, University of Copenhagen, Denmark
Prof. Ph.D. Mogens LUND, Institute of Food and Resource Economics, Copenhagen, Denmark
Associate Prof. Ph.D. Ove MADSEN, Grinsted Agricultural Academy, Denmark
Prof. Ph.D. Pascal Anton OLTENACU, Oklahoma State University, Stillwater, United States of America
Prof. Ph.D. Rangesan NARAYANAN, University of Nevada, Reno, United States of America
Ph.D. Patrick ANGEL, US Department of the Interior, Office of Surface Mining Appalachian Regional Office, United States of America
Prof. Ph.D. Gerhard MOITZI, University of Natural Resources and Applied Life Sciences, Vienna, Austria
Acad. Prof. Ph.D. Paolo GAJO, University of Florence, Italy
Prof. Ph.D. Diego BEGALLI, University of Verona, Italy
Prof. Ph.D. Alistair Mc CRACKEN, The Queen's University, Belfast, United Kingdom
Ph.D. Hab. Stefan MANN, Research Station Agroscope, Federal Office for Economics, Tanikon, Switzerland
Prof. Ph.D. Drago CVLIJANOVIC, University of Kragujevac, Serbia
Prof. Ph.D. Jonel SUBIC, Institute of Agricultural Economics, Belgrade, Serbia
Prof. Ph.D. Nebojsa RALEVIC, University of Belgrade, Serbia
Prof. Ph.D. Mamdouh Abbas HELMY, Modern University for Technology and Information, Cairo, Egypt
Prof. Ph.D. Tarek FOUDA, Tanta University, Egypt
Prof. Ph.D. Christopher Ogbonna EMEROLE, Abia State University, Uturu, Nigeria
Prof. Ph.D. Vecdi DEMIRCAN, Isparta University of Applied Sciences, Turkey
Prof. Ph.D. Mevlüt GÜL, Isparta University of Applied Sciences, Turkey
Prof. Ph.D. Philippe LEBAILLY, University of Liege, Belgium
Prof. Ph.D. Philippe BURNY, University of Liège, Belgium
Prof. Ph.D. Hab. Volodymyr Anatoliiovych KOLODIICHUK, Stepan Gzhyskyi National University of Veterinary Medicine and Biotechnologies, Lviv, Ukraine
Acad. Prof. Ph.D. Hab. Pavel MOVILEANU, Agricultural State University of Moldova, Chisinau, Republic of Moldova
Acad. Prof. Ph.D. Hab. Alexandru STRATAN, National Institute of Economic Research, Chisinau, Republic of Moldova
Associate Prof. Ph.D. Veronica PRISĂCARU, Agricultural State University of Moldova, Chisinau, Republic of Moldova
Associate Prof. Ph.D. Veronica MOVILEANU, Agricultural State University of Moldova, Chisinau, Republic of Moldova
Associate Prof. Ph.D. Hab. Mariana DOGA-MIRZAC, Moldova State University, Chisinau, Republic of Moldova
Associate Prof. Ph.D. Hab. Dariusz KUSZ, Rzeszow University of Technology, Poland
Associate Prof. Ph.D. Zuzana PALKOVA, Slovak University of Agriculture, Nitra, Slovakia
Associate Prof. Ph.D. Petar BORISOV, Agricultural University of Plovdiv, Bulgaria
Associate Prof. Ph.D. Rashid SAEED, International Islamic University, Islamabad, Pakistan
Ph.D. Cecilia ALEXANDRI, Institute for Agricultural Economics, Romanian Academy, Bucharest, Romania
Prof. Ph.D. Emilian MERCE, University of Agricultural Sciences and Veterinary Medicine, Cluj-Napoca, Romania
Prof. Ph.D. Gheorghe MUREȘAN, University of Agricultural Sciences and Veterinary Medicine, Cluj-Napoca, Romania
Associate Prof. Ph.D. Radu Lucian PĂNZARU, University of Craiova, Romania
Prof. Ph.D. Stejărel BREZULEANU, "Ion Ionescu de la Brad" Iasi University of Life Sciences, Iasi, Romania
Prof. Ph.D. Gavrilă ȘTEFAN, "Ion Ionescu de la Brad" Iasi University of Life Sciences, Iasi, Romania
Prof. Ph.D. Vasile GOȘA, Banat University of Agricultural Sciences and Veterinary Medicine "King Mihai I of Romania", Timisoara, Romania
Prof. Ph.D. Nicoleta MATEOC-SÎRB, Banat University of Agricultural Sciences and Veterinary Medicine "King Mihai I of Romania", Timisoara, Romania
Prof. Ph.D. Tiberiu IANCU, Banat University of Agricultural Sciences and Veterinary Medicine "King Mihai I of Romania", Timisoara, Romania
Prof. Ph.D. Ioan BRAD, Banat University of Agricultural Sciences and Veterinary Medicine "King Mihai I of Romania", Timisoara, Romania
Prof. Ph.D. Ioan Nicolae ALECU, University of Agronomic Sciences and Veterinary Medicine of Bucharest, Romania
Prof. Ph.D. Manea DRĂGHICI, University of Agronomic Sciences and Veterinary Medicine of Bucharest, Romania
Prof. Ph.D. Mihai BERCA, University of Agronomic Sciences and Veterinary Medicine of Bucharest, Romania
Prof. Ph.D. Gina FÎNTÎNERU, University of Agronomic Sciences and Veterinary Medicine of Bucharest, Romania
Prof. Ph.D. Romeo Cătălin CREȚU, University of Agronomic Sciences and Veterinary Medicine of Bucharest, Romania
Prof. Ph.D. Cristiana TINDECHE, University of Agronomic Sciences and Veterinary Medicine of Bucharest, Romania
Prof. Ph.D. Elena TOMA, University of Agronomic Sciences and Veterinary Medicine of Bucharest, Romania
Prof. Ph.D. Ion DONA, University of Agronomic Sciences and Veterinary Medicine of Bucharest, Romania
Prof. Ph.D. Elena STOIAN, University of Agricultural Sciences and Veterinary Medicine of Bucharest, Romania
Prof. Ph.D. Adelaida Cristina HONȚUȘ, University of Agronomic Sciences and Veterinary Medicine of Bucharest, Romania
Prof. Ph.D. Daniela CREȚU, University of Agronomic Sciences and Veterinary Medicine of Bucharest, Romania
Prof. Ph.D. Adrian TUREK-RAHOVEANU, University of Agronomic Sciences and Veterinary Medicine of Bucharest, Romania
Prof. Ph.D. Alina MĂRCUȚĂ, University of Agronomic Sciences and Veterinary Medicine of Bucharest, Romania
Prof. Ph.D. Liviu MĂRCUȚĂ, University of Agronomic Sciences and Veterinary Medicine of Bucharest, Romania
Associate Prof. Ph.D. Silviu BECIU, University of Agronomic Sciences and Veterinary Medicine of Bucharest, Romania
Associate Prof. Ph. D. Dragoș SMEDESCU, University of Agronomic Sciences and Veterinary Medicine of Bucharest, Romania

