Studii şi Cercetări Ştiinţifice
Chimie şi Inginerie Chimică, Biotehnologii, Industrie Alimentară

2020, **21** (2), pp. 243 – 252

Scientific Study & Research
Chemistry & Chemical Engineering, Biotechnology, Food Industry

ISSN 1582-540X

ORIGINAL RESEARCH PAPER

VALORISATION POTENTIAL OF *FETEASCĂ NEAGRĂ* GRAPE POMACE FOR OBTAINING HONEYBASED FORTIFIED INNOVATIVE PRODUCT

Elena-Mirela Suceveanu*, Luminiţa Grosu, Irina-Claudia Alexa*, Adriana-Luminiţa Fînaru

"Vasile Alecsandri" University of Bacău, Faculty of Engineering, Department of Chemical and Food Engineering, 157, Calea Mărăşeşti, Bacău, 600115, Romania

*Corresponding author: irinaalexa@ub.ro, mirela.suceveanu@ub.ro

Received: January, 14, 2020
Accepted: June, 04, 2020

Abstract: Grape pomace (GP) is the main by-product from the wine industry, consisting of remaining skin, seeds and pulp. Extremely rich in flavones, anthocyanins and tannins, this by-product has attracted the attention of scientists leading to an interest in the study of different uses in various fields especially as it is very inexpensive: as an additive in animal feed, as ingredients in the food industry, cosmetics, medicine, etc. GP may have applications as food additives with nutritional benefits. For the present research, an innovative product based on Acacia honey (AH) and GP powder in different proportion (5, 10 and 15 %) was prepared. Fortification with GP may impact the sensory characteristics of products, such as flavor, color, and texture. The results revealed that the fortified innovative product obtained is well accepted by the consumers.

Keywords: *fortification, grape pomace, honey, valorisation*

INTRODUCTION

Romania ranks an important place among the largest wine producers in the world. The wine sector in Romania is one of the most developed sectors of agriculture, in recent years significant investments have been made in the modernization of plantations and wineries.

Wine pomace also called grape pomace (GP) is a bioresource available on a large-scale being the by-product of winemaking.

The idea of valorizing of GP is not new and different alternatives have been proposed with an emphasis on exploiting the interesting compounds found in its composition [1, 2]. Extremely rich in flavones, anthocyanins and tannins, this by-product has attracted the attention of scientists leading to an interest in the study of different uses in various fields especially as it is very inexpensive: as additive in animal feed, as ingredients in the food industry, cosmetics, medicine, etc.

It is known that GP may have applications as food additives with nutritional benefits, a wide range of products being developed over recent decades: cereal products, mainly bread and cookies, dairy products – yogurt and cheese, marmalade or candies [3, 4].

The most common functions associated with GP products in food industry are their use as antioxidants, followed by their use as fortifying, coloring, and antimicrobial agents.

Among the natural additives, GP products have been reported as excellent alternative for the synthetic antioxidants, mainly due to their high content of phenolic compounds [5, 6].

Fortification involves the incorporation of nutrients to foods whether or not the nutrients are originally present in the food. The development of foods that provide additional health benefits beyond basic nutrients is actually a trend in the food processing industry [7].

Cereal products, mainly bread and cookies have been successfully enriched by incorporating grape pomace products. Other products such as candies, salad dressing, cheese, tomato puree have also been fortified with GP flours [8, 9].

Fetească Neagră is a variety of Romanian grape cultivated mainly in several in several regions of Romania, including Moldova.

GP from Romanian red variety of *Vitis vinifera* (L.) var. *Fetească neagră* are reported as an important source of natural antioxidants, because of their high concentration of different phenolic compounds. Recently, was reported a research concerning the antioxidant and cardioprotective effects of *Fetească neagră* GP [10].

Knowing that GP and honey are extremely valuable because of their rich nutrient content, new products obtained by mixing honey with GP flours may be considered food with high nutritional value as well as fortified food.

Therefore, the aim of the present study was to valorize the *Fetească Neagră* grape pomace for the development of a new honeybased fortified product.

