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RESEARCH OF THE PROPERTIES OF GRAPE PROCESSING PRODUCTS IN RELATION TO ITS APPLICATION IN SPA AND WELLNESS INDUSTRIES

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Abstract. The work analyzes the global experience of using wines and grape-processing products to support a person's physical, mental, and psychological health, to slow down aging, to prevent and treat many diseases, in particular cardiovascular and oncological ones, endocrine system disorders, etc. It has been shown that a great deal of waste, including marc, is obtained while processing grapes and producing wine. The fact has been pointed out that in Ukraine, the technologies of using wine-making waste in food and cosmetic industries and in medicine are being developed and introduced but slowly, though the level of viticulture is high. The importance and prospects of finding ways to process grape marc have been proved, as its valuable chemical composition allows obtaining dietary supplements and oenotherapeutic products for spa and wellness industry. The following rational parameters have been suggested to extract the most valuable biologically active substances (polyphenols) from grape marc: microwave extraction; specific power of the microwave installation 1.6–1.7 kW/kg; 40% ethyl alcohol as the extractant; proportion of water (hydromodulus) 1:5; extraction temperature 60–65°C; 4 heating stages; stage interval 1.5–2 minutes; total extraction time 12–14 minutes. The physico-chemical parameters of the marc extracts obtained from the grapes harvested in 2016 and 2017 have been determined. It has been established that, besides polyphenols, a whole complex of biologically active substances is extracted. It has been shown that grape marc can be used to produce dietary fibre, pectins, and other valuable substances. The medical and biological properties of the polyphenolic complex obtained from marc (the Odesky Chorny variety of grapes) have been studied on laboratory rats to determine its antioxidant activity and the prospects of its use in treating type 2 diabetes. The protective properties of the obtained product have been proved. Such processes have been established to take place as the mobilization of the antioxidant system of cells, the normalization of the enzyme activity of the antioxidant protection system, and a decrease in the level of markers of oxidative modification of proteins and lipids (that are higher than normal with diabetes mellitus). It has been suggested to use polyphenolic complex extracts in oenotherapy as a skin and face care product with protective properties.

Key words: wine, oenotherapy, wine therapy, Spa and Wellness industry, polyphenols, grape marc.

ДОСЛІДЖЕННЯ ВЛАСТИВОСТЕЙ ПРОДУКТІВ ПЕРЕРОБКИ ВИНОГРАДУ З ОГЛЯДУ ВИКОРИСТАННЯ В SPA ТА WELLNESS ІНДУСТРІЇ

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Анотація. У представленій роботі проаналізовано світовий досвід використання вин та продуктів переробки винограду для комплексної підтримки фізичного, психічного, психологічного здоров'я людини, сповільнення старіння. Показано, що використання даних продуктів має профілактичний, лікувальний єфект при багатьох захворюваннях, зокрема серцево-судинних, онкологічних, розладів роботи ендокринної системи тощо. Зазначено, що при переробці винограду та виготовленні вина утворюється значна кількість відходів, зокрема вичавків, при цьому в Україні темпи розробки і впровадження технологій використання відходів виноробства в харчовій, косметичній індустрії, в медицині, досить низькі при високому розвитку виноградарства Із огляду цінного хімічного складу виноградних вичавків, обґрунтовано актуальність і перспективність пошуку способів їхньої переробки з метою отриманням біологічно активних добавок та засобів енотерапії для використання у Spa та Wellness індустрії. Запропоновано вилучення найбільш цінних біологічно активних речовин з виноградних вичавків – поліфенолів шляхом НВЧ-екстракції. Встановлено наступні раціональні параметри НВЧ-екстракції: питома потужність НВЧ-установки 1,6–1,7 кВт/кг; екстрагент – 40% етиловий спирт; гідромодуль 1:5; температура екстрагування 60–65°С; інтервал ступеню 1,5–2 хв; кількість ступенів нагрівання 4; загальний час екстракції 12–14 хв. Визначено фізико-хімічні показники отриманих екстрактів з вичавків винограду 2016 і 2017 року врожаю та здійснено вилучення крім поліфенолів, цілого комплексу біологічно активних речовин. Показано можливість використання виноградних вичавків також для отримання харчових волокон, пектинів й інших цінних речовин. Проведено медико-біологічні дослідження поліфенольного комплексу екстрактів вичавків винограду Одеський чорний на лабораторних щурах для визначення їхньої антиоксидантної активності та перспективності використання при лікуванні діабету 2 типу. Доведено протекторні властивості отриманого продукту, показано мобілізацію антиоксидантної системи клітин, нормалізацію активності ферментів системи антиоксидантного захисту та зниження рівня маркерів окисної модифікації білків та ліпідів. Запропоновано використання екстрактів поліфенольного комплексу в енотерапії як засіб із захисними властивостями для догляду за шкірою і обличчям.

Ключові слова: вино, енотерапія, Spa та Wellness індустрія, поліфеноли, виноградні вичавки.

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Introduction. Formulation of the problem

In the last decade, in the general concept of the development of modern society, of global medical science, and of an individual's lifestyle principles, the focus has shifted from diagnosing and treating diseases to preventing them. That means the adoption of health-protective strategies and prolonging every person's life through maintaining the best possible quality of health. Health is viewed as a benefit, a precondition for happiness, for full implementation of an individual's life projects. Besides, health is the basis that ensures a state's steady progress. It involves a set of interrelated elements to comprise and join spiritual, physical, mental, social, psychological and other aspects of life. People can only become and remain healthy when they have peace of mind and are in harmony with their natural and social environment [1].