Publishing Committee:

**Assoc. Prof. Ph.D. Silviu BECIU, Lecturer Eng. Teodora POPESCU, Lecturer Ph.D. Mariana BURCEA,
Lecturer Ph.D. Ionela VLAD, Lecturer Ph.D. Eugenia ALECU, Assistant Prof. Ph. D. Student Eng. Valentin ȘERBAN**

The papers belong to the following research fields: economic engineering in agriculture, management, marketing and agri-food trade, rural economy, agricultural policies, accounting, financial analysis, finance, agrarian legislation, durable development, environment protection, tourism, agricultural extension and other connected areas.

51.IDENTIFICATION OF FATTY ACIDS IN GRAPE AND TOMATO POMACE – SUSTAINABLE VALORIZATION OF AGRICULTURAL WASTE

Gjore NAKOV, Silviya IVANOVA, Iliana LAZOVA-BORISOVA,
Mishela TEMKOV 431

52.RESULTS ON THE INFLUENCE OF PLANTING DISTANCE AND MEASUREMENT DATE, ON SPAD VALUES IN *PRIMULA OFFICINALIS* HILL. SPECIES

Sorina NIȚU (NASTASE), Nina BARASCU,
Emilia CONSTANTINESCU..... 437

53.ANALYSIS OF MARKET INTEGRATION OF NIGERIAN TOMATO MARKETS

Angela Ebere OBETTA, Anthonia Ifeyinwa ACHIKE,
Nnameka Andegbe CHUKWUONE..... 443