For the present research, an innovative product based on Acacia honey (AH) and *Fetească Neagră* grape pomace (GP) powder in different proportion (5, 10 and 15 %) was prepared. The influence of *Fetească Neagră* GP on the sensorial properties and overall acceptability of fortified honey was evaluated.

MATERIALS AND METHODS

GP powder obtention

GP derived from the dark-skinned grape of the Romanian grape variety *Fetească Neagră* (harvest 2017) from the northeastern Panciu - Vrancea (wine region of Moldova - Romania) was collected immediately after the grape press and was stored at -18 °C.
The samples were thawed overnight at 4 °C prior to use, and then were dried in an air circulation oven (Memmert Universal, model UFE 500, Germany) at 60 °C for 16 hours [11].
The dried GP was then milled 5 minutes using a household grinder. The powder obtained was sieved using a 1 mm sieve and stored in plastic bags until used.

Figure 1. *Fetească neagră grape pomace*

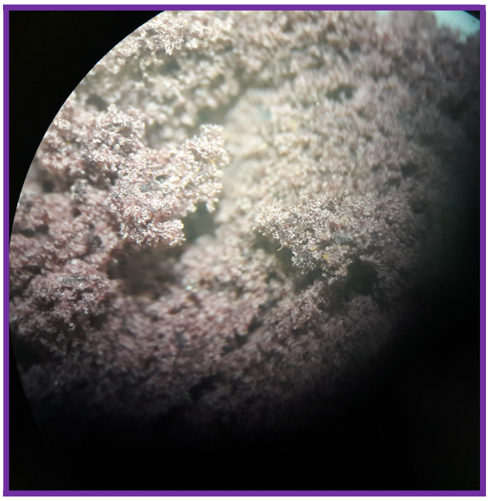

Figure 2. *Image of GP powder at Digital Microscope Celestron (model 44340, USA)*

GP moisture content was determined by drying at 105 °C for 4 h in an air circulation oven (Memmert Universal, model UFE 500) to constant weight. Moisture was calculated by the difference in the mass of the sample before and after drying; the result was expressed in percentage of moisture.
Vitamin C levels can be considered an index of nutritional quality of foods. So, for both raw materials GP and AC, vitamin C content was determined by titration according to the iodometric method and also using HI 3850 Ascorbic Acid test kit (Hanna

Instruments, USA). For this analysis, 5 g GP (fresh and powder) was suspended in 100 mL of water.

Acacia honey

AH was purchased directly from a local producer.
Honey analysis is carried out to verify the quality and the authenticity of this food.
The most common determinations are sensory and physicochemical methods.
Thus, to verify the quality of AH before use, sensory properties were analyzed. Sensory evaluation is important in verifying the conformity of unifloral honeys [12].
Some physicochemical parameters were also determined [13, 14].
All analysis was performed at room temperature.

Sensorial analysis
The color of honey was assessed by visual examination in daylight on a quantity of 10-15 g of honey, placed in a transparent test tube with a diameter of 10 mm. The results of the examination could be expressed in the following terms: water-white, extra white, white, light robinia, extra light amber, light amber.
The smell and taste was appreciated by smelling and tasting. In this case, the name of the dominant plant and its origins are indicated, as well, a few possible gustatory particularities: sour, bitter, astringent, etc. The smell and taste are expressed by the terms: pleasant, sweet, characteristic of bee honey, slightly aromatic etc.
The consistency of honey was evaluated by the way the honey flows from a wooden pick. It can be uniform, fluid, and viscous, with different aspects of crystallization.
The purity was assessed by examining the sample of honey that served to determine the color in direct daylight and identify fragments of bee's carcasses, beeswax, honeycomb etc.