To make and keep a person healthy, certain conditions must be created to maintain the body's ability to resist environmental hazards. This includes controlling the body balance, improving the general state of the organism and its adaptability, using the protective properties of foods and bio-active agents, and taking actions aimed at bettering the quality of life.

A modern prospective method of complex health improvement, effecting on people's physical state as well as their morals and aesthetic sphere of life, is wine therapy (oenotherapy). The practice of using wine to treat diseases is very old. In the pharmacology of many countries and hospitals, wine is prescribed as a medicine. The modern method also includes using such grapevine-derived products as vine leaves, wine yeast, grapeseed oil, grape skins, grape seed extracts, etc.

According to their chemical composition, wines fall into four categories – table, fortified, dessert, and sparkling wines. Their action upon the human organism is different. Table wines are considered to be the healthiest. They contain a moderate amount of alcohol and are sufficiently acidic. White table wines are diuretic, red wines are more nutritious and tonic. Muscat wines stimulate the nervous system and have a positive effect on the respiratory apparatus. Sparkling wines are used to treat some diseases of the respiratory and digestive systems, or to avoid nervous overstimulation. Oenotherapists can treat influenza or pneumonia by means of wine. To this end, they prescribe hot sweet or semi-sweet wine with seltzer water to adults, and baths of warm red wine to children. European oenotherapists believe that for tuberculosis, strong wine is more effective, as it contains not only alcohol, but tannins, mineral salts, and other biologically active agents. Red, especially mulled, wine helps regain energy, and is a good remedy for colds. For rheumatic skin diseases, dry white wine with alkaline waters is recommended. This wine is also prescribed to be used before and after meals in case of depression or melancholy. There are quite a lot of recipes including wine to treat disorders of the digestive tract, liver, and kidneys. In the treatment of dysentery, red Bordeaux wine is often drunk or used for gastric lavage. The same wine is also effective against poisoning (but not alcoholic intoxication). It is a well-known fact that a daily intake of 400 ml of dry red wine quickens the healing of breaks in bones. For a lot of long-living residents of the Caucasian Mountains, pure natural wine is a source of vitality [2].

Alcohol is not for children, though, and any wine is contraindicated to people with certain health problems, such as acute nephritis. However, the enormous potential of vine and grape products makes it possible to find safe and effective ways of using them to improve and maintain the health of both children and adults with some physiological or psychological problems.

Analysis of recent research and publications

Today, the property of food viewed worldwide as highly important is its ability to maintain genetic homeostasis, viability, and proper functioning of an individual's organism, of different social, national, or other groups, and of people in general. In the world characterized by the anthropogenic pollution of the biosphere and by the constant impact of numerous chemical, physical, and psychoemotional factors, food is supposed to remediate permanent oxidative stress and prevent mutations.

To make the human organism more resistant and adaptable, according to the healthcare strategy for the development of the society and the medical science, and based on the theory of healthy dietary nutrition (both therapeutic and preventive), food and other components of a lifestyle are supposed to improve the general state and functioning of body organs and systems: 1) to maintain the integrity and protective qualities of the body's physiological barriers (skin, gastrointestinal mucosa, urogenital tract, blood vessels, cellular biomembranes) due to the antioxidant, antisclerotic, lipotropic, anti-inflammatory properties; 2) to regulate the functioning of the gastrointestinal tract, liver, nervous system; 3) to strengthen the organism in general and restore the nutrients that are overspent in the conditions described above. Besides, of vital importance are the factors that are able to regulate the human body's antioxidant defence system, to reduce the depositing and to accelerate the excretion of carcinogenic and mutagenic agents, thus preventing the cell genome from mutations resulting in cancers and congenital pathologies [3].

Skin is the most important physiological barrier of the human organism. It is a multi-purpose organ that can perform protective, thermoregulatory, sensory,

secretory, metabolic, respiratory, immune, and other functions, and serves as an interface with the environment. How effective it is against mechanical impacts, radiation, and adverse microorganisms depends on its general condition – whether it is damaged or not, how soon it regenerates, whether it has areas of inflammation. Besides, the skin influences a person's emotions, mood, mental, psychological, and social welfare.

Oenotherapy and wine masks for face and body are quite novel skin-repair and antiageing methods. They are based on using wine for better blood circulation and cellular respiration, skin regeneration and fewer wrinkles. When the skin health declines with age or due to environmental hazards, the antioxidant substances contained in grapes and their seeds help the skin resume producing collagen and provide protection against free radicals.

Oenotherapy is considered to have been born in France. The cosmetic properties of wine were first used there as early as the 1990s. In 1993, the French company Caudalie working in co-operation with the Pharmaceutical Science Faculty of Bordeaux Segalen University started using the antioxidant properties of grapes for spa services. Then, the company registered its own trademark and presented a line of quality products made with the use of wine and grapeseed oil. In 1999, in the vicinity of Bordeaux vineyards, Caudalie opened its first spa centre Les Sources de Caudalie offering oenotherapeutic services (massage with the use of grapevine-derived products). Later, in Italy, the company opened another spa centre. Italy, as a country of the oldest traditions of wine-making, never lags behind its European neighbours when it comes to oenotherapy. Italy's most famous vinotherapeutic spa centres are located in Umbria, in the central part of the country, where vineyards cover thousands of square kilometres. The oenotherapeutic services include massage with grape and herbal ointments, baths with grapes that have been crushed in a wooden barrel.

