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Preparation of Functional Cookies with Red Grape Pomace Bio-Dust

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ABSTRACT

The influence of secondary raw materials in primary winemaking on the organoleptic and physico-chemical parameters of butter cookies made of wheat and oat flour has been studied. It was revealed that cookies with this additive have appropriate consumer properties and physicochemical parameters that meet accepted standards. It was shown that the processed product was enriched with the elements necessary for the body. These elements include *Na, C, Mg, Ca, P, Fe, Zn,* and *Cu*, and the powerful antioxidant resveratrol. Obtaining food additives by processing grape pomace and their use in confectionery products will contribute to primary winemaking with minimal waste.

Introduction

Studies of secondary raw materials for winemaking began in the 80s of the last century (Kondratiev, 2009). The secondary raw material of wine production is about 40 % of processed grapes (Tagirova and Kasyanov, 2015), and according to A. N. Tikhonova makes 20 % (Tikhonov, 2017), out of which 8.0-17.0 % is fermented pomace (Tikhonova, 2015). For the first time, in 1999 in the Theodosia region juice was removed from dark grapes and a dark dispersion mass was produced from pomace bio-dust, which contains resveratrol, vitamins *A* and *E*, and fiber (Tikhonov, 2015; Sedrakyan, 2017). Grape bunch, peel/skin, seeds and remaining juice are included in the grape pomace (Kondratev, 2007). The red grape peel contains twice more polyphenols than the white grape. The red grape peel contains anthocyanins, and antioxidants, including resveratrol, vitamin, dihydrocretin, and trace elements; due to the high content of copper and cobalt salts, they have a positive effect on metabolic processes, and the extract provides antioxidant protection of the cell. Resveratrol is found as well as in blueberries, peanuts, cranberries, and Sakhalin's gorse, with large amounts – in black mulberries (Tagirova and Kasyanov, 2015). For the first time, resveratrol was written about in 1939 by Japanese researcher M. Takaoka noting that it is found in the peel of red grapes, and therefore in red wine. This substance accounts for the positive effect of red wine on blood vessels and low cholesterol levels. There is also an opinion that a large amount of these substances can protect a person from obesity and diabetes (www.mfarm.ru). Many researchers suggest that moderate consumption of red wine reduces the risk of developing cardiovascular disease. This phenomenon is known as the "French paradox".

It has been found out that resveratrol helps treat certain types of cancer, as it kills up to 65 % of melanoma cells when used with radiotherapy. The cardioprotective, anti-inflammatory, immunomodulatory, antitumor, antimicrobial, and neuroprotective effects of resveratrol are currently confirmed. The obtained data make it possible to select resveratrol as a promising therapeutic agent (Moiseeva, et al., 2012). The research aims to increase the efficiency of wine production through the processing of red grape pomaces as secondary raw materials for winemaking, producing food additives, and using them in the production of cookies, which will increase the usefulness of cookies and contribute to the development of waste-free production in primary winemaking.

Materials and methods

The study objects are bio-dust processed from grape pomaces produced in the wine industry from the red grape varieties of "Tigrani" and "Kakhet" common in the winemaking sector of the Republic of Armenia, 9 samples of wheat flour cookies with biological additives (Table 1) and 5 samples of oat flour cookies (Table 2). The following raw materials were used in the cookie production: "Baghramyan" wheat high-grade baking flour – GOST 26574-2017, oatmeal – GOST 31945-2012, white sugar – GOST 33222-2011, "NAZ" margarine – GOST 32188-2013, sodium bicarbonate – GOST 32802-20147, ammonium carbonate – GOST R 55580-2013, table salt – AST 239-2005, drinking water – SanPin N2-III-A 2-1-02, "Kakhet" and "Tigrani" grape fermented pomaces bio-dusts produced via processing by convective drying with the technology developed by A. Sedrakyan (Sedrakyan, 2017). "Kakhet" and "Tigrani" are late-ripening Armenian grape varieties (www.files.stroyinf.ru; www.vinograd.info). Sensory indicators of baked butter cookies were assessed according to GOST 5897-90. The tasting committee has evaluated the quality of cookies with different contents of red grape wine fermented pomaces bio-dust with a 10-point grading system developed by our research group, per the sensory indicators normalized by the standard. Following the physicochemical alanysis, the indicators were normalized and not normalized. Based on the evaluation data provided by the tasting committee, the cookies with the highest score were selected for further examination. The quality indicators of cookies were determined in the laboratories of YSU (Yerevan State University) and the "National Institute of Health Named after Academician S.Kh. Avdalbekyan" CJSC. Per the physicochemical indicators of cookies, the mass fraction of moisture was measured according to GOST 5900-2014, the wetness index – according to GOST 10114-8013, the basicity – according to GOST 5898-8714, the mass fraction of total sugar – according to GOST 5903-8916, and the mass fraction of ash – according to GOST R 51411-99 (ISO 2171-93). The chemical elements were determined through flame photometric, voltammetry, and photo colorimetric methods, and the resveratrol content was measured by high-performance liquid chromatography at the Institute of Horticulture, Viticulture and Winemaking of Georgia (www.pubmed.ncbi.nlm.nih.gov).