54.THE STUDY OF SOCIO-ECONOMIC CHARACTERISTICS AND COOPERATIVE-PARTNER RELATIONS OF AGRICULTURAL DEVELOPMENT COOPERATIVES

Gulay OZKAN, Ismail Bulent GURBUZ..... 457

55.CHICKPEAS - A POSSIBLE NICHE CULTURE FOR ROMANIAN FARMERS

Radu Lucian PÂNZARU, Dragoș Mihai MEDELETE, Gheorghe MATEI,
Marius VLADU 469

56.ARE FOOD WASTE AND FOOD LOSS A REAL THREAT FOR FOOD SECURITY?

Mirela PARASCHIVU, Otilia COTUNA, Gheorghe MATEI,
Veronica SĂRĂȚEANU..... 479

57.DEVELOPMENT OF EXPORT POTENTIAL OF UKRAINE'S AGRICULTURAL SECTOR

Nataliia PARKHOMENKO, Iryna OTENKO, Vasyl OTENKO,
Marharyta CHEPELIUK..... 485

58.THE RELATIONSHIP BETWEEN YIELD AND PATHOGENS ATTACK ON THE ADVANCED BREEDING WINTER WHEAT LINES ASSESSED FOR ADULT PLANT RESISTANCE

Gabriela PĂUNESCU, Mirela PARASCHIVU, Ramona Aida PĂUNESCU,
Cătălin Aurelian ROȘCULETE..... 493

IDENTIFICATION OF FATTY ACIDS IN GRAPE AND TOMATO POMACE – SUSTAINABLE VALORIZATION OF AGRICULTURAL WASTE

Gjore NAKOV¹, Silviya IVANOVA¹, Iliana LAZOVA-BORISOVA¹, Mishela TEMKOV²

¹Institute of Cryobiology and Food Technologies, Agricultural Academy – Sofia, 53, Cherni Varh Blvd, 1407 Sofia, Bulgaria, E-mails: gore_nakov@hotmail.com, sylvia_iv@abv.bg; iliana_lazova@abv.bg

²”St. Cyril and Methodius” University in Skopje, Faculty of Technology and Metallurgy, Department of Food Technology and Biotechnology, 16, Ruger Boskovic, 1000 Skopje, R.N. Macedonia, Emails: mishela@tmf.ukim.edu.mk

Corresponding author: gore_nakov@hotmail.com

Abstract

Food industry generates large quantities of waste material containing significant amounts of biologically active compounds such as polyphenols, dietary fibers, essential fatty acids etc. Wine industry creates grape pomace during wine manufacturing, whereas tomato derived products industry (ketchup, tomato puree, canned tomatoes, tomato juice, and tomato sauce) produces tomato pomace. Both food wastes contain fruits' seeds as source rich in fatty acids. The aim of this study is to identify fatty acids that are containing in aforementioned types of food waste and to demonstrate the alternative food waste applications other than animal feed. Fatty acids were analyzed using gas chromatography. Grape pomace is richer in linoleic and palmitoleic acid and ω -6 fatty acid in comparison with tomato pomace. Tomato pomace is richer in ω -3 fatty, stearic, palmitic and oleic acids. Grape pomace holds up higher quantity of PUFA and CLA, but lesser amount of SFA and MUFA and cis isomers of oleic acid than tomato pomace.

Key words: by-product, fatty acid profile, grape pomace, sustainable, tomato pomace

INTRODUCTION

Roughly, one third from world's annual food production (1.3 metric billion tons) is food waste [25]. European Union countries are given plans to be implemented for proper management with this type of waste, in order to decrease it up to 30% until 2025 and up to 50% until 2030 [7]. Due to the current inefficiency in food economy, there is a constant loss in productivity, energy and ecosystem. Circular Economy encompasses reuse, recovery and recycle of existing materials, briefly, the waste becomes resource at a certain point [14]. It helps in amelioration and optimization of the sustainability of Western food system. According to Rana et al., 2021 [19] valorization of agro industrial waste through green and biotechnological processes is feasible approach for its reduction. Wine and tomato industries generate large and bulky waste, which is

challenging to manage. Grape pomace (GP) is a by-product of the wine industry. This waste contains skin, seeds and stalks (Fig. 1a) [24]. Tomato pomace (TP) is a by-product of tomato derived products industry and contains seeds and skin (Fig. 1b) [3].