For South Africa, one of the world's wine-making leaders, oenotherapy is quite a new idea so far. In that country, using wine in medicine has some peculiarities, and the names of the local spa centres offering oenotherapeutic services are hardly known in Europe. South African oenotherapy experts use local grape varieties (mainly Pinotage). The Librisa Spa centre in the Mount Nelson Hotel, Cape Town, offers a complex of special treatments (including exfoliation, wraps, massage, and facials) with products made from local-grown grapes. There are day spas in Cape Town that introduce elements of aromatherapy into vinotherapeutic sessions. For exfoliation, a mixture of grape skins, sugar, cloves, and juniper berries is used. Then, it is turn of aromatic oil massage. The oils are specially selected to emphasize the wine odours. Finely powdered grape seeds are used as facial scrubs. Naturally, too much alcohol is never recommended, especially in combination with thermal treatment. However, in reasonable amounts, oenotherapeutic sessions are sure to be effective for any skin type [4].

The phenomenon termed French Paradox is often explained by drinking wine daily and its ability to improve the overall condition of the body. The paradox consists in a lower incidence of ischemic heart disease in France, compared to other countries, though the French diet is traditionally rich in saturated fats. The fact was given much attention to in the media in the early 1990s, which resulted in joint effort of researchers throughout the world to study and explain how wine was related to health. Due to this work, red wine is now included into the Mediterranean diet, which is considered to be healthy. More epidemiologic studies, with different social groups as objects, have established that people who drink wine but moderately die of cardiovascular diseases less frequently (by 20–30%) than those who abstain from alcohol or overconsume it [5].

There are more than 500 compounds in red wine. Its main components are water, ethyl alcohol, and polyphenols, which are of special interest due to their protective properties – antioxidant and cardioprotective. The bioactivity of polyphenols and the effect they are supposed to have on a person's health depend on their state, qualitative composition, and bioavailability. The latter can be increased by appropriate technological methods, in particular, by fermentation, and becomes higher than that in the starting raw material, grapes, in the course of the wine-making process.

Polyphenols fall into two main groups, flavonoids and non-flavonoids. The former are responsible for the mouthfeel and colour of the wine, and act as cardioprotective and antiatherosclerotic agents. Flavonoid quercetin is a strong antioxidant with an antihypertensive and anti-inflammatory action [6]. Non-flavonoid polyphenol resveratrol (phytoalexin), found in red wine and grapes, is considered to be the main source of their curative powers. It has estrogenic, antiaggregatory, anticarcinogenic, and anti-inflammatory properties and can be used for many purposes, from chemoprevention to cardioprotection [7-10].

Wine polyphenols are suggested as an alternative therapy for the induction and support of the remission of cancer, as they control the apoptosis of cells of different cancer forms by increasing reactive oxygen species and reducing the cell growth. Alcohol ingestion, when it is regular and moderate (1–2 glasses a day), is believed to result in a lower incidence of cardiovascular diseases, essential hypertension, diabetes. Wine polyphenols can be used for some dermatological injuries and in treatment of muscular and articular changes [11-15]. Intakes of wine at regular intervals is also viewed as useful in diabetes mellitus. Diabetes mellitus is a group of endocrine diseases resulting from disorders in the secretion or

action of insulin and causing chronic hyperglycemia. So, it is an urgent task to find effective means of preventing diabetes and helping the sore body, as in well-developed countries, about 4–5% of the population are ill with it, and the number is growing fast. Type 2 diabetes is characterized by low glucose in the peripheral tissues, insulin resistance, glucose overproduction by the liver, and defects in the beta cells of the pancreas. Vascular risk markers related to type 2 DM include endothelial dysfunction, oxidative stress (especially after meals), inflammation, and insulin resistance.

The main pathogenetic mechanisms of DM chronic complications make using antioxidant medications a reasonable approach to their prevention and treatment. These medications can be developed on the basis of phenolic compounds obtained from grape wine or from other grape processing products. However, it is necessary to study, analyze, and systemize the data on the bioactivity of grape processing products and wastes, and it is important to develop recommendations for using them as food and food enrichers, as biologically active dietary supplements, as components of preventive medications, and for medical treatment sessions.

That is why our **purpose** was to study the antioxidant effect of the natural polyphenol complex obtained from grape wine and grape marc extracts in the context of diabetes-induced oxidative stress.

Objectives of the study.

1. To establish the reasonable parameters of grape marc extraction to obtain the polyphenol complex most effectively.

2. To study, compare, and characterize the chemical composition of the grape marc extracts obtained from grapes harvested in 2016 and 2017.

3. To determine the physical and chemical properties and the bioactivity of the obtained extracts by biomedical experiments on laboratory rats.

4. To develop a complex grape processing scheme to use the obtained grape products as oenoproducts and as components of preventive and therapeutic nutrition.