Physicochemical analysis
AH moisture content was determined using refractometric method. Refractive index of the honey was measured at 20 °C with an Abbe refractometer (Kruss Optotronik D 22297, Germany). Moisture percentage was calculated from the refractive index of the honey by using a relative conversion table [15].
Density of honey was established using pycnometer density method.
For *p*H and conductivity measurements, 10 g of AH sample was dissolved in 100 mL demineralized water.
The *p*H was determined using a Handheld meter *p*H 315i WTW model Germany.
Electrical conductivity has been measured with Hach conductivity meter (model Sension 5, USA) on a honey solution at 20 °C.
Diastase activity is estimating amylase activity in honey using the *Gothe* method [16]. The results are expressed in Gothe units and are defined as the number of mL of 1 % starch solution which is completely hydrolyzed in one hour at 45 °C by the amylase existing in 1 g of honey. Soluble starch from Merck was used after the blue value was verified.
Vitamin C amount for a honey solution (5 g of AH in 100 mL water) was determined by titration according to the iodometric method [17] and also using HI 3850 Ascorbic Acid test kit (Hanna Instruments, USA).

The free acidity of honey consisting in the content of all free acids was analyzed by titration method. The sample is dissolved in water (10 g honey to 100 mL water), stirred with the magnetic stirrer and then titrated with 0.1M NaOH (Merck) through a burette. The free acidity is expressed in milliequivalents / kg honey [15].
All chemicals used in this study were of analytical grade.

Fortified honey with grape pomace samples preparation

The new fortified samples were obtained by mixing AH with GP fine powder in different proportions (5, 10 and 15 %), in the glass bottles (100 mL capacity).
The mixture was well homogenized for 10 minutes.
The fortified honey samples were subjected to sensory evaluation by scoring method after 14 days of maceration and 6 month, respectively.

Figure 3. *Steps in preparation of fortified honey with grape pomace powder*

Sensorial evaluation of fortified honey samples

The samples prepared in the present study were organoleptically analyzed by a multi-sensory approach using the scoring method with a 30 points scoring system.
An evaluation form presented in Table 1 was filled out by the tasters which accorded points for each descriptor.
The sensorial analysis was carried out in a room in which minimum requirements were respected: temperature 20 - 22 °C, lighting - white natural, without odors and noise.
About 20 - 30 g of the each sample was put into identical sampling beaker for each taster with no distinguishing marks apart. For mouth rinsing between the samples water was provided to the panelists (Figure 4).
To guarantee anonymity, an identification code for each sample was attributed, varying the order in which the samples were offered to the tasters.
The present sensory evaluation was performed by 20 untrained panelists of both sexes, each one working individually, filling the evaluation forms.

Table 1. *Evaluation form of sensory analysis by scoring method for fortified honey samples*

Descriptor	**Scoring limit [points]**	**Accorded score [points]**	**Overall impression and other observations**
Visual			
Color intensity	1-5		
Olfactory			
Intensity of odor	0-3		
Flavor	0-3		
Tasting			
Sweetness	1-3		
Acidity	0-3		
Persistence	0-3		
Crystalisation rate	1-3		
Fluidity / Consistence	1-3		
Acceptability	0-4		
Total points	**max. 30**		

Figure 4. *Fortified honey with grape pomace samples set for sensorial evaluation*

RESULTS AND DISCUSSION

Grape pomace

For the fresh *Fetească neagră* GP was established the proportion of skin + pulp : seeds as being 74 : 26.
In Table 2 are presented the moisture and vitamin C content of fresh and powder grape pomace, respectively.

Table 2. *Moisture and vitamin C content of Fetească neagră grape pomace*

Characteristics	**Fresh GP**	**GP powder**
Moisture content [%]	74	3.5
Vitamin C content [mg ascorbic acid/100g]	63.4	23

Acacia honey

The results of sensorial and physicochemical analysis of Acacia honey that was used in our study are shown below in Tables 3 and 4.