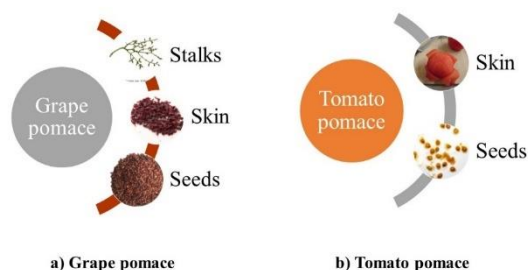


Fig. 1. Constituents of grape and tomato pomace
Source: Own design.

In our previous work, the chemical composition of grape pomace was estimated. [18]. According to many authors, GP by-product is an excellent source of dietary fibers

[11], phenolic compounds [4] and lipids [13]. Moreover, GP has high antioxidant activity [10], whereas grape seed oil is plentiful in linoleic and oleic acids [1]. The chemical composition of grape pomace is grape variety and level of ripeness dependent among other factors [1]. Once tomatoes are transformed in puree, juice, sauces and ketchup, the generated waste is called tomato pomace that is composed of seeds, peels and a little quantity of pulp [26]. Due to the good chemical composition of tomato, tomato waste is characterized as an excellent source of lycopene, dietary fibers, proteins and lipids. This chemical composition relies on the proportion of peels and seeds in the tomato pomace, since the peels are richer in dietary fibers, lycopene and phenols, while the seeds generally contain lipids and proteins [17]. According to the scientifically available information, the dietary fiber content in TP is in the range of 39.11 and 68.04 g per 100 g DM, the protein content is in the range of 16.00 and 24.67 g per 100 g DM, the amount of minerals lies between 2.88 and 5.29 g per 100 g DM, while the amount of lipids varies between 2.00 and 16.24 g per 100 g DM [9, 12, 20, 21]. Grape pomace is abundant in unsaturated fatty acids (UFA), linoleic and oleic in particular, which make up more than 68% from the total content of fatty acids [5]. The essential oil of tomato seeds can be used in daily nutrition due to its high nutritional value. This tomato seed oil extract is high in content in palmitic, linoleic, arachidic, oleic and stearic acids, whereas the content of unsaturated fatty acids (UFA) accounts for approximate 80% [17]. Due to the high lipid quantity in GP and TP, the aim of this paper was determine the fatty acid profile and highlight the most important fatty acids. In this manner, we can validate the potential alternative use of these types of food waste as a source of functional foods, nutraceuticals and cosmetics formulation. Their further use will contribute for sustainable agro food waste development.

MATERIALS AND METHODS

Preparation of grape and tomato pomace

Grape pomace was collected after separating the grape juice from the red grapes. The residuals (stalks, seed and skin) were placed on stainless steel pans and were dried for 48 hours at 60 °C in the UFE 500 oven (Memmert GmbH, Schwabach, Germany). Afterwards the dry grape pomace was ground using an IKA MF10 grinder (IKA®-Werke GmbH & Co. KG, Staufen, Germany). Tomato pomace (seeds and peels) was collected after extracting the juice from technological mature tomatoes. It was dried at 45 °C in UFE 500 oven (Memmert GmbH, Schwabach, Germany), and subsequently pulverized on an IKA MF10 grinder (IKA®-Werke GmbH & Co. KG, Staufen, Germany). Both types of pomace were placed in vacuum bags and vacuum stored at a temperature of 4°C.

Lipid extraction form grape and tomato pomace

For the lipid extraction, 25 g from the grape pomace powder and 10 g from tomato pomace powder were used. Static extraction was performed employing chloroform and methanol as an extracting solvent in ratio 1:2. The extraction process was repeated twice. The whole extract was transferred in separating funnel, while water was added for phase separation. After the separation of the aqueous phase, the non-polar phase was transferred into vacuum evaporator, followed by complete drying and evaporation of the extracting solution [6].