Research materials and methods

The objects of research were grapes of the Odessky Chorny variety (Alicante Bouschet X Cabernet Sauvignon) created by the Ukrainian NSC Tairov Viticulture and Oenology Institute, the wine-making materials obtained from it, and hydroalcoholic infusions of grape marc. The polyphenol complex (PC) concentrate was obtained by evaporation of red wine provided by the employees of the Tairov Institute and Odessa National Academy of Food Technologies. The evaporation was carried out at the Ivan Franko National University of Lviv. The product obtained was stabilized with biogenic surface-active substances (bioSAS) produced by biosynthesis of the *Pseudomonasspecies* 17 strain.

For the experiments, adult male outbred white rats were used, each weighing 150–180 g. The rats were divided into the following groups: 1 – control animals (C), 2 – control animals that were given orally the PC concentrate in a daily dose of 9.5 mg of polyphenol compounds per 1 kg body weight (C+PC), 3 – rats with streptozotocin-induced diabetes (D), 4 – rats with streptozotocin-induced diabetes who were given the PC concentrate (D+PC). After 14 days of taking in PC, the rats were etherized into the surgical stage, decapitated, their blood was collected and stabilized, and peripheral blood leukocytes were separated.

The activity of superoxide dismutase (SOD), catalase, glutathione peroxidase (GPO), and glutathione reductase (GR) was determined by the conventional method. The content of TBA-positive products (TBA-PP) and of protein carbonyl groups was determined [16]. The experimental results were analyzed with Microsoft Excel. They were presented as $M \pm m$. The difference was considered significant at the probability index $p \geq 0.95$ (the significance level $P \leq 0.05$).

The flavonoid content in the grape marc extracts was determined spectrophotometrically [17], and the volume ratio of ethyl alcohol by State Standard 13191-73. The mass concentration of sugars in the fermenting must was determined by a hydrometer test, the mass concentration of titrating acids by the standard titrimetric method, the mass concentration of phenolic compounds by using the Folin – Ciocalteu colourimetric method, the mass concentration of the reduced extract by refractometry, the mass concentration of colourants by the photocolourimetric method [18].

Results of the research and their discussion

The technology of obtaining materials to be further used to make red wines and other wine products can be presented as a chart shown in Fig. 1. A large part of grape components, after it is industrially processed, remains in the by-products, or wine wastes (Table 1). In the context of the acute global food crisis and the anthropogenic pollution of the environment (with food industry waste, too), a task of primary importance for the world is making use of all types of raw material, developing and introducing low-waste and waste-free production technologies, searching for directions and ways of utilizing by-products and wastes efficiently.

Lately, the rapid development of industrial technologies outfitted with state-of-the-art equipment, and the computerization of science and production have made it possible to suggest new applications of food industry waste, improve the existing methods of its recycling, develop technologies for new products with various sensory, physical, and chemical characteristics and a wide bioactivity range. However, utilization of processed wine-making raw materials is still an acute problem.

As wine-making waste treatment is a topical industrial task, we have studied ways of its technological processing to determine the rational parameters that will allow the formation of the required characteristics. Besides, we have considered how wine-making waste can be used in oenotherapy.