Results and discussions

The preparation of functional cookies includes the following technological processes: raw material preparation, dough making, dough formation, baking, cooling, packaging, labeling, and storage.

In the first stage of dough making the fat mass is prepared, in case of which margarine is mixed with white sugar with the help of a mixer.

In the second stage sifted wheat flour (or oat flour) is taken separately, to which the bio-dust of fermented grape pomace was added in different amounts: 2; 3; 5; 10 %, and in amounts of 2; 3; 5; 10; 20 % (by weight of flour) to obtain functional cookies of different compositions; sodium bicarbonate, ammonium carbonate, and table salt were then added and mixed for 1-2 minutes until all ingredients were evenly mixed.

In the third stage, the flour mass was added to the whipped fat mass and mixed for 6-8 minutes until a crumbly dough was obtained so as it should not stick to the hands. Balls are made from the dough, which is opened in the form of a layer of 2-3 mm thickness, shaped by cutting into a shape, and placed in the oven of the stove. The baking process was conducted at 180-190 ^{0}C for 17-18 minutes, thereafter cooling of the finished baked cookies was implemented to a temperature of 22-25 ^{0}C. Cookies without a grape pomace bio-dust were taken as control samples. The evaluations of the tasting committee are presented in Table 1.

As a result of the sensory analysis of functional cookies with biodust of wine pomace from "Tigrani" and "Kakhet" varieties (Table 1), the maximum score was given to the cookies containing 3 % bio-dust (sample N 3 and sample N 7). Samples N 3 and N 7 were selected for further testing. The low scores of samples N 4, N 5, N 8, and N 9 containing red wine pomace bio-dust are due to the low indicator in the color score.

To exclude the significant effect of bio-dust, especially on the color index, wheat flour was replaced with oat flour. The data are presented in Table 2.

As a result of the average scores of the tasting committee, the highest score – 9.5 points – was given to the cookies containing 10 % red grape pomace bio-dust.

Table 1. Scoring the sensory analyses of functional cookies made from wheat flour with wine pomace bio-dust produced from red grape varieties "Tigrani" and "Kakhet"*

Cookie samples	Scoring per sensory analysis, points				
Sensory analyses	**appearance**	**color**	**taste and smell**	**appearance in a fracture**	**total**
Maximum score, points	**1.0**	**3.0**	**5.0**	**1.0**	**10.0**
"Tigrani" with grape pomace bio-dust					
Control Sample - N 1	1.0	3.0	4.0	0.7	8.7
Sample N 2 - 2% bio-dust	0.8	2.8	4.4	0.7	8.7
Sample N 3 - 3% bio-dust	0.8	2.8	5.0	0.8	9.4
Sample N 4 - 5% bio-dust	0.8	1.0	5.0	0.5	7.3
Sample N 5 - 10 % bio-dust	0.8	0.7	4.9	0.3	6.7
"Kakhet" with grape pomace bio-dust					
Sample N 6 - 2 % bio-dust	0.8	2.6	4.7	0.6	8.7
Sample N 7 - 3 % bio-dust	0.8	2.8	5.0	0.7	9.3
Sample N 8 - 5 % bio-dust	0.8	1.3	4.9	0.6	7.6
Sample N 9 - 10 % bio-dust	0.8	0.9	4.8	0.4	6.9

Table 2. Scoring functional cookies made from oat flour with grape variety "Tigrani" pomace bio-dust*

