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THE CURRENT STATE AND TRENDS OF PROCESSING SECONDARY RAW MATERIALS OF WINEMAKING IN UKRAINE

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Abstract. The current state of processing secondary raw materials of winemaking in Ukraine has been analysed. It has been shown that these materials are a rich source of bioactive compounds. This allows using them to manufacture a wide range of products (oenological tannin, food oenocolourant, polyphenolic extracts, tartaric acid, beverages, grape oil, vitamin D, protein, animal feed, food powder, fertilisers, abrasive materials, etc.) with high consumer value for various industries: food, pharmaceutical, perfume and cosmetics, chemical, compound feed, etc. In the light of modern views, phenolic compounds contained in large quantities in grape stems and pomace have been shown to be indispensable factors in nutrition and treatment. It has been noted that in today's Ukraine, there are no specialised enterprises for complex processing of secondary raw materials of winemaking. In particular, unprocessed grape stalks and pomace are in most cases uncontrollably carried away to farmlands. This leads to acid erosion of the soil and to polluting the environment by micromycete metabolites, which but exacerbates one of mankind's global problems, the environmental one. It has been concluded that traditional domestic technologies of processing secondary raw materials of winemaking are technologically, economically, and environmentally ineffective. There is no comparative analysis of innovative domestic and foreign technologies and equipment for processing secondary raw materials of winemaking. Modern innovations to obtain bioactive additives and other products cannot be introduced, since there is no necessary home-manufactured equipment, and imported machines are too expensive. Besides, there is but weak interaction among wineries, research institutions, business structures, and administrative authority. Cluster ideology has been suggested as a basis to organise comprehensive processing of secondary raw materials of winemaking in Ukraine. This will unite the interests of wineries (producers of secondary raw materials), processing enterprises (manufacturers of products from secondary raw materials), research institutions, and potential consumers of innovative products.

Keywords: grapes, stalks, pomace, phenolic compounds, complex processing of secondary raw materials of winemaking, cluster.

Introduction. Formulation of the problem

The problem of full and rational use of secondary material resources of the food industry exists in all countries where this industry is developed enough. This problem is constantly paid attention to at conferences and congresses at various levels, and various approaches are suggested to change the situation radically. The global trend the world's scientific community proclaims for development of the food and processing industry is the maximum utilisation of raw materials, involvement of secondary material resources in the production cycle, and, consequently, minimisation of waste and prevention of its generation. At the current stage of development of food technologies, the traditional term "waste" should give way to the term "secondary material resources," as engineering and technological innovations allow processing them completely to manufacture valuable food ingredients. When processing grapes into wine, secondary raw materials are formed (viewed in Ukraine, in fact, as waste). The most significant of them, in terms of volume and value, are stems, or stalks, and pomace, the share of which is 15–20%. Due to the anatomical features of grapes and to modern low-impact processing technologies, the secondary winemaking raw material is richer in bioactive compounds (phenolic compounds, minerals, nitrogenous substances, lipids, etc.) than grapes and wine are. Despite the undeniable value and significant volumes, currently in Ukraine, there are no specialised enterprises for complex processing of secondary raw materials of winemaking. In particular, untreated grape stalks and pomace are in most cases uncontrollably carried away to farmlands. This leads to acid erosion of the soil and to polluting the environment by micromycete metabolites, which but exacerbates one of mankind's global problems, the environmental one. Traditional domestic technologies of processing secondary raw materials of winemaking were developed way back in the Soviet times and are now technologically, economically, and environmentally ineffective. There is no comparative analysis of innovative domestic and foreign technologies and equipment for processing secondary raw materials of winemaking. At present, there are a number of scientific developments to obtain valuable products from secondary winemaking raw materials, but they cannot be introduced, since there is no necessary home-manufactured equipment, and imported machines are too expensive. Another restraint is weak interaction among wineries, research institutions, business structures, and administrative authority. Processing of secondary raw materials of winemaking into products with high biological and consumer value is an important scientific and practical problem. Its effective solution is a strategic direction to use rationally the limited raw material resources and to protect the environment.

The purpose of the study: analysis of the current state and trends of processing secondary raw materials of winemaking in Ukraine.

Objectives of the study: 1) analysis of the qualitative and quantitative composition of grapes and secondary raw materials of winemaking; 2) determining the range and technology of products that can be obtained from secondary raw materials of winemaking; 3) giving reasons that cluster ideology can be the basis to organise complex processing of secondary raw materials of winemaking.

Analysis of recent research and publications

Analysis of qualitative and quantitative composition of grapes and secondary raw materials of winemaking. Studies by domestic and foreign scientists, such as M. Amerin, V. Arasimovich, S. Baltago, G. Valuyko, S. Durmishidze, A. Merzhanian, N. Ponomareva, M. Prostoserdov, M. Razuvaev, F. Davitaya, etc., fundamentally analyse the quantitative and qualitative composition of grapes and secondary raw materials of winemaking. According to the scientists' research, in the composition of grapes (the main raw material for winemaking), the following structural elements can be identified: stalks, skins, seeds, and pulp, the ratio of which varies considerably and depends on the variety, ecological, geographical, and agronomic factors of growth, meteorological conditions of the year, etc. [1-2].

For the above reasons, a general characteristic of the chemical composition of individual structural elements of a grape bunch is but a rough estimation. It is presented in Table 1.

As follows from Table 1, the content of compounds in individual structural elements of grapes ranges quite widely. Pulp, the structural element most valuable for winemaking (it produces the bulk of grape juice which is then converted into wine), contains most glucose and fructose.

Table 1 – Chemical composition of individual structural elements of a grape bunch [3]

Component	Mass fraction (%) of compounds in			
	stalks	skins	seeds	pulp
Water	55–80	65–75	30–45	65–85
Monosaccharides: pentoses, including pentosans	1.0–2.8	1.0–1.2	3.9–4.5	0.2–0.5
hexoses (glucose, fructose)	Traces	Little	Traces	10–30
Polysaccharides:				
sucrose	–	–	–	0.06–3.9; in American varieties, up to 5, in some Michurin's cultivars, up to 7.3
starch	Traces	–	–	In green grapes. Little
cellulose	5	3.5–4.0	28	Traces
pectin compounds, gums and mucilage	0.7	0.9	–	0.1–0.3
Acids:				
tartaric	Traces	very little	–	0.4–1.0
malic	0.05–0.3	–	–	0.1–1.5
Phenolic compounds	1.0–5.4	0.5–4.0	1.8–8.5	Traces
Enzymes	Limited quantities			
Vitamins	Small quantities			
Nitrogen-containing compounds	0.7–2.2	0.8–1.9	4–6	0.2–0.5
Aromatic compounds	–	Traces	Traces	Traces
Lipids	–	0.1	8–20	–
Minerals	1–2	0.5–1.0	1.2–2.9	0.2–0.6