Identification of fatty acid profile of grape and tomato pomace

Identification of fatty acids in grape and tomato pomace was performed using gas chromatograph Shimadzu-2010 gas chromatograph (Kyoto, Japan). The assay was performed with a CP7420 capillary column (100 m x 0.25 mm i.d., 0.2 m, Varian Inc., Palo Alto, CA), with carrier gas-hydrogen and make-up gas-nitrogen. A five-stage gas chromatographic oven program has been used.

Statistical analysis

The presented values are the mean values from three replicates. To determine least significant difference Fisher’s test was employed ($p < 0.05$), using the software XL STAT 2019 (Addinsoft Inc. Long Island City, NY, USA).

RESULTS AND DISCUSSIONS

In the food industry, the oil extracted from grape and tomato seeds can be promoted as cheaper oil compared to other types of oil, representing a new source of nutrition in humans’ diet at the same time [17, 22]. Nevertheless, tomato pomace contains extensive quantities of lipophilic bioactive compounds (carotenoids and unsaturated fatty acids). Therefore, this food waste can be utilized as a source for manufacturing high quality extracts [23]. Mainly, the fatty acid content in grape and tomato pomace comes from the occurrence of the seeds in the pomace itself. The seeds are highly valued due to the good nutritional characteristics of

the extracted oil from them, which are high in unsaturated fatty acids (oleic and linoleic) [5]. In Fig. 2, the quantities of stearic, palmitic, palmitoleic, oleic, linolenic and linoleic fatty acids in grape and tomato pomace are presented. The highest content of unsaturated fatty acids present in pomaces were oleic and linoleic acids. According to Lu et al., 2019 [17] oil extract from tomato seeds had the highest linoleic acid content. The quantity of palmitic acid in tomato pomace was higher than the one in grape pomace. Jin et al., 2019 [13] presented results for the palmitic acid content varying between 7.81 and 10.6 g/100 oil and steric acid content in the range between 2.51 and 6.12 g/100 g oil in their investigation of fatty acids identification in grape pomace produced from different varieties of red grapes. The amount of palmitoleic acid in grape and tomato pomace was estimated to be 0.39 and 0.35 g/100 g oil, respectively, while stearic acid can be found in capacity of 3.75 g/100 g oil in grape pomace and 5.98 g/100 g oil in tomato pomace.

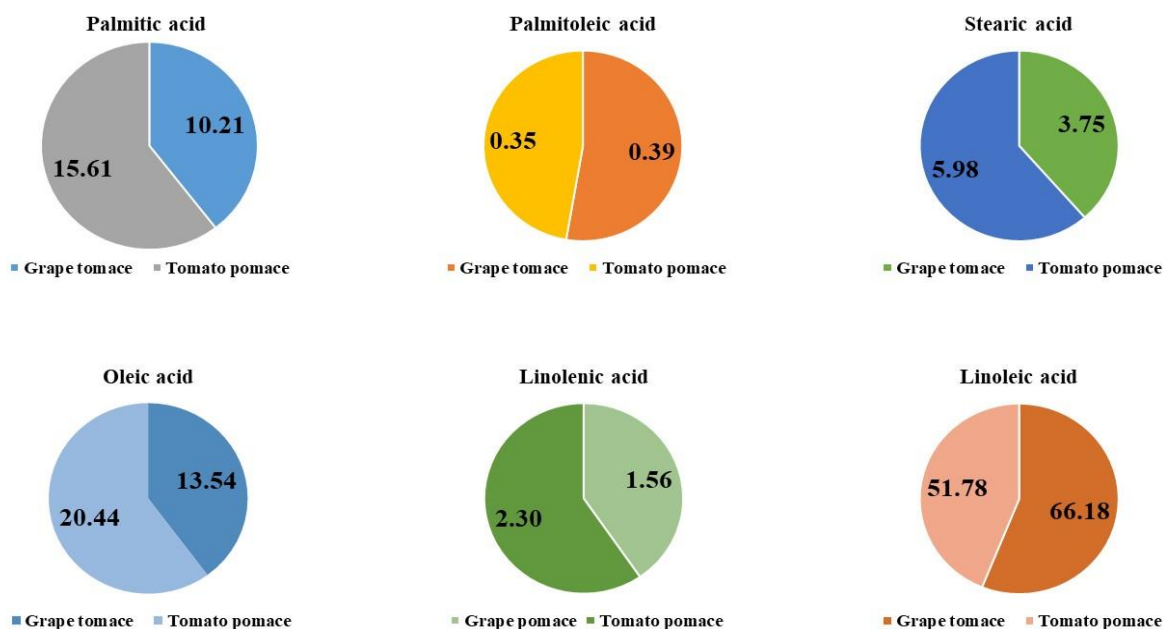


Fig. 2 Different fatty acids (g/100g oil) in grape and tomato pomace
Source: Own design.