Sensory analyses	Cookie samples, scoring points					
	maximum score, points	**control sample N 1**	**sample N 2 3 % bio-dust**	**sample N 3 5 % bio-dust**	**sample N 4 10 % bio-dust**	**sample N 5 20 % bio-dust**
Appearance	1.0	0.8	0.8	1.0	1.0	0.7
Color	3.0	3.0	3.0	2.7	2.7	2.5
Taste and smell	5.0	4.3	4.4	4.5	4.8	4.5
Appearance in a fracture	1.0	0.8	0.8	1.0	1.0	0.3
Total	10.0	8.9	9.0	9.2	9.5	8.0

*Composed by the authors.

Table 3. Chemical composition of wheat and oat flour cookies prepared with red grape pomace bio-dust*

Index Name	Number of the indicator testing method	Index value				
		bio-dust content of red grapes with wheat flour			bio-dust content of red grapes with oat flour	
		control sample N 1	sample N 3 "Tigrani"	sample N 7 "Kakhet"	control Sample N 1	sample N 10 "Tigrani"
Mass fraction of moisture, %	GOST 5900-2014	15	15	15	15	15
Mass fraction of protein, %	GOST 26889-96	7.77	7.41	8.10	7.10	7.20
Mass fraction of carbohydrates, %	GOST 5903-89	58.6	59.89	59.82	58.3	58.5
Mass fraction of total sugars, %	GOST 5903-89	21.94	22.10	21.50	21.90	22.15
Mass fraction of oil, %	GOST 31902-89	18.0	17.9	16.5	18.3	18.1
Mass fraction of total ash, %	GOST 5901-99	0.614	0.632	0.585	1.30	1.45
Mass fraction of 10 % insoluble HCL ash, %	GOST 5901-99	0.04	0.05	0.05	0.07	0.09

Table 4. Chemical composition of functional cookies made from wheat and oat flour with grape variety "Tigrani" pomace bio-dust*

Index Name	Number of the indicator testing method	Measuring unit	Index value			
			wheat flour		oat flour	
			control	3.0 % bio-dust	control	10 % bio-dust
Potassium	GOST 30504-97	mg/%	113.0	115.6	182.0	195.4
Sodium	GOST13496.1-98	mg /%	4.2	4.3	10	12
Calcium	GOST 26570-95	mg /%	8.0	8.5	22.0	23.1
Magnesium	GOST 26570-95	mg /%	11.0	13.2	74.5	75.8
Phosphorus	GOST 26657-97	mg /%	156.0	166.0	201	212
Iron	GOST 26928-86	mg /%	1.20	1.30	1.80	2.02
Zinc	GOST 51301-99	mg /%	0.78	0.80	1.30	1.85
Copper	GOST 51301-99	mg /%	0.26	0.29	0.20	0.25
Total resveratrol	HPLC/ 9/	mg /kg	0.00	0.03	0.00	0.08

*Composed by the authors.

As a result of the examination it was disclosed, that normative indicators of butter cookies were defined by GOST 24901-2014 (GOST 24901-2014. Cookie. General Specifications), i.e., mass fractions of moisture, oil, ash content insoluble in 10 % *HCl*, humidity, and solidity meet the requirements of the standard. The chemical composition of the wheat and oat flour cookies was determined through the physicochemical analysis: the total and 10 % mass fractions of carbohydrates, sucrose, and oil, chemical elements, and the amount of resveratrol were determined (Tables 3, 4).

The data in Table 3 show that the cookies have a high nutritional value.

It can be seen from Table 4 that the functional cookies made from wheat, and oat flour with the bio-dust of the fermented pomace of "Tigrani" grape variety were enriched with the elements *Na, K, Mg, Ca, P, Fe, Zn, Cu,* and antioxidant resveratrol required for the human body.

Conclusion

It is necessary to produce pomace bio-dust from the secondary raw materials generated in primary winemaking and use it in the production of cookies to enrich them with mineral elements: *Na, K, Mg, Ca, P, Fe, Zn, Cu,* and antioxidant resveratrol, using red grape pomace bio-dust with 3 % in wheat flour cookies and 10 % – in oat flour cookies. Wine production efficiency will surely increase by producing food additives from winemaking secondary raw materials and using them in confectionery production.

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