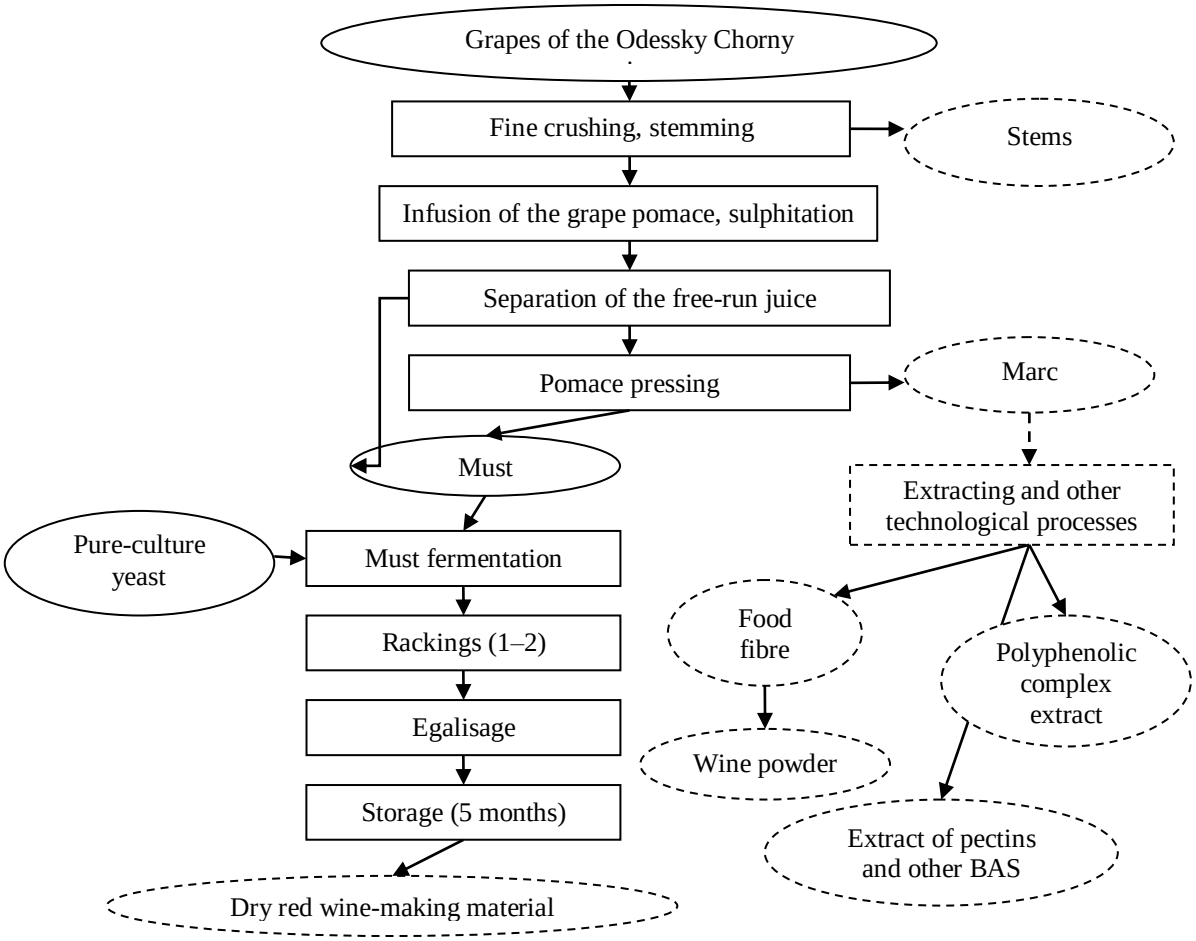

Fig. 1. Scheme of grape processing to obtain dry wine-making material and wine products

Table 1 – Products of wine processing [19, 20]

Types of wine industry waste	Product of processing	Product output, %
Stems	Fodder	30
	Pectins	3–7
Stem must	Alcohol (mainly ethyl)	0.8–1
Skins	Oenocolourant	2
	Feed meal	35
	Alcohol	10–15
Seeds	Grapeseed oil	11
	BAS	1–1.5
Sulphurized deposit	Alcohol	3–7
CO_2	CO_2	45
	Alcohol	0.17–1.5
Yeast deposit	Oenanthic ester	0.04
	Alcohol	45–50
Racking sludges	Fusel oils	5–8
	Alcohol	23–25
Cognac stillage	Tartaric acid	9–12

To this end, extraction of grape marc has been studied to obtain oenoproducts. On average, marc contains 37–39% of skins, 30–32% of pulp, 28–29% of seeds, 1.08–1.25% of stems with stalks, 0.20–0.25% of grapevine remains.

Basing on the literature analysis of the ways of extraction and mass transfer process intensification [21], for our study, we chose microwave extraction, with the working parameters of the microwave installation optimized according to the flavonoid output from the grape marc.

The main adjustable parameters of a microwave installation are the preset specific power and the time of raw material treatment. The study has established that the optimum temperature of extracting thermolabile substances from grape marc is 60–65°C. That was the reason to choose the multistage heating and cooling mode. Compared to ultrasound, the undeniable advantage of microwaves is a much shorter time of extraction, with the same output of bioactive substances. Another important thing is that, unlike ultrasound, microwave extraction allows obtaining an extract low in ballast material (chlorophyll, resins) that is present in the product when the structure of plant cells is destroyed significantly (which is likelier to be caused by an acoustic wave). Also, when microwave treatment intensifies the extraction, it allows reducing the alcohol strength from 70 to 40%.

The determination of how the specific power, the heating time, and the number of stages influence flavonoid extraction has revealed that it is the number of heating stages that its effectiveness primarily depends on. The dependence of the flavonoid content in a grape marc extract on this parameter is shown in Fig. 2.

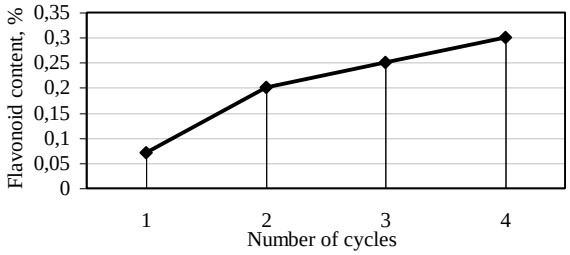

Fig. 2. Extraction of flavonoids from grape marc

In this study, the parameters of grape marc extraction were: the specific power 1.6–1.7 kW/kg; the stage interval 1.5–2 min.; the extraction temperature 60–65°C; the proportion of water (hydromodulus) 1:5; 40% ethyl alcohol as the extractant. With 4 extraction stages, the output of flavonoids was 0.37% (96.3% of its total content in the grape marc). There is no point in more than 4 heating stages, as this does not increase the output of phenolic compounds.

The study of the chemical composition of aqueous alcoholic extracts obtained by microwave extraction from grape marc of the Odessky Chorny grape variety harvested in 2016 (1) and 2017 (2) has shown the presence of sugars, their stable content, and a wide BAS range (Table 2).

The results of the physical and chemical research indicate that grape marc extracts are high in polyphenolic compounds. This proves that it is practical to utilize it to obtain a product that can further be used in oenotherapy.

The next stage of the research was studying the protective properties of the obtained grape marc extracts.