According to Beres et al., 2017 [5] saturated stearic fatty acids in grape seeds were present in quantities of 3-6%. α -linolenic acid as a part of essential fatty acids has a role of

precursor for long chain fatty acids [22]. This fatty acid is present in quantities of 1.54 g/100 g oil in grape pomace, while in tomato pomace the concentration is higher (2.30

g/100g oil). According to Lazos et al., 1998 [15] tomato pomace is a good source of fatty acids: linoleic, oleic, and palmitic acids present in different ratios, dependant of tomato varieties producing the pomace, the degree of ripeness, and climate conditions during cultivation.

The values of different groups of fatty acids present in the grape and tomato pomace are demonstrated in Table 1. The ANOVA for different groups of fatty acids highlighted significant differences among the two pomaces (grape and tomato) types. The total amount of saturated fatty acids (SFA) in our grape pomace was 14.78% in comparison to 21.97% in tomato pomace.

Table 1. Total groups of fatty acids (%) present in grape and tomato pomace

	Grape pomace	Tomato pomace
Saturated fatty acids (SFA)	14.78 ^e ±0.01	21.97 ^c ±0.02
Monounsaturated fatty acids (MUFA)	15.38 ^d ±0.01	22.00 ^c ±0.02
Polyunsaturated fatty acid (PUFA)	68.81 ^a ±0.07	55.02 ^a ±0.05
Conjugated linoleic acid (CLA)	0.22 ^h ±0.00	0.15 ^g ±0.00
ΣΩ-3 fatty acid	1.77 ^g ±0.00	2.95 ^f ±0.00
ΣΩ-6 fatty acid	66.84 ^b ±0.06	51.92 ^b ±0.05
Σn-6/Σn-3	37.78 ^c ±0.01	17.58 ^e ±0.00
Cis isomers of oleic acid	14.36 ^f ±0.01	21.02 ^d ±0.02

The means are calculated from three repetitions. Values in the same row with different letters are significantly different ($p < 0.05$) following Fisher's LSD test.

Source: Own results.

Fernandes et al., 2013 [9] determined 14.94% SFA in the seeds of the grape variety Tinta Barroca that is in accordance with our results. In addition, Aksoylu Özbek et al., 2020 [2] discovered 18.06% SFA in tomato pomace acquired from tomatoes cold pressing and their subsequent drying. The quantity of monounsaturated fatty acids (MUFA) in GP was 15.38% and in TP was 22.00%.

In the study of Aksoylu Özbek et al., 2020 [2] the fraction of monounsaturated fatty acids (MUFA) in tomato pomace was 28.84%, while the same fraction was reported in

quantities in the range of 14.19 - 21.29% by Fernandes et al., 2013 [8]. These literature data are in accordance with our findings. The amount of monounsaturated fatty acid (MUFA) in grape and tomato pomace was estimated as 15.38% and 22.00%, respectively. In the study of Fernandes et al., 2013 [8] the content of PUFA fraction evaluated in the seeds of different grape varieties was in the range of 63.64% to 73.53% which was significantly higher than our results. In contrast to our results, Aksoylu Özbek et al., 2020 [2] reported 53.10% PUFA in tomato pomace. The occurrence of conjugated linoleic acid (CLA) was determined in grape pomace (0.22%) and in tomato pomace (0.15%). It is assumed that CLA has positive effects on cardio metabolic risk factors, while its positive impact on glycemic index, arteriosclerosis and cancer are already proven with experimental methods [16]. Modern lifestyle differs from what human genetic structure is created. The studies show enormous changes in the nutrition, especially in the type and quantity uptake of essential fatty acids and antioxidants from food [16]. ω-3 and ω-6 are essential fatty acids likewise found in food waste. The total amount of ω-3 fatty acid in GP was 1.77%, while its content in TP was 2.95%. In addition, the quantity of ω-6 fatty acids in GP and TP was found to be 66.84% and 51.92%, respectively. The ratio between essential fatty acids in GP and TP was 37.8/1 and 17.6/1, respectively. Today's human nutrition evolved from nutrition in which ω-6/ω-3 ratio was approximately 1 to a nutrition with ω-6/ω-3 ratio in the range of 15/1 and 16/1. The agribusiness and modern agriculture promote the reduction of ω-3 fatty acids and increase of ω-6 fatty acids. All this causes imbalance of the characteristic food from the past [16]. Cis isomers of oleic acid in grape and tomato pomace was 14.36% and 21.02% respectively.