***Table 3**. Sensorial profile of Acacia honey sample*

Sensorial parameter	Attributes of AH sample
Color	extra light amber
Smell and taste	sweet, characteristic of Acacia honey
Consistency	viscous, uniform, without crystallization
Purity	without impurities

***Table 4**. Physicochemical parameters of Acacia honey sample*

Physicochemical parameter	Value for AH sample
Moisture [%]	17.7
Density [$g{\cdot}cm^{-1}$]	1.425
*p*H	4.01
Electrical conductivity [$\mu S{\cdot}cm^{-1}$]	106.2
Diastase activity [Gothe scale units]	29.41
Vitamin C [mg / 100 g honey]	98
Free acidity [meq / kg honey]	8.1

The results exposed in the Tables 3 and 4 were in accordance with the literature and revealed that Acacia honey used for this study had a high-quality.

Sensorial evaluation of fortified honey samples

A significant role in the choice of food is represented by the sensorial quality.
Sensorial analysis is based on the evaluation of the olfactory-gustatory characteristics of fortified honey samples with different proportions of GP powder: 5 % - TM5, 10 % - TM10 and 15 % - TM15, respectively.
Using the scoring method with 30 points scoring system it is possible to establish the differences in acceptance among the consumers and the size of this difference.
The most relevant parameters analyzed were: taste, color intensity and acceptability.
Figures 5 and 6 graphically presented the sensory profile of the fortified honey samples after 14 days from preparation.
The tasters had evaluated the most intense taste for TM10 sample. The color intensity had similar values for both TM10 and TM15 samples.
As shown in Figure 6 a), the sample with 10 % GP powder (TM10) obtained the highest average total score followed of only 1.7 points by TM5 sample.
Also, the results revealed that all samples of AH fortified with GP powder presented good acceptability - Figure 6 b). The most accepted by the tasters was TM5 sample with 71 % acceptability. It can be observed that the increasing proportion of GP powder in AH samples decreased their acceptability with 21 %.