Table 2 – Chemical composition of the grape marc extractions

Parameter	Extract samples	
	1	2
Ethyl alcohol, proportion by volume, %	16	16
Mass concentration of sugars, g/dm^3	160	160
Mass concentration of titrating acids, g/dm^3	5.5	4.8
Mass concentration of the reduced extract, g/dm^3	20.0	25
Mass concentration of phenolic compounds, g/dm^3	1663	2079
Effectiveness of the extraction of phenolic compounds, %	67	83
Mass concentration of colourants, mg/dm^3	1332	1543
Effectiveness of the extraction of colourants, %	77	89

The environment affects the human body with physical, biological, and chemical mutagenic factors. This impact is inevitable, and it is only increasing with the development of mankind. A universal form in which the toxicity of xenobiotics, environmental impact, and psychoemotional strain reveal themselves is oxidative stress in the human organism. It is accompanied by activated nonenzymic free-radical oxidation (FRO), intensified formation of reactive oxygen species (ROS), and reinforced lipid peroxidation (LPO). This can result in a loss of the integrity and properties of biomembranes, in oxidative modifications of proteins, and in destruction of nucleic acids and carbohydrates. Besides, it can cause structural and metabolic disorders in the cells, unbalance the human body system, and exhaust the body's own antioxidant protection system (AOPS), which is a common element of the aetiology of a lot of pathologic processes. The functioning of AOPS, the induction of synthesis of enzymes, and the regulation of their activity are in close relation to the intercellular redox state and to adequateness of nutrition – primarily, of proteins, amino acids of cysteine, methionine, glutamate, glycine, taurine, other thiol-containing compounds, vitamins E, A, C, trace elements (including selenium), and exogenous antioxidants (first of all, polyphenols) [22].

So, in the course of oxidative modifications of proteins by carbonylation, aldehyde and ketone groups are formed in radicals of amino acid residues. In fact, these modified amino acid residues and lipoperoxidation products are considered to be the best oxidative stress markers.

We have established an increase in the TBA-PP (from 99.03 ± 1.15 to 158.13 ± 4.05 nM/mil) and in the carbonyl groups of neutral (from 0.016 ± 0.002 to

0.047 ± 0.005 arb. unit/g of protein) and basic (from 0.021 ± 0.007 to 0.192 ± 0.036 arb. unit/g of protein) character in the leucocytes of animals with experimental DM, compared to the control. When a PC concentrate was introduced under DM, the level of protein oxidative modification products returned to normal, and a significant decrease in TBA-PP (to 26.04 ± 2.37 nM/mil). This is a sign of inhibited oxidative stress in the immunocompetent cells when they are influenced by the natural polyphenolic compounds present in the concentrate obtained.

The accumulation of ROS and of the products of oxide modification of biomolecules (secondary ROS) stimulates the enzymatic and nonenzymatic antioxidant protection system [22].

It has been established that, under DM, the functioning of the key enzymes of the antioxidant protection system becomes unbalanced. This manifested itself in inhibited SOD (from 1398 ± 1738 to 296.13 ± 4.05 U/mg) and in increased catalase activity (from 0.006 ± 0.002 до 0.083 ± 0.002 nM H_2O_2/min*mg of protein). With the intake of the PC concentrate, there is an increase in the SOD activity in the leucocytes of animals ill with DM (up to 1042.13 ± 6.28 U/mg of protein), while the catalase activity is within normal limits (0.007 ± 0.001 nM H_2O_2/min*mg of protein).

Besides, we have studied the enzymatic glutathione-dependent element of the antioxidant protection system. It has been found that the GPO activity during DM is higher (from 22.16 ± 0.10 to 199.29 ± 0.93 nM GSH/min*mg of protein), compared to the control, and with the PC concentrate introduced, the activity of the enzyme does not exceed the control values. Compared to the control (0.0034 ± 0.0002 nM GSH/min*mg of protein), the activity of GR increased in the leucocytes of the animals ill with DM (up to 0.0045 ± 0.0003 nM GSH/min*mg of protein), and it was even higher in the cells of the diabetic animals that had been given the PC concentrate (0.0052 ±0.0004 nM GSH/min*mg of protein). The results of studying the activity of glutathione reductase conform with the changes in the glutathione peroxidase activity. The latter increases during DM, and the product of the reaction, oxygen glutathione, increases accordingly. This results in the activation of glutathione reductase that reduces it. Polyphenolic compounds mobilize the antioxidant system of the cell, thus the activity of SOD, catalase, and GPO does not exceed the control values and increases under DM.

This medical and biological research has shown a great antioxidant capacity of the polyphenolic complex of aqueous alcoholic extracts obtained from the grape marc of the Odessky Chorny variety: it normalizes the enzyme activity of the antioxidant protection system and lowers the level of markers of oxidative modification of proteins and lipids.

Conclusion

The theoretical basis and the experimental results have made it possible to prove that using wine, wine-making materials, and processed wine production waste to improve a person's health is timely, prospective, and practical.

Some directions have been suggested of processing wine production waste (such as grape marc) to produce dietary fibre and BAS extracts, in particular, a polyphenolic complex. The following rational parameters of microwave extraction have been determined to extract polyphenols from grape marc and to form the required properties of the extracts: 40% ethyl alcohol as the extractant; proportion of water (hydromodulus) 1:5; extraction temperature 60–65°C; specific power of the microwave installation 1.6–1.7 kW/kg; 4 heating stages; stage interval 1.5–2 minutes; total extraction time 12–14 minutes. The physical and chemical characteristics of the product obtained have been determined, and the extraction of a whole BAS complex has been established.