CONCLUSIONS

Grape and tomato pomace are by-products from the food industry, which have large quantities of biologically active compounds

(polyphenols, dietary fibers, vitamins) in their content. They also contain big quantities of fatty acids due to the presence of the fruit seeds in both types of pomace. From the fatty acid profile of both pomaces, it can be concluded that GP is richer in linoleic acid and ω -6 fatty acid in comparison to TP. On the other hand, TP has a higher content of palmitic, stearic, oleic and ω -3 fatty acids than GP. When the comparison is in terms of different groups of fatty acids, grape pomace has more PUFA and CLA in its content than tomato pomace. The latter is richer in SFA, MUFA and cis isomers of oleic acid.

ACKNOWLEDGEMENTS

The financial support of this work by the Bulgarian Ministry of Education and Science, National Research Fund under the contract number KII-O6-M56/3-2021 is gratefully acknowledged.

REFERENCES

- [1]Ageyeva, N., Tikhonova, A., Biryukova, S., Globa, E., 2021, Study of phenolic compounds and lipids of grape pomace. E3S Web Conf. 285, 05018.
- [2]Aksoylu, Ö, Z., Çelik, K., Ergönül, P.G., Hepçimen, A.Z., 2020, A promising food waste for food fortification: Characterization of dried tomato pomace and its cold pressed oil. J. Food Chem. Nanotechnol. 6, 9–17.
- [3]Azabou, S., Louati, I., Ben Taheur, F., Nasri, M., Mechichi, T., 2020, Towards sustainable management of tomato pomace through the recovery of valuable compounds and sequential production of low-cost biosorbent. Environ. Sci. Pollut. Res. 27, 39402–39412.
- [4]Balli, D., Cecchi, L., Innocenti, M., Bellumori, M., Mulinacci, N., 2021, Food by-products valorisation: Grape pomace and olive pomace (pâté) as sources of phenolic compounds and fiber for enrichment of tagliatelle pasta. Food Chem. 355, 129642.
- [5]Beres, C., Costa, G.N.S., Cabezudo, I., da Silva-James, N.K., Teles, A.S.C., Cruz, A.P.G., Mellinger-Silva, C., Tonon, R. V., Cabral, L.M.C., Freitas, S.P., 2017, Towards integral utilization of grape pomace from winemaking process: A review. Waste Manag. 68, 581–594.
- [6]Bligh, E.G, Dyer, W.J, 1959, A Rapid Method Of Total Lipid Extraction And Purification. Can. J. Biochem. Physiol. 37(9): 911–917.
- [7]EU 2018/851, 2018, Directive 2018/851 amending Directive 2008/98/EC on waste Framework. Off. J. Eur. Union (L-150/109-140).
- [8]Fernandes, L., Casal, S., Cruz, R., Pereira, J.A., Ramalhosa, E., 2013, Seed oils of ten traditional Portuguese grape varieties with interesting chemical and antioxidant properties. Food Res. Int. 50, 161–166.
- [9]Fuentes, E., Carle, R., Astudillo, L., Guzmán, L., Gutiérrez, M., Carrasco, G., Palomo, I., 2013, Antioxidant and antiplatelet activities in extracts from green and fully ripe tomato fruits (*Solanum lycopersicum*) and pomace from industrial tomato processing. Evidence-based Complement. Altern. Med. vol.2013, 867578.
- [10]Goñi, I., Brenes, A., Centeno, C., Viveros, A., Saura-Calixto, F., Rebolé, A., Arijia, I., Estevez, R., 2007, Effect of dietary grape pomace and vitamin E on growth performance, nutrient digestibility, and susceptibility to meat lipid oxidation in chickens. Poul. Sci. 86, 508–516.
- [11]Ilyas, T., Chowdhary, P., Chaurasia, D., Gnansounou, E., Pandey, A., Chaturvedi, P., 2021, Sustainable green processing of grape pomace for the production of value-added products: An overview. Environ. Technol. Innov. 23, 101592.
- [12]Jawad, M., Schoop, R., Suter, A., Klein, P., Eccles, R., 2013, Perfil de eficacia y seguridad de *Echinacea purpurea* en la prevención de episodios de resfriado común: Estudio clínico aleatorizado, doble ciego y controlado con placebo (*Echinacea purpurea* Efficacy and Safety Profile in Prevention of Common Cold Episodes: Randomized, Double-Blind, Placebo-Controlled Clinical Study), Rev. Fitoter. 13, 125–135.
- [13]Jin, Q., Hair, J.O., Stewart, A.C., Keefe, S.F.O., Neilson, A.P., Kim, Y., Mcguire, M., Lee, A., Huang, H., 2019, Compositional Characterization of Different Industrial White and Red Grape Pomaces in Virginia and the Potential Valorization of the Major Components. Foods 8, 667.
- [14]Jurgilevich, A., Birge, T., Kentala-Lehtonen, J., Korhonen-Kurki, K., Pietikäinen, J., Saikku, L., Schösler, H., 2016, Transition towards circular economy in the food system. Sustain. 8, 1–14.
- [15]Lazos, E.S., Tsaknis, J., Lalas, S., 1998, Characteristics and composition of tomato seed oil. Grasas y Aceites 49, 440–445.
- [16]Lehnen, T.E., da Silva, M.R., Camacho, A., Marcadenti, A., Lehnen, A.M., 2015, A review on effects of conjugated linoleic fatty acid (CLA) upon body composition and energetic metabolism. J. Int. Soc. Sports Nutr. 12.
- [17]Lu, Z., Wang, J., Gao, R., Ye, F., Zhao, G., 2019, Sustainable valorisation of tomato pomace: A comprehensive review. Trends Food Sci. Technol. 86, 172–187.
- [18]Nakov, G., Brandolini, A., Hidalgo, A., Ivanova, N., Stamatovska, V., Dimov, I., 2020, Effect of grape