The second highest is the content of organic acids in the pulp, mainly malic and tartaric. Stems, skins, and seeds, which are secondary raw materials of winemaking, contain very little or no glucose and fructose. Their most characteristic feature is the presence of many phenolic compounds with a wide range of physiological activity [4-9]. Scientists call phenolic compounds a wonder of the plant kingdom. They are only synthesised in plants and microorganisms. Phenolic compounds are active cellular metabolites and affect various physiological functions of plants, humans, and animals. Numerous studies confirm that phenolic compounds can prevent cardiovascular disease, especially coronary artery disease and stroke, which is one of the main causes of premature death and incapacity for work in economically developed countries [6,10]. Phenolic compounds are the strongest antioxidants known. Epidemiological studies show that high antioxidant intake can reduce the occurrence of cardiovascular diseases. However, today, even in economically developed countries, only a small proportion of the population (for example, about 9% of Americans) consumes enough vegetables, fruit, and other food products every day to maintain the body's required antioxidant status. Products high in antioxidants normalise and maintain this status and reduce or prevent the occurrence of cardiovascular and other diseases of civilisation. Antioxidant properties of plant phenolic compounds are the basis of their interaction with ascorbic acid (vitamin C) [10]. Maintaining the right level of ascorbic acid in the body is not easy. Ascorbic acid is easily oxidised and eliminated from the body without accumulating in organs and tissues. Thus, taking this vitamin in the form of tablets is ineffective. In recent years, it has been found that phenolic compounds protect ascorbic acid from oxidation in fresh fruit, in solutions (for example, in juices), and in the very body [5,6,10]. That is why it is only in the season when vegetables and fruit are rich in both phenolic compounds and ascorbic acid that the body receives the latter in sufficient quantities. Through all the rest of the year, from late autumn to late spring, vitamin C is clearly lacking. Phenolic compounds in the animal body significantly increase the accumulation of ascorbic acid in the adrenal glands, liver, and other organs, and at the same time slow down its elimination from the body. The peculiarities of the action of phenolic compounds on mammals allow classifying them as low toxicity compounds [5,6]. With plant foods, large quantities of these substances constantly enter the human body. There, they affect not only the capillaries, but also the function of the digestive tract and liver, the heart and blood vessels, the blood pressure and blood clotting, the activity of endocrine glands and of various enzymes [5,6,8,10]. The knowledge of the main manifestations of the biological action of phenolic compounds has already revealed significant prospects for their practical application. They can be used as physiological nutritive factors, as preventers of and remedies for infections, intoxications, blood diseases, hypertension, rheumatism, cancer, diabetes, as food preservatives and antioxidants, as antisclerotics, antimutagens, antimicrobial and antiviral agents. They can serve as desensitising, antitoxic, hepatoprotective, anti-inflammatory, and antiulcer medications, as radioprotectives, antitumour and choleretic compounds, as ones inhibiting hyperthyroidism, as photosensitisers and stimulators of adrenal glands. This list of possible applications of plant phenolic compounds is far from complete [5,6,8, 10].

In the Ukrainian wine industry, the use of grapes as raw materials for the main product (wine) never exceeds 75–76%. The share of secondary raw materials, mainly in the form of grape stems and pomace (seeds, skins, pulp residues) is 15–20%. On average, 1 tonne of grapes yields 75–76 dal of must (freshly squeezed juice for wine production), 35kg of stalks, and 130–140kg of pomace (dense residue of solid parts of grapes which is formed after the must is isolated). The latter includes 30kg of seeds and 86–92 kg of skins [2]. In 2019, 124.2 thousand tonnes of grapes were processed into wine materials in Ukraine [11]. The primary and secondary raw materials of winemaking obtained in Ukraine in 2019, with their volumes indicated, are listed in Table 2.

Table 2 – Products of processing grapes into wine materials in Ukraine in 2019 [2,11]

Raw materials	Quantity, thousand tonnes
Basic raw material	
Grapes, thousand tonnes	124.2
Secondary raw materials	
Stalks, thousand tonnes	4.3
Pomace, thousand tonnes	16.1–17.4
Seeds, thousand tonnes	3.7
Skins, thousand tonnes	10.6–11.5

Analysis of the above data allows us to conclude that stalks, skins, and seeds (secondary raw materials of winemaking) are high in phenolic and nitrogen compounds, minerals, and lipids (Table 1), and make up a significant proportion of the grapes processed (Table 2). This makes it necessary to involve them in the production cycle in order to minimise waste, prevent its generation, and obtain from them food ingredients and products highly valuable to a number of sectors of the economy [2].

Determining the range and technology of products that can be obtained from secondary raw materials of winemaking. Examples of products that can be obtained from secondary raw materials of winemaking are given in Table 3.

Table 3 – Products of processing secondary raw materials of winemaking [2,12]

Secondary raw materials	Products of processing secondary raw materials of winemaking (their content in raw materials)
Stalks	Oenological tannin (0.22–2.5%), polyphenolic extracts, tartaric acid, beverages, fertilisers
Pomace	Ethanol, tartaric acid, carbohydrates, polyphenolic extracts, beverages, melanin
Seeds	Grape oil (9.9–17.9%), oilcake, vitamin D, animal feed, food powder, abrasives, oenological tannin (0.31–5.6%), polyphenolic extracts, melanin, protein (8.2%)
Skins	Polyphenolic extracts, oenological tannin (0.15–4.2%), food oenocolourant, melanin, animal feed, fertilisers

In the Soviet times, scientists from the Scientific Research Institute of Vineyards and Wine *Maharach*, in co-operation with manufacturers, developed process flows allowing complex processing of secondary raw materials of winemaking [2]. One of those is charted in Fig. 1.

According to this chart, fermented pomace is subjected to direct distillation in distillers of various types to yield raw alcohol. After its purification, vodka is produced. Distilled pomace, after separation of the vinasse, is covered with an acid solution and boiled a second time to extract tartaric acid.

The resulting tartaric acid solution is neutralised, and the calcium tartrate (tartaric lime) formed is used to manufacture tartaric acid and its salts in specialised plants. Grape seeds and skins are separated from the washed and dried pomace. After the seeds are dried and crushed, grape seed oil is extracted from them, which is further refined. This oil has extreme biological value and is in high demand, but the lack of appropriate technological solutions and organisation makes it too costly to be competitive and narrows the range of its applications [12].