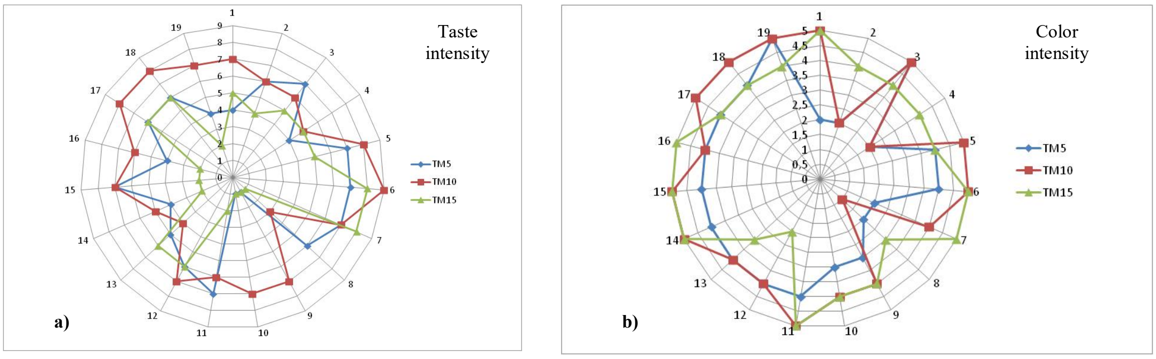

***Figure 5.** Sensory profile of the fortified honey samples*
a) taste intensity; b) color intensity

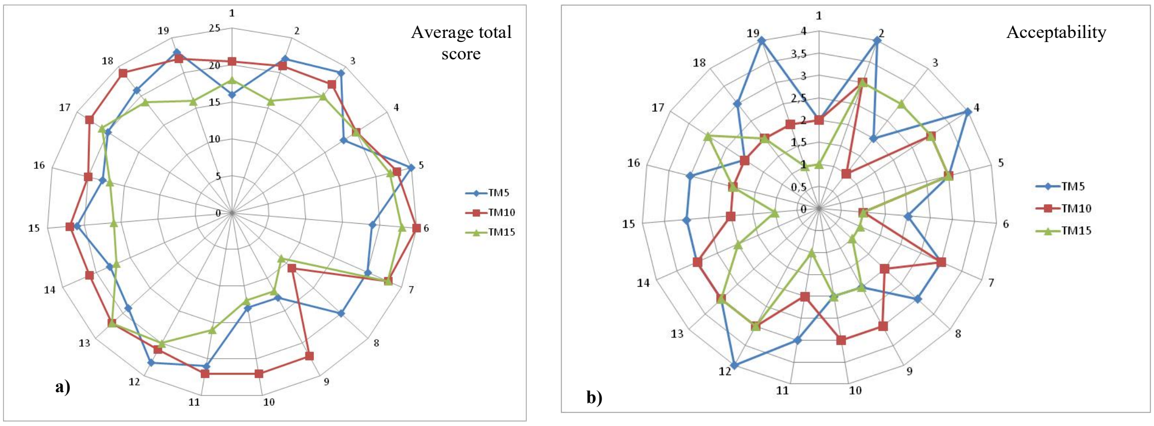

***Figure 6.** Sensory profile of the fortified honey samples*
a) average total score; b) acceptability

After 6 months of storage at room temperature in a dark place, the acceptability for all samples remains around the same values, with an insignificant increase (Figure 7), as well as the average total score. This small augmentation may be due to the increase of homogenization degree and the intensification of aroma and taste over time.

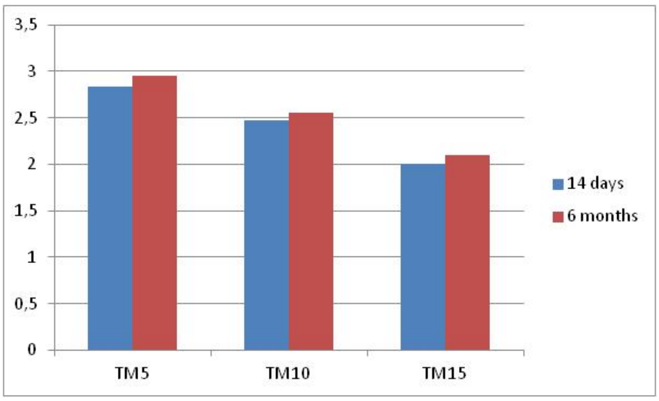

***Figure 7.** The acceptability of the fortified honey samples after 14 days and 6 months*

CONCLUSIONS

Fortification with grape pomace may impact the sensory characteristics of Acacia honey, such as flavor, color, and texture.

In the present study, the highest average total score in the sensorial evaluation was obtained by the sample with 10 % GP powder. Regarding the acceptability, the sample with 5 % GP powder was well received by the consumers which is in accordance with others studies concerning cookies, biscuits, muffins fortified with GP [18, 19].

Incorporating a higher level of GP powder (> 15%) can led to consumers' rejection due to darker color and possible bitterness.

The overall results indicate that grape pomace powder can be used as functional ingredients for the development of new product honeybased, contributing to a sustainable process innovation.

For the improvement of the consumers' acceptability, research concerning the incorporation of seedless grape pomace powder is in progress.

The comparative study of physicochemical parameters between the Acacia honey sample and fortified honey with grape pomace powder will be the subject to a future publication.