After studying the protective qualities of the polyphenolic complex of grape marc extracts on laboratory rats, it has been proved that the product mobilizes the antioxidant system of cells, normalizes the enzyme activity of the antioxidant protection system, and lowers the level of markers of oxidative modification of proteins and lipids. This makes it highly probable that consuming red wine will effect positively on treating type 2 diabetes. Besides, it makes it reasonable to use polyphenolic complex extracts (obtained from the Odessky Chorny grape marc) in oenotherapy as a skin and face care product.

List of references:

1. Woolf S.H., Aron L.U.S. Health in International Perspective: ShorterLives, PoorerHealth. -Washington (DC): National Academies Press (US). 2013. 394 p.: https://www.ncbi.nlm.nih.gov/books/ NBK115854/pdf/Bookshelf_-NBK115854.pdf
2. Энотерапия – лечение вином // Рецепты здоровья. URL: https://nmedik.org/enoterapiya.html (дата звернення: 02.08.2018).
3. Іоргачова К.Г., Лебеденко Т.Є. Хлібобулочні вироби оздоровчого призначення з використанням фітодобавок К.: К-Прес, 2015. 464 с.
4. Энотерапия – лечение вином: не удовольствия ради, а для защиты здоровья // Woman.ru. URL: http://www.woman.ru/health/ medley7/article/89490/ (дата звернення: 02.08.2018).
5. Guilford J.M., Pezzuto J.M. Wine and Health: A Review // American Journal of Enology and Viticulture. 2011. Vol. 62. P. 471-486. DOI: 10.5344/ajev.2011.11013
6. Haseeb S., Alexander B., Baranchuk A. Wine and Cardiovascular Health. A Comprehensive Review // Circulation. 2017. Vol. 136. P. 1434-1448. DOI: 10.1161/CIRCULATIONAHA.117.030387
7. Das D.K., Mukherjee S., Ray D. Resveratrol and red wine, healthy heart and longevity // Heart Failure Reviews. 2010. Vol. 15(5). P. 467-77. DOI: 10.1007/s10741-010-9163-9
8. Resveratrol in primary and secondary prevention of cardiovascular disease: a dietary and clinical perspective / Tomé-Carneiro J., et al. // Annals of the New York Academy of Science. 2013. Vol. 1290. P. 37-51. DOI: 10.1111/nyas.12150
9. Guerrero R.F., García-Parrilla M.C., Puertas B., Cantos-Villar E. Wine, resveratrol and health: a review // Natural Product Communications. 2009. Vol. 4(5). P. 635-658.
10. Effects of resveratrol and other wine polyphenols on vascular function: an update / Gresele P., et al. //The Journal of Nutritional Biochemistry. 2011. Vol. 22(3). P. 201-211. DOI: 10.1016/j.jnutbio.2010.07.004

11. Sancho M., Mach N. Effects of wine polyphenols on cancer prevention // NutricionHospitalaria. 2014. Vol. 31(2). P. 535-551. DOI: 10.3305/nh.2015.31.2.8091
12. Juillière Y., Bosser G., Schwartz J. Wine: Good for all cardiovascular diseases? // La PresseMedicale. 2014. Vol. 43(7-8). P. 852-7. DOI: 10.1016/j.lpm.2014.02.021
13. Flesch M., Morbach S., Erdmann E., Bulut D. Wine consumption and prevention of coronary artery disease // Herz. Cardiovascular diseases. 2016. Vol. 41(6). P. 469-477. DOI: 10.1007/s00059-016-4467-8
14. Fehér J., Lengyel G., Lugasi A. Cultural history of wine, the theoretical background of wine therapy // OrvosiHetilap. 2005. Vol. 146(52). P. 2635-2639.
15. Impact of short-term intake of red wine and grape polyphenol extract on the human metabolome / Jacobs D.M., et al. // Journal of Agricultural and Food Chemistry. 2012. Vol. 60(12). P. 3078-3085. DOI: 10.1021/jf2044247
16. Voloshchuk O.M., Kopylchuk G.P., Mishyna Y.I. Activity of the mitochondrial isoenzymes of endogenous aldehydes catabolism under the conditions of acetaminophen-induced hepatitis // Ukrainian Biochemical Journal. 2018. Vol. 90, N 1. P. 42-47. DOI: 10.15407/ubj90.01.042
17. Державна Фармакопея України. Доповнення 1. 2-е вид. Харків: ДП "Український науковий фармакопейний центр якості лікарських засобів", 2016. 360 с.
18. Методы технохимического контроля в виноделии / под ред. Гержиковой В.Г. Симферополь: Таврида, 2002. 260 с.
19. Крусір Г.В., Соколова І.Ф. Тверді відходи – екологічні аспекти виноробного підприємства // Екологічна безпека. 2012. №2(14). С. 112-115.
20. Friedman M. Antibacterial, antiviral, and antifungal properties of wines and winery byproducts in relation to their flavonoid content // Journal of Agricultural and Food Chemistry. 2014. Vol. 62(26). P. 6025-6042.
21. Кондратьев Д.В. Разработка способов получения экстрактов из виноградных выжимок и их применение в технологии хлебобулочных изделий профилактического назначения: автореф. дис. … канд. техн. наук: 05.18.01. – Москва: МГУПП, 2009. 23 с.
22. Лозінська Л.М., Семчишин Г.М. Біологічні аспекти неензиматичного глікозилювання // Український біохімічний журнал. 2012. Т. 84, № 5. С. 16-37.