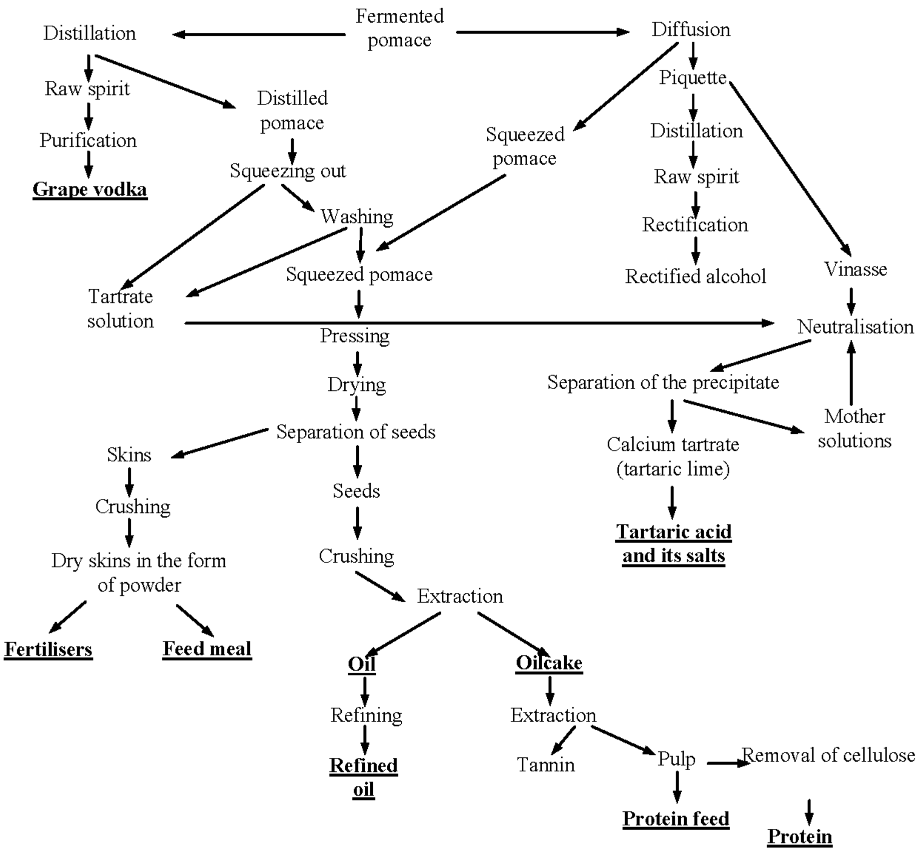

Fig. 1. Flowchart of complex processing of fermented grape pomace [2]

A new direction of grape seed processing, which has recently been developed abroad, is the production of bioactive additives. Further expansion of application areas of grape seeds is strongly associated with a comprehensive approach to their processing based on innovative technological solutions.

Tannin is obtained from seed cake by extraction, and the dry residue (pulp) is used as protein feed for animals.

Skins are ground to obtain powder and used as feed meal or a fertiliser.

Besides direct distillation of fermented pomace, diffusion is used as a method to extract alcohol. It is carried out with acidified water, and alcohol is distilled from the resulting piquette (aqueous extract of the pomace). Part of the vinasse remaining after distillation of the piquette is neutralised, calcium tartrate is precipitated, and tartaric acid is obtained. After extraction, the pomace is squeezed by pressing. The squeezed-out liquid is returned for enrichment, and the pomace is dried. The skins are ground to obtain feed meal and used to manufacture compound feed or as animal feed in combination with other feeds. If the feed meal is pelletised, pelleted feed is obtained.

Dried seeds are used to make grape oil for food and medicinal purposes. The extraction method allows obtaining grape seed oil used both as food and for technical purposes, and tannin can be obtained at the same time. Pulp is used as protein feed for animals. Hydrolysing the extraction cake results in furfural. Traditionally, seeds are separated from dried pomace and cleaned of impurities. Separation of grape seeds from wet pomace is carried out on seed separators, which are usually grain cleaning machines of various designs. Cyclones are used to separate grape seeds from dried pomace. Dry seeds must be further purified in a cleaner, which removes large portions of pomace and other impurities remaining on the separated seeds. The inadequate design of devices that separate seeds from dried pomace is one of the reasons for the small volumes of separated seeds. It is more efficient to separate seeds from wet grape pomace [2,12-13].

To manufacture food anthocyanin (grape colourant), the most suitable material is sweet (unfermented) stalk-free pomace from intensively coloured grape varieties. An extract from the pomace is then evaporated in a vacuum apparatus, and a concentrate is thus obtained [2,13].

I. Matchina, A. Buzni, M. Razuvaev, Y. Lebedinsky, L. Chernyuk, L. Ganechko, etc. have analysed the above technologies and equipment for recycling secondary raw materials and found them inadequate, too energy-intensive, and economically inefficient. For this reason, as well as due to lack of adequate production capacities and equipment, and too big time gaps between the main grape processing operations, these technologies were considered inefficient and sometimes unprofitable, so they are no longer used in production [2,12-13].

Not all wine-producing countries practise complex processing of secondary raw materials to produce alcohol, seeds, animal feed, anthocyanin, bioactive additives. The highest level of recycling secondary winemaking raw materials is in Italy [13].

Technologies of processing secondary raw materials of winemaking differ but little from country to country. Throughout the world, the main applications of secondary raw materials of winemaking are their artisanal distillation to obtain grape vodka (like grappa in Italy and rakia in Bulgaria) and industrial distillation to obtain grape alcohol or vodka. Industrial processing of secondary raw materials of winemaking, besides alcohol, yields tartaric acid, tartaric compounds, seeds, grape oil [13,15].

N. Ageeva, G. Zaiko, L. Donchenko, D. Kasyanov, O. Kvasenkov, Yu. Gaponenko, S. Butova, T. Ismailov, N. Shcheglov, T. Isrigova, Yu. Ogai, V. Zagoruyko, V. Chernousova, A. Ptitsyn, E. Mukhtarov, N. Musaeva, L. Vlashchik, A. Sidorenko, V. Perevertkina, M. Islamov, M. Bondakova, L. Katrich, L. Osipova, S. Lozovska, G. Arpentin, B. Gaina, G. Kobirman, G. Brenner-Weiss, M. Franzreb, M. Nusser, R. P. Metivier, P. Tataridis, K. Apostolopoulos, and others researched the development of the newest technologies of processing secondary raw materials, including those used in winemaking.

Most scientists focus on studying the composition of grape pomace, in order to obtain extracts and oil from it, on determining how efficiently phenolic compounds are extracted [16-43], on their identification and establishing their bioactivity [44-47].

A lot of foreign and domestic studies consider how to use secondary raw materials of winemaking to produce flavourings [48], enzyme preparations [49], medicines and cosmetics [50-51], bioactive additives [52-53].

Some technologies of processing secondary raw materials of winemaking are aimed at obtaining extracts for their further use in the production of wines, beverages [54-55], confectionery [56], or in therapeutic and prophylactic nutrition [57].

Manufacturers from France, Italy, Bulgaria, and other countries use grape seeds to obtain fodder, food powder, abrasives (fine-grained high-hardness substances used to treat metal, wooden, etc. surfaces), oenological tannin, and grape seed oil. The latter, due to its high concentration of polyunsaturated fatty acids, in particular linoleic acid, is more nutritious than sunflower, soya bean, and maize oils. When grape oil is exposed to ultraviolet radiation, vitamin D is produced [2,12,13].

Oenological tannin is used to make bioactive substances, drugs, cosmetics, products stimulating the growth of crops [13,58-59].

Waste-free technology for processing by-products of winemaking is introduced in Bulgaria. The Bulgarian association *Vinprom* has special recycling shops in the areas where white grapes are mainly grown, which deal with extraction of sugar from sweet pomace, separation of grape seeds and their drying. The extracted pomace is supplied to the enterprises of the agricultural complex where livestock are fattened. In the areas where red grape varieties are mainly grown, grape pomace is comprehensively processed, and anthocyanin, feed meal, and calcium tartrate are obtained annually [2,13].

Currently, revival and organisation of complex processing of secondary raw materials of winemaking in Ukraine are hampered by the lack of systematic research on its microbial and toxicological composition, the lack of comparative analysis of modern technologies and equipment in order to select the best options, the lack of home-made equipment and high cost of imported machines, the lack of funds at individual wineries to solve this problem. Poor co-operation of scientific and educational institutions, manufacturers, business organisations, legislative and executive authorities prevents developing and introducing technologies of making innovative products from secondary raw materials of winemaking [2,12,14].