REFERENCES

1. Kalli, E., Lappa, I., Bouchagier, P., Tarantilis, P.A., Skotti, E.: Novel application and industrial exploitation of winery by products, *Bioresouces and Bioprocessing,* **2018**, **5** (46), 1-21;
2. Gómez-Brandón, M., Lores, M., Insam, H., Domínguez, J.: Strategies for recycling and valorization of grape marc, *Critical Reviews in Biotechnology,* **2019**, **39** (4), 437-450;
3. Garcia-Lomillo, J., Gonzalez-SanJos, M.L.: Applications of Wine Pomace in the Food Industry: Approaches and Functions, *Comprehensive Reviews in Food Science and Food Safety*, **2017**, **16**, 3-22;
4. Fontana, A.R., Antoniolli, A., Bottini, R.: Grape Pomace as a Sustainable Source of Bioactive Compounds: Extraction, Characterization, and Biotechnological Applications of Phenolics, *Journal of Agricultural and Food Chemistry*, **2013**, **61**, 8987-9003;
5. Manach, C., Scalbert, A., Morand, C., Rémésy, C., Jiménez, L.: Polyphenols: food sources and bioavailability, *The American Journal of Clinical Nutrition*, **2004**, **79** (5), 727-747;
6. Mattos, G.N., Tonon, R.V., Furtado, A.A.L., Cabral, L.M.C.: Grape by-product extracts against microbial proliferation and lipid oxidation: a review, *Journal of the Science of Food and Agriculture*, **2017**, **97** (4), 1055-1064;
7. Augusto, P.E.D., Falguera, V., Cristianini, M., Ibarz, A.: Influence of fibre addition on the rheological properties of peach juice, *International Journal of Food Science and Technology*, **2011**, **46**, 1086-1092;
8. Lavelli, V., Sri Harsha, P.S.C., Torri, L., Zeppa, G.: Use of winemaking by-products as an ingredient for tomato puree: The effect of particle size on product quality, *Food Chemistry*, **2014**, **152**, 162-168;
9. Marchiani, R., Bertolino, M., Ghirardello, D., McSweeney, P.L.H, Zepp, G.: Physicochemical and nutritional qualities of grape pomace powder-fortified semi-hard cheeses, *Journal of Food Science and Technology*, **2016**, **53** (3), 1585-1596;
10. Balea, Ş.S., Pârvu, A.E., Pop, N., Zamora Marín, F., Pârvu, M.: Polyphenolic Compounds, Antioxidant, and Cardioprotective: Effects of Pomace Extracts from Fetească Neagră Cultivar, *Oxidative Medicine and Cellular Longevity*, **2018**, 1-11;
11. Sousa, E.C., Uchôa-Thomaz, A.M.A., Carioca, J.O.B., de Morais, S.M., de Lima, A., Martins, C.G., Alexandrino, C.D., Ferreira, P.A.T., Rodrigues, A.L.M., Rodrigues, S.P., Silva, J.N., Rodrigues, L.L.: Chemical composition and bioactive compounds of grape pomace (*Vitis vinifera*

L.), *Benitaka* variety, grown in the semiarid region of Northeast Brazil, *Food Science and Technology*, Campinas, **2014**, **34** (1), 135-142;

12. Piana, M.L., Persano Oddo, L., Bentabol, A., Bruneau, E., Bogdanov, S., Guyot Declerck, C.: Sensory analysis applied to honey: state of the art, *Apidologie*, **2004**, **35**, S26-S37;
13. Llobera, A., Canellas, J., Pascual-Maté, A., Osés, S.M., Fernández-Muiño, M.A., Sancho, M.T.: Methods of analysis of honey, *Journal of Apicultural Research,* **2018**, **57** (1), 38-74;
14. Trifković, J., Andrić, F., Ristivojević, P., Yesilada, E.: Analytical Methods in Tracing Honey Authenticity, *Journal of AOAC International*, **2017**, **100** (4), 827-839;
15. Bogdanov, S.: *Harmonised Methods of the International Honey Commission*, **2009**, https://www.bee-hexagon.net/english/network/publications-by-the-ihc/
16. Alencar Arnaut de Toledo, V.: *Honey Analsis*, InTech, Rijeka, **2017**;
17. Dobrinas, S., Matei, N., Soceanu, A., Birghila, S., Popescu, V.: Estimation of vitamin C and Cd, Cu, Pb content in honey and propolis, *Scientific Study & Research - Chemistry & Chemical Engineering, Biotechnology, Food Industry*, **2006**, **VII** (4), 729-734;
18. Acun, S, Gul, H.: Effects of grape pomace and grape seed flours on cookie quality, *Quality Assurance and Safety of Crops & Foods*, **2014**, **6** (1), 1-88;
19. Walker, R., Tseng, A., Cavender, G., Ross, A., Zhao, Y.: Physicochemical, Nutritional, and Sensory Qualities of Wine Grape Pomace Fortified Baked Goods, *Journal of Food Science,* **2014**, **79** (9), S1811-S1822.