References:

1. Woolf S. H., Aron L. U.S. HealthinInternationalPerspective: ShorterLives, PoorerHealth. -Washington (DC): NationalAcademiesPress (US). 2013. 394 p.: https://www.ncbi.nlm.nih.gov/books/NBK115854/pdf/ Bookshelf_-NBK115854.pdf
2. Enoterapiia – lechenie vinom. Retseptyz dorovia [Internet]. [cited 02 August 2018]. Available from: https://nmedik.org/enoterapiya.html
3. Iorhachova KH, Lebedenko TIe. Khlibobulochni vyroby ozdorovchoho pryznachennia z vykorystanniam fitodobavok. K.: K-Pres; 2015.
4. Enoterapyia – lechenye vynom: ne udovolstvyia rady, a dlia zashchyty zdorovia. Woman.ru. URL: http://www.woman.ru/health/medley7/article/89490/ (data zvernennia: 02.08.2018).
5. Guilford JM, Pezzuto JM. Wine and Health: A ReviewюAmerican Journal of Enology and Viticulture. 2011; 62: 471-486. DOI: 10.5344/ajev.2011.11013
6. Haseeb S, Alexander B, Baranchuk A. Wine and Cardiovascular Health. A Comprehensive Review. Circulation. 2017; 136: 1434-1448. DOI: 10.1161/CIRCULATIONAHA.117.030387
7. Das DK, Mukherjee S, Ray D. Resveratrol and red wine, healthy heart and longevity. Heart Failure Reviews. 2010; 15(5): 467-77. DOI: 10.1007/s10741-010-9163-9
8. Tomé-Carneiro J, et al. Resveratrol in primary and secondary prevention of cardiovascular disease: a dietary and clinical perspective. Annals of the New York Academy of Science. 2013; 1290: 37-51. DOI: 10.1111/nyas.12150
9. Guerrero RF, García-Parrilla MC, Puertas B, Cantos-Villar E. Wine, resveratrol and health: a review. Natural Product Communications. 2009; 4(5): 635-658.
10. Gresele P, et al. Effects of resveratrol and other wine polyphenols on vascular function: an update. The Journal of Nutritional Biochemistry. 2011; 22(3): 201-211. DOI: 10.1016/j.jnutbio.2010.07.004
11. Sancho M, Mach N. Effects of wine polyphenols on cancer prevention. NutricionHospitalaria. 2014; 31(2): 535-551. DOI: 10.3305/nh.2015.31.2.8091
12. Juillière Y, Bosser G, Schwartz J. Wine: Good for all cardiovascular diseases? La PresseMedicale. 2014; 43(7-8): 852-7. DOI: 10.1016/j.lpm.2014.02.021
13. Flesch M, Morbach S, Erdmann E, Bulut D. Wine consumption and prevention of coronary artery disease. Herz. Cardiovascular diseases. 2016; 41(6): 469-477. DOI: 10.1007/s00059-016-4467-8
14. Fehér J, Lengyel G, Lugasi A. Cultural history of wine, the theoretical background of wine therapy. OrvosiHetilap. 2005; 146(52): 2635-2639.
15. Jacobs DM, et al. Impact of short-term intake of red wine and grape polyphenol extract on the human metabolome. Journal of Agricultural and Food Chemistry. 2012; 60(12): 3078-3085. DOI: 10.1021/jf2044247
16. Voloshchuk OM, Kopylchuk GP, Mishyna YI. Activity of the mitochondrial isoenzymes of endogenous aldehydes catabolism under the conditions of acetaminophen-induced hepatitis. Ukrainian Biochemical Journal. 2018;90(1).42-47. DOI: 10.15407/ubj90.01.042
17. Derzhavna Farmakopeia Ukrainy. Dopovnennia 1. 2nd ed. Kharkiv: DP "Ukrainskyi naukovyi farmakopeinyitsentryakostilikarskykhzasobiv"; 2016.
18. Gerzhikova VG, editor. Metodytekhnokhimicheskogokontrolia v vinodelii. Simferopol: Tavrida; 2002.
19. Krusir HV, Sokolova IF. Tverdividkhody – ekolohichniaspektyvynorobnohopidpryiemstva. Ecological safety. 2012; 2(14): 112-115. DOI: 10.1021/jf501266s
20. Friedman M. Antibacterial, antiviral, and antifungal properties of wines and winery byproducts in relation to their flavonoid content. Journal of Agricultural and Food Chemistry. 2014; 62(26): 6025-6042. DOI: 10.1021/jf501266s
21. Kondratev D.V. Razrabotka sposobov poluchenііa ekstraktov iz vinogradnyh vyzhimok I ih primenenie v tehnologii hlebobulochnyh izdeliy profilakticheskogo naznacheniia. Moscow: MSUFP; 2009.
22. Lozinska LM, Semchyshyn HM. Biolohichniaspektyneenzymatychnohohlikozyliuvannia. Ukrainian Biochemical Journal. 2012; 84(5): 16-37.

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