Proving the feasibility of organising complex processing of secondary raw materials of winemaking on the basis of cluster ideology. In order to solve effectively the current problems related to complex processing of secondary raw materials of winemaking in Ukraine, it is necessary to unite wineries in specialised clusters, which may include enterprises of different activity profiles (grape growing, industrial processing, wine and distillate production, processing of valuable secondary raw materials: seeds, pomace, skins, tartaric acid salts, lees, etc.).

Clusters are geographically concentrated groups of interdependent enterprises, specialised service providers, firms in relevant industries, and organisations related to their activities: universities, research institutes, standardisation agencies, trade associations, and others. Clusters often include companies dealing with distribution channels and consumers, manufacturers of additional products, Internet providers, government bodies and other organisations responsible for special training, information flow, research and standardisation, industrial associations and private organisations. Industrial clusters differ in the type of integration and the complexity of their structure [59].

Thus, a cluster is not confined to a certain industry, but comprises several related industries. Its organisational form of interacting and interdependent enterprises offers opportunities to increase the competitiveness of the regional economy and is an important criterion of the development of an economic system or a certain region.

The noteworthy studies in the field of scientific ideology of clustering include works by such domestic and foreign scientists as S. Sokolenko, M. Voynarenko, V. Dubnytsky, V. Zakharchenko, V. Osipov, O. Ermakova, S. Kara, S. Kuraksina, M. Porter, A. Marshall, K. Budry, S. Breschi [59]. However, there are no similar studies specifically devoted to the field of grape processing.

In Ukraine, the prerequisites for the formation of a cluster for processing secondary raw materials of winemaking are the following:

– significant volumes of secondary raw materials of winemaking;

– lack of domestic enterprises for their processing;

– high economic efficiency of production.

Interaction among cluster members is based on long-term contracts. Auxiliary members of a cluster (transport, marketing, research, and other enterprises) receive income from their core activities and are interested in the interaction within a cluster, because it allows them to find new consumers of their services. The mechanisms of profit distribution between the founder enterprises of a cluster can vary depending on its organisational schemes.

Specialised enterprises (production shops) where secondary raw materials of winemaking are prepared for further processing (e. g. stalks, seeds, and skins are dried and packaged) should become new zones. They are to be located in the centre of regions (with a radius of 50–70km) where there are large winemaking enterprises and primary winery stations with a production capacity of up to 500 tonnes of grapes a day.

Complex processing of secondary raw materials of winemaking is also possible on the basis of combining specialised shops with large wineries.

Construction of one specialised enterprise (production shop) instead of several recycling shops at each winery is much more economical, requires less investment and transportation costs. Such enterprises significantly reduce labour costs, their productivity increases as well as their interest in obtaining the maximum output at the lowest cost, the technology levels up, and there appear opportunities to manufacture a number of innovative products.

With integrated utilisation of secondary raw materials on a more advanced, consolidated technical basis, production will increase, labour intensity reduce, profits rise, profitability of production improve, and cost recovery accelerate.

Abroad, in countries with developed winemaking industries (France, Italy, Spain, and Portugal), processing of secondary raw materials of winemaking tends to be concentrated in large industrial enterprises operating all year round. These enterprises are created on a co-operative basis and serve several dozen wineries [2,13].

The organisation of processing secondary raw materials of winemaking is one of the most important tasks for Ukraine’s wine industry. Worldwide experience shows that it is, primarily, the ability to join forces that makes companies stably competitive. Therefore, creation of clusters aimed at processing secondary raw materials of winemaking is the right way to ensure success in this important sector of Ukraine’s economy.

It should be noted that the domestic legal framework is more permissive towards inappropriate treatment of secondary raw materials than the laws and requirements in Europe and other continents are. Today’s Ukrainian legislation does not oblige enterprises to recycle food waste, while the laws of many European and other countries prohibit dumping waste containing more than 5% of organic matter in landfill sites. These regulations encourage foreign companies to modernise production and introduce scientific and technological innovations into the practice of recycling secondary resources of the food industry. For Ukraine’s entering successfully the field of legal norms of the European Union and the world, the problem of organising the processing of secondary raw materials of winemaking must be solved as soon as possible.

Conclusion

Analysis of the current state of processing secondary raw materials of winemaking proves that it is absent in Ukraine. In particular, grape stalks and pomace are in most cases uncontrollably carried away to farmlands without any special treatment. This leads to acid erosion of the soil and to polluting the environment by micromycete metabolites, which but exacerbates one of mankind's global problems, the environmental one. In terms of volume and chemical composition, secondary raw materials of winemaking are of great value in the manufacture of food, animal feed, and technical products. Of these, the most competitive ones are oenological tannin, food oenocolourant, polyphenolic extracts, tartaric acid, beverages, grape oil, vitamin D, protein, animal feed, food powder, abrasives, and other products with high consumer value for various industries: food, pharmaceutical, perfume and cosmetics, chemical, compound feed. Organization of complex processing of secondary raw materials of winemaking in Ukraine is hampered by the poor technical resources and inefficiency of traditional technologies. Besides, there is but weak interaction among wineries, research institutions, business structures, and administrative authority. It has been suggested to create clusters (associations uniting producers of secondary raw materials of winemaking, processing enterprises that manufacture products from these materials, scientists and potential consumers of innovative products), which will provide comprehensive processing of grapes using innovative solutions.

References:

1. Prostoserdov NN. Izucheniye vinograda dlya opredeleniya yego ispolzovaniya (uvologiya) Moskwa: Pishchepromizdat; 1963.
2. Razuvayev NI. Kompleksnaya pererabotka vtorichnykh produktov vinodeliya. Moskwa: Pishcheprom; 1975.
3. Osipova LA., Rusakov VA. Uglevody vinograda i vina [Internet]. Kyiv: Osvíta Ukraїni; 2012 [citovano 2020 Grud 15]. Dostupno: https://card-file.onaft.edu.ua/jspui/bitstream/123456789/2314/1/Rusakov.pdf
4. Sturua ZSH, Mekhuzla HA. Fenolnyy sostav vinograda i produktov yego pererabotki. Vinograd i vino Rossii. 1997;3:26-28.
5. Zaprometov MN. Fenolnyye soyedineniya: Rasprostraneniye, metabolizm i funktsii v rasteniyakh. Moskwa: Nauka; 1993.
6. Baraboy VA, Zaprometov MN. Rastitelnyye fenolnyye soyedineniya i zdorovye cheloveka. Moskwa: Nauka; 1984.
7. Gonzalez-Centeno MR, Rossello C, Simal S, Garau MC, Lopez, Femenia A. Physico-chemical properties of cell wall materials obtained from ten grape varieties and their byproducts: grape pomaces and stems. LWT – Food Science and Technology. 2010;43(10):1580-1586. https://doi.org/10.1016/j.lwt.2010.06.024
8. Blazhey A, Shutyy L. Fenolnyye soyedineniya rastitelnogo proiskhozhdeniya. Moskwa: Mir;1977.
9. Deng Q, Penner MH, Zhao Y. Chemical composition of dietary fiber and polyphenols of five different varieties of wine grape pomace skins. Food Research International. 2011;44(9):2712-2720. https://doi.org/10.1016/j.foodres.2011.05.026
10. Maksyutina NP. Rastitelnyye antioksidanty, ikh svoystva i ispolzovaniye v profilaktike zabolevaniy. Biologicheski aktivnyye dobavki i bioprodukty. Kiev; 2000.
11. Holovne upravlinnya statystyky v Odeskiy oblasti [Internet]. Upravlinnya informatsiynymy tekhnolohiyamy Holovnoho upravlinnya statystykoyu v Odes′kiy oblasti; Odesa, 2004 [onovleno 2020 Grud 15, citovano 2020 Grud 29]. Dostupno: http://www.od.ukrstat.gov.ua/
12. Lebedinskiy YuP, redactor. Kompleksnoye ispolzovaniye syrya v pishchevoy promyshlennosti. Kiev: Tekhníka; 1983.
13. Razuvayev NI, Byvshev VF. Bessmertnaya TS. Pererabotka otkhodov vinodeliya za rubezhom. Moskwa: TSNIITEIPishcheprom; 1978.
14. Matchina IG, Buzni AN. Winemaking economics. Simferopol: Tavrida; 2003.
15. Kasko SV, Razuvayev NI. Opyt ispolzovaniya vtorichnykh resursov v vinodelcheskoy promyshlennosti. Moskwa: TSNIITEIPishcheprom; 1983.
16. Cai Y, Yu Y, Duan G, LiY. Study on infrared-assisted extraction coupled with high performance liquid chromatography (HPLC) for determination of catechin, epicatcchin, and procyanidin B2 in grape seeds. Food Chemistry. 2011; 127(4):1872-1877. https://doi.org/10.1016/j.foodchem.2011.02.026
17. Xu C, Zhang Y, Wang J, Lu J. Extraction, distribution and characterisation of phenolic compounds and oil in grape seeds. Food Chemistry. 2010;122(3):688-694. https://doi.org/10.1016/j.foodchem.2010.03.037
18. Prado JM, Dalmolin I, Carareto NDD, Basso RC, Meirelles AJA, Oliveira JV, et al. Supercritical fluid extraction of grape seed: Process scale-up, extract chemical composition and economic evaluation. Journal of Food Engineering. 2012;109(2):249-257. https://doi.org/10.1016/j.jfoodeng.2011.10.007
19. Passos CP, Silva RM, Da Silva FA, Coimbra MA, Silva CM. Supercritical fluid extraction of grape seed (Vitis vinifera L.) oil. Effect of the operating conditions upon oil composition and antioxidant capacity. Chemical Engineering Journal. 2010;160(2):634-640. https://doi.org/10.1016/j.cej.2010.03.087
20. Yilmaz EE, Ozvural EB, Vural H. Extraction and identification of proanthocyanidins from grape seed (VitisVinifera) using supercritical carbon dioxide. Journal of Supercritical Fluids. 2011;55(3):924-928. https://doi.org/10.1016/j.supflu.2010.10.046
21. Vatai T, Skerget M, Knez Z, Kareth S, Weliowski M, Weidner E. Extraction and formulation of anthocyanin-concentrates from grape residues. Journal of Supercritical Fluids. 2008;45(1):32-36. https://doi.org/10.1016/j.supflu.2007.12.008
22. Chedea VS, Braicu C, Socaciu C. Antioxidant/prooxidant activity of a polyphenolic grape seed extract. Food Chemistry. 2010;121(1):132-139. https://doi.org/10.1016/j.foodchem.2009.12.020
23. Sidani B, Makris DP. Interactions of natural antioxidants with red grape pomace anthocyanins in a liquid model matrix: stability and copigmentation effects. Chemical Industry and Chemical Engineering Quarterly. 2011;17(1):59-66. https://doi.org/10.2298/CICEQ100701055S
24. Rodriguez-Rodriguez R, Justo ML, Claro CM, Vila E, Parrado J, Herrera MD, et al. Endothelium-dependent vasodilator and antioxidant properties of a novel enzymatic extract of grape pomace from wine industrial waste. Food Chemistry. 2012;135(3):1044-1051. https://doi.org/10.1016/j.foodchem.2012.05.089
25. Lutterodt H, Slavin M, Whent M, Turner E, Yu L. Fatty acid composition, oxidative stability, antioxidant and antiproliferative properties of selected cold-pressed grape seed oils and flours. Food Chemistry. 2011;128(2):391-399. https://doi.org/10.1016/j.foodchem.2011.03.040