pomace powder addition on chemical, nutritional and technological properties of cakes. *Lwt* 134, 109950.

[19]Rana, P., Inbaraj, B.S., Gurumayum, S., Sridhar, K., 2021, Sustainable Production of Lignocellulolytic Enzymes in Solid-State Fermentation of Agro-Industrial Waste: Application in Pumpkin (*Cucurbita maxima*) Juice Clarification. *Agronomy* 11(12): 2379.

[20]Savadkoochi, S., Farahnaky, A., 2012, Dynamic rheological and thermal study of the heat-induced gelation of tomato-seed proteins. *J. Food Eng.* 113, 479–485.

[21]Shao, D., Atungulu, G.G., Pan, Z., Yue, T., Zhang, A., Chen, X., 2013, Separation methods and chemical and nutritional characteristics of tomato pomace. *Am. Soc. Agric. Biol. Eng.* 56, 261–268.

[22]Shinagawa, F.B., de Santana, F.C., Torres, L.R.O., Mancini-Filho, J., 2015, Grape seed oil: A potential functional food? *Food Sci. Technol.* 35, 399–406.

[23]Šojić, B., Pavlić, B., Tomović, V., Kocić-Tanackov, S., Đurović, S., Zeković, Z., Belović, M., Torbica, A., Jokanović, M., Uromović, N., Vujadinović, D., Ivić, M., Škaljac, S., 2020, Tomato pomace extract and organic peppermint essential oil as effective sodium nitrite replacement in cooked pork sausages. *Food Chem.* 330, 127202.

[24]Spinei, M., Oroian, M., 2021, The potential of grape pomace varieties as a dietary source of pectic substances. *Foods* 10(4), 867.

[25]Wang, Y., Yuan, Z., Tang, Y., 2021, Enhancing food security and environmental sustainability: A critical review of food loss and waste management. *Resour. Environ. Sustain.* 4, 100023.

[26]Zuorro, A., Fidaleo, M., Lavecchia, R., 2011, Enzyme-assisted extraction of lycopene from tomato processing waste. *Enzyme Microb. Technol.* 49, 567–573.