26. Sandhu AK, Gu LW. Antioxidant capacity, phenolic content, and profiling of phenolic compounds in the seeds, skin, and pulp of Vitisrotundifolia (Muscadine grapes) as determined by HPLC-DAD-ESI-MS. Journal of Agricultural and Food Chemistry. 2010;58(8):4681-4692. https://doi.org/10.1021/jf904211q.
27. Orhan N, Aslan M, Orhan DD, Ergun F, Yeşilada E. In-vivo assessment of antidiabetic and antioxidant activities of grape vine leaves (Vitisvinifera) in diabetic rats. Journal of Ethnopharmacology. 2006;108(2):280-286. https://doi.org/10.1016/j.jep.2006.05.010
28. Burin VM, Rossa PN, Ferreira-Lima NE, Hillmann MCR, Boirdignon-Luiz MT. Anthocyanins: optimisation of extraction from Cabernet Sauvignon grapes, microcapsulation and stability in soft drink. International Journal of Food and Technology. 2010;46(1):186-193. https://doi.org/10.1111/j.1365-2621.2010.02486.x
29. Khanal RC, Howard LR, Prior RL. Effect of heating on the stability of grape and blueberry pomace procyanidins and total anthocyanins. Food Research International. 2010;43(5):1464-1469. https://doi.org/10.1016/j.foodres.2010.04.018
30. Laroze LE, Moure A, Zuniga ME. Extraction of antioxidants from several berries pressing conventional and supercritical solvents. European Food Research and Technology. 2010;231(5):669-677. https://doi.org/10.1007/s00217-010-1320-9
31. Li Y, Skouroumounis GK, Elsey GM, Taylor DK. Microwave-assistance provides very rapid and efficient extraction of grape seed polyphenols. Food Chemistry. 2011;129(2):570-576. https://doi.org/10.1016/j.foodchem.2011.04.068
32. Rockenbach II, Jungfer E, Ritter C, Santiago-Schubel B, Thiele B, Fett R, et al. Characterization of flavan-3-ols in seeds of grape pomace by CE, HPLC- DAD-MSn and LC-ESl-FTICR-MS. Food Research International. 2012;48(2):848-855. https://doi.org/10.1016/j.foodres.2012.07
33. Hernández-Jiménez A, Gómez-Plaza E, Martínez-Cutillas A, Kennedy JA. Grape skin and seed proanthocyanidins from Monastrell Syrah grapes. Journal of Agricultural and Food Chemistry. 2009;57(22):10791-10803. https://doi.org/10.1021/jf903465p
34. Andersen OM, Markham KR, editods. Flavonoids: chemistry, biochemistry and application. New York: CRC Press; 2005. https://doi.org/10.1201/9781420039443
35. Davidov-Pardo G, Arozarena I, Mann-Arroyo MR. Stability of polyphenolic extracts from grape seeds after thermal treatments. European Food Research and Technology. 2011;232(2):211-220. https://doi.org/10.1007/s00217-010-1377-5
36. Nawaz H, Shi J, Mittal GS, Kakuda Y. Extraction of polyphenols from grape seeds and concentration by ultrafiltration. Separation and Purification Technology. 2006;48(2):176-181. https://doi.org/10.1016/j.seppur.2005.07.006
37. Munoz O, Sepulveda M, Schwartz M. Effects of enzymatic treatment on anthocyanic pigments from grapes skin from Chilean wine. Food Chemistry. 2004;87(4):487-490. https://doi.org/10.1016/j.foodchem.2003.12.024
38. Sun B, Ribes AM, Conceigdo ML, Belchior AP, Spranger MI. Stilbenes: Quantitative extraction from grape skins, contribution of grape solids to wine and variation during wine maturation. 4 Symposium in Vino Analytica Scientia, Montpellier, 7-9 July, 2005. Analytica Chimica Acta. 2006;563(1-2):382-390. https://doi.org/10.1016/j.aca.2005.12.002
39. Garcia-Marino M, Rivas-Gonzalo JC, Concepción García-Moreno EC. Recovery of catechins and proanthocyanidins from winery by-products using subcritical water extraction. 4 Symposium in Vino Analytica Scientia, Montpellier, 7-9 July, 2005. Analytica Chimica Acta. 2006;563(1-2):44-50. https://doi.org/10.1016/j.aca.2005.10.054
40. Vatai T, Skerget M, Knez Z, Kareth S, Weliowski M, Weidner E. Extraction and formulation of anthocyanin-concentrates from grape residues. Journal of Supercritical Fluids. 2008;45(1):32-36. https://doi.org/10.1016/j.supflu.2007.12.008
41. Jin Z-M, Bi H-Q, Liang N-N, Duan C-Q. An extraction method for obtaining the maximum non-anthocyanin phenolics from grape berry skins. Anal. Lett. 2010;43(5):776-785. https://doi.org/10.1080/00032710903486351
42. Spigno G, Tramelli L, De Faveri DM. Effects of extraction time, temperature and solvent on concentration and antioxidant activity of grape marc phenolics. Journal of Food Engineering. 2007;81(4):200-208. https://doi.org/10.1016/j.jfoodeng.2006.10.021
43. Rubio M, Álivarez-Ortí M, Pardo JE. A review on the utilization of grape seed oil as an alternative to conventional edible vegetable oils. Riv. ital. sostanzegrasse. 2009;84:121-129.
44. Luther M, Parry J, Moore J, Meng J, Zhang Y, Cheng Z, et al. Inhibitory effect of Chardonnay and black raspberry seed extracts on lipid oxidation in fish oil and their radical scavenging and antimicrobial properties. Food Chemistry. 2007;104(3):1065-1073. https://doi.org/10.1016/j.foodchem.2007.01.034
45. Liobera A, Canellas J. Dietary fibre content and antioxidant activity of Manto Negro red grape (Vitis vinifera): pomace and stem. Food Chemistry. 2007;101(2):659-666. https://doi.org/10.1016/j.foodchem.2006.02.025
46. Yildirim HK, Akcay YD, Guvenc U, Altindisli A, Sozmen EY. Antioxidant activities of organic grape, pomace, juice, must, wine and their correlation with phenolic content. International Journal of Food Science and Technology. 2005;40(2):133-142. https://doi.org/10.1111/j.1365-2621.2004.00921.x
47. Halliwell B, Gutteridge JMC. Free Radicals in Biology and Medicine. 2 ed. Oxford: Clarendon Press; 1989.
48. Duan JM, Zeng XY, Liu YY , Zhe W, Zhou LJ, Bao CY, et al. Preparation of Grape Pomace as Cigarette Flavor by Biological Fermentation and the Analysis of Volatile Composition. Fine Chemicals [Internet]. 2009;26(8):781-784. Available from: https://en.cnki.com.cn/Article_en/CJFDTOTAL-JXHG200908019.htm
49. Couto SR, Sanroman MA. Utilisation of grape seeds for laccase production in solid-state fermentors. Journal of Food Engineering. 2006;74(2):263-267. https://doi.org/10.1016/j.jfoodeng.2005.03.004
50. Zuyeva TA. Razrabotka malootkhodnoy tekhnologii pererabotki semyan vinograda i polucheniye na ikh osnove lekarstvennykh i kosmeticheskikh sredstv [avtoref. dis. kand. farm. n.]. Pyatigorsk; 2004. Available from: https://static.freereferats.ru/_avtoreferats/01004064437.pdf
51. Bokshan EV, Darmogray RE., Dzera V, Choliy LF, Stein T. Maslo iz kostochek vinograda – perspektivnoye syrye dlya farmatsevticheskoy i kosmeticheskoy produktsii. Provizor. 2000;5:42-43. Available from: www.provisor.com.ua/archive/2000/№ 5/oil.php
52. Aleshin VN, Nazarko MD, Stepuro MV, Shcherbakov VG. Otkhody vinodeliya – perspektivnoye syrye dlya polucheniya biologicheski aktivnykh veshchestv. Izvestiya Vuzov. Pishchevaya Tekhnologiya. 2011;1:7-9.
53. Sadovoy VV, Selimoye MA, Aralina AA. Polucheniye pishchevoy dobavki iz vinogradnykh vyzhimok. Izvestiya Vuzov. Pishchevaya Tekhnologiya. 2011;5-6:41-43. Available from: http://journalkubansad.ru/pdf/20/02/09.pdf
54. Pedroza MA, Carmona M, Salinas MR. Use of dehydrated waste grape skins as a natural additive for producing rose wines: Study of extraction conditions and evolution. Journal of Agricultural and Food Chemistry. 2011;59(20):10976-10986. https://doi.org/10.1021/jf202626v
55. Mateus N, Pinto R, Ruao P, De Freitas V. Influence of the addition of grape seed procyanidins to Port wir in the resulting reactivity with human salivary proteins. Food Chemistry. 2004;84(2):195-200. https://doi.org/10.1016/S0308-8146(03)00201-2
56. Kondratyev DV, Shcheglov MG. Sposoby polucheniya ekstrakta iz vinogradnykh vyzhimok i vozmozhnosti yego ispolzovaniya v pishchevoy promyshlennosti. Izvestiya Vuzov. Pishchevaya Tekhnologiya. 2009;1:62-64.
57. Katrich LI. Razrabotka tekhnologii proizvodstva biologicheski aktivnykh produktov iz vinogradnoy vyzhimki [avtoref. dis. kand. tekhn. nauk]. Yalta: NIVV «Magarach»; 2014.
58. Goodwin TW, editor. Chemistry and biochemistry of plant pigments. London: Academic Press; 1976.
59. Sokolenko SI. Klastery v hlobalniy ekonomitsi. Kiev: Logos; 2004.

СТАН І ПЕРСПЕКТИВИ ПЕРЕРОБКИ ВТОРИННОЇ СИРОВИНИ ВИНОРОБСТВА В УКРАЇНІ

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Анотація. Наведено аналіз сучасного стану переробки вторинної сировини виноробства в Україні. Показано, що остання є багатим джерелом біологічно активних сполук, що обумовлює можливість її використання для виробництва широкого асортименту продуктів (енотаніну, харчового енобарвника, поліфенольних екстрактів, винної кислоти, напоїв, виноградної олії, вітаміну D, білка, кормів для тварин, харчового порошку, добрив, абразивних матеріалів то що) з високою споживчою цінністю для різних галузей промисловості: харчової, фармацевтичної, парфумерно-косметичної, хімічної, комбікормової та ін. У світлі сучасних доглядів показана роль фенольних сполук, що містяться у великих кількостях у виноградних гребенях та вичавках, як незамінних факторів харчування та лікування. Відзначено, що на даний час в Україні відсутні спеціалізовані підприємства з комплексної переробки вторинної сировини виноробства. У переважній більшості випадків, зокрема, виноградні гребені і вичавки безконтрольно вивозять на сільськогосподарські угіддя без спеціальної обробки, що призводить до кислотної ерозії ґрунтів та забруднення навколишнього середовища метаболітами мікроміцетів, посилюючи одну з глобальних проблем людства – екологічну. Зроблено висновок про те, що традиційні вітчизняні технології переробки вторинної сировини виноробства не ефективні з технологічної, економічної та екологічної точки зору; відсутній порівняльний аналіз інноваційних вітчизняних і зарубіжних технологій та обладнання для переробки вторинної сировини виноробства; впровадження сучасних інноваційних розробок отримання біологічно активних добавок та інших продуктів неможливе в зв'язку з відсутністю вітчизняного та дороженчею імпортного обладнання; слаба взаємодія між виноробними підприємствами, науковими установами, бізнесом та адмінресурсом. Запропонована організація комплексної переробки вторинної сировини виноробстві в Україні на основі кластерної ідеології, реалізація якої дозволить об'єднати інтереси виноробних підприємств (виробників вторинної сировини), переробних підприємств (виробників продуктів із вторинної сировини), наукових установ і потенційних споживачів інноваційної продукції.

Ключові слова: виноград, гребені, вичавки, фенольні сполуки, комплексна переробка вторинної сировини виноробства, кластер.

Список літератури:

1. Простосердов Н.Н. Изучение винограда для определения его использования (увология) М.: Пищепромиздат. 1963. 79 с.
2. Разуваев Н. И. Комплексная переработка вторичных продуктов виноделия. М.: Пищепром. 1975. 121 с.
3. Осипова Л.А., Русаков В.А. Углеводы винограда и вина. Київ: Освіта України. 2012. 140 с.
4. Струра З.Ш., Мехузла Н.А. Фенольный состав винограда и продуктов его переработки // Виноград и вино России. 1997. № 3. С. 26-28.
5. Запрометов М.Н. Фенольные соединения: Распространение, метаболизм и функции в растениях. М.: Наука. 1993. 272 с.
6. Барабой В.А., Запрометов М.Н. Растительные фенольные соединения и здоровье человека. М.: Наука. 1984. 160 с.
7. Physico-chemical properties of cell wall materials obtained from ten grape varieties and their byproducts: grape pomaces and stems / Gonzalez-Centeno M.R. et al // LWT Food Science and Technology. 2010. Vol. 43, Issue 10. P. 1580-1586. https://doi.org/10.1016/j.lwt.2010.06.024
8. Блажей А., Шутый Л. Фенольные соединения растительного происхождения. М.: Мир. 1977. 239 с.
9. Deng Q., Penner M.H., Zhao Y. Chemical composition of dietary fiber and polyphenols of five different varieties of wine grape pomace skins // Food Research International. 2011. Vol. 44, Issue 9. P. 2712-2720. https://doi.org/10.1016/j.foodres.2011.05.026
10. Максютина Н.П. Растительные антиоксиданты, их свойства и использование в профилактике заболеваний // Биологически активные добавки и биопродукты. К. 2000. С. 9-21.
11. Головне управління статистики в Одеській області: [Веб-сайт] Одеса, 2019 URL: http://www.od.ukrstat.gov.ua/ (дата звернення: 29.12.2020).
12. Комплексное использование сырья в пищевой промышленности / Ю.П. Лебединский и др. К.: Техніка. 1983. 143 с.
13. Разуваев Н.И., Бывшев В.Ф., Бессмертная Т.С. Переработка отходов виноделия за рубежом. М.: ЦНИИТЭИПищепром. 1978. 17 с.
14. Матчина И.Г., Бузни А.Н. Экономика виноделия. Симферополь: Таврида. 2003. 256 с.
15. Касько С.В., Разуваев Н.И. Опыт использования вторичных ресурсов в винодельческой промышленности. М.: ЦНИИТЭИПищепром. 1983. Вып. 4. 32 с.
16. Study on infrared-assisted extraction coupled with high performance liquid chromatography (HPLC) for determination of catechin, epicatechin, and procyanidin B2 in grape seeds / Cai Yi et al // Food Chemistry. 2011. Vol. 127, Issue 4. P. 1872-1877. https://doi.org/10.1016/j.foodchem.2011.02.026
17. Extraction, distribution and characterization of phenolic compounds and oil in grape seeds / Xu Changmou et al // Food Chemistry. 2010. Vol. 122, Issue 3. P. 688-694. https://doi.org/10.1016/j.foodchem.2010.03.037
18. Supercritical fluid extraction of grape seed: Process scale-up, extract chemical composition and economic evaluation / Juliana M. Prado et al // Journal of Food Engineering. 2012. Vol. 109, Issue 2. P. 249-257. https://doi.org/10.1016/j.jfoodeng.2011.10.007
19. Supercritical fluid extraction of grape seed (Vitisvinifera L.) oil. Effect of the operating conditions upon oil composition and antioxidant capacity / Passos C. P. et al // Chemical Engineering Journal. 2010. Vol. 160, Issue 2. P. 634-640. https://doi.org/10.1016/j.cej.2010.03.087
20. Yilmaz. E.E, Ozvural E.B., Vural H. Extraction and identification of proanthocyanidins from grape seed (VitisVinifera) using supercritical carbon dioxide // Journal of Supercritical Fluids. 2011. Vol. 55, Issue 3. P. 924-928. https://doi.org/10.1016/j.supflu.2010.10.046

21. Extraction and formulation of anthocyanin-concentrates from grape residues / Vatai T. et al // Journal of Supercritical Fluids. 2008. Vol. 45, Issue 1. P. 32-36. https://doi.org/10.1016/j.supflu.2007.12.008
22. Chedea V.S., Braicu C., Socaciu C. Antioxidant/prooxidant activity of a polyphenolic grape seed extract // Food Chemistry. 2010. Vol. 121, Issue 1. P. 132-139. https://doi.org/10.1016/j.foodchem.2009.12.020
23. Sidani B., Makris D.P. Interactions of natural antioxidants with red grape pomace anthocyanins in a liquid model matrix: stability and copigmentation effects // Chemical Industry and Chemical Engineering Quarterly. 2011. Vol. 17, Issue1. P. 59-66. https://doi.org/10.2298/CICEQ100701055S
24. Endothelium-dependent vasodilator and antioxidant properties of a novel enzymatic extract of grape pomace from wine industrial waste / Rodriguez-Rodriguez R. et al // Food Chemistry. 2012. Vol. 135, Issue 3. P. 1044-1051. https://doi.org/10.1016/j.foodchem.2012.05.089
25. Fatty acid composition, oxidative stability, antioxidant and antiproliferative properties of selected cold-pressed grape seed oils and flours / Lutterodt H. et al // Food Chemistry. 2011. Vol. 128, Issue 2. P. 391-399. https://doi.org/10.1016/j.foodchem.2011.03.040
26. Sandhu A.K., Gu L.W. Antioxidant capacity, phenolic content, and profiling of phenolic compounds in the seeds, skin, and pulp of Vitis rotundifolia (Muscadine grapes) as determined by HPLC-DAD- ESI-MS // Journal of Agricultural and Food Chemistry. 2010. Vol. 58, Issue 8. P. 4681-4692. https://doi.org/10.1021/jf904211q
27. In-vivo Assessment of antidiabetic and antioxidant activities of grape vine leaves (Vitisvinifera) in diabetic rats / Orhan N. et al // Journal of Ethnopharmacology. 2006. Vol. 108, Issue 2. P. 280-286. https://doi.org/10.1016/j.jep.2006.05.010
28. Anthocyanins: optimisation of extraction from Cabernet Sauvignon grapes, microcapsulation and stability in soft drink / Burin V. M. et al // International Journal of Food and Technology. 2010. Vol. 46, Issue 1. P. 186-193. https://doi.org/10.1111/j.1365-2621.2010.02486.x
29. Khanal R.C., Howard L.R., Prior R.L. Effect of heating on the stability of grape and blueberry pomace procyanidins and total anthocyanins // Food Research International. 2010. Vol. 43, Issue 5. P. 1464-1469. https://doi.org/10.1016/j.foodres.2010.04.018
30. Laroze L.E., Moure A., Zuniga M.E. Extraction of antioxidants from several berries pressing conventional and supercritical solvents // European Food Research and Technology. 2010. Vol. 231, Issue 5. P. 669-677. https://doi.org/10.1007/s00217-010-1320-9
31. Microwave-assistance provides very rapid and efficient extraction of grape seed polyphenols / Li Y. et al // Food Chemistry. 2011. Vol. 129, Issue 2. P. 570-576. https://doi.org/10.1016/j.foodchem.2011.04.068
32. Characterization of flavan-3-ols in seeds of grape pomace by CE, HPLC- DAD-MSn and LC-ESl-FTICR-MS / I.I. Rockenbach et al // Food Research International. 2012. Vol. 48, Issue 2. P. 848-855. https://doi.org/10.1016/j.foodres.2012.07
33. Grape skin and seed proanthocyanidins from Monastrell Syrah grapes / Hernández-Jiménez A. et al // Journal of Agricultural and Food Chemistry. 2009. Vol. 57, Issue 22. P. 10791-10803. https://doi.org/10.1021/jf903465p
34. Andersen O.M., Markham K.R. Flavonoids: chemistry, biochemistry and application. New York: CRC Press. 2005. P. 397–441. https://doi.org/10.1201/9781420039443
35. Davidov-Pardo G., Arozarena I., Mann-Arroyo M.R. Stability of polyphenolic extracts from grape seeds after thermal treatments // European Food Research and Technology. 2011. Vol. 232, Issue 2. P. 211-220. https://doi.org/10.1007/s00217-010-1377-5
36. Extraction of polyphenols from grape seeds and concentration by ultrafiltration / Nawaz H. et al // Separation and Purification Technology. 2006. Vol. 48, Issue 2. P. 176-181. https://doi.org/10.1016/j.seppur.2005.07.006
37. Munoz O., Sepulveda M., Schwartz M. Effects of enzymatic treatment on anthocyanic pigments from grapes skin from Chilean wine // Food Chemistry. 2004. Vol. 87, Issue 4. P. 487-490. https://doi.org/10.1016/j.foodchem.2003.12.024
38. Stilbenes: Quantitative extraction from grape skins, contribution of grape solids to wine and variation during wine maturation / Sun B. et al // 4 Symposium in Vino Analytica Scientia, Montpellier, 7-9 July, 2005 // Analytica Chimica Acta. 2006. Vol. 563, Issue 1-2. P. 382-390. https://doi.org/10.1016/j.aca.2005.12.002
39. Recovery of catechins and proanthocyanidins from winery by-products using subcritical water extraction / Garcia-Marino M. et al // 4 Symposium in Vino Analytica Scientia, Montpellier, 7-9 July, 2005 // Analytica Chimica Acta. 2006. Vol. 563, Issue 1-2. P. 44-50. https://doi.org/10.1016/j.aca.2005.10.054
40. Extraction and formulation of anthocyanin-concentrates from grape residues / Vatai T. et al // Journal of Supercritical Fluids. 2008. Vol. 45, Issue 1. P. 32-36. https://doi.org/10.1016/j.supflu.2007.12.008
41. An extraction method for obtaining the maximum non-anthocyanin phenolics from grape berry skins / Jin Z.-M. et al // Anal. Lett. 2010. Vol. 43, Issue 5. P. 776-785. https://doi.org/10.1080/00032710903486351
42. Spigno G., Tramelli L., De Faveri D.M. Effects of extraction time, temperature and solvent on concentration and antioxidant activity of grape marc phenolics // Journal of Food Engineering. 2007. Vol. 81, Issue 4. P. 200-208. https://doi.org/10.1016/j.jfoodeng.2006.10.021
43. Rubio M., Álivarez-Ortí M., Pardo J.E. A review on the utilization of grape seed oil as an alternative to conventional edible vegetable oils // Riv. ital. sostanzegrasse. 2009. Vol. 84. P. 121-129.
44. Inhibitory effect of Chardonnay and black raspberry seed extracts on lipid oxidation in fish oil and their radical scavenging and antimicrobial properties / Luther M. et al // Food Chemistry. 2007. Vol. 104, Issue 3. P. 1065-1073. https://doi.org/10.1016/j.foodchem.2007.01.034
45. Liobera A., Canellas J. Dietary fibre content and antioxidant activity of Manto Negro red grape (Vitis vinifera): pomace and stem // Food Chemistry. 2007. Vol. 101, Issue 2. P. 659-666. https://doi.org/10.1016/j.foodchem.2006.02.025
46. Antioxidant activities of organic grape, pomace, juice, must, wine and their correlation with phenolic content / Yildirim H.K. et al // International Journal of Food Science and Technology. 2005. Vol. 40, Issue 2. P. 133-142. https://doi.org/10.1111/j.1365-2621.2004.00921.x
47. Halliwell D., Gutteridge J.M.C. Free Radicals in Biology and Medicine. 2 ed. Oxford: Clarendon Press. 1989. P. 531-542.
48. Preparation of Grape Pomace as Cigarette Flavor by Biological Fermentation and the Analysis of Volatile Composition / Duan J.M. et al // Fine Chemicals. 2009. Vol. 26, Issue 8. P. 781-784. URL: https://en.cnki.com.cn/Article en/CJFDTOTAL-JXHG200908019.htm (viewed 20.12.2020)
49. Couto S.R., Sanroman M.A. Utilisation of grape seeds for laccase production in solid-state fermenters // Journal of Food Engineering. 2006. Vol. 74, Issue 2. P. 263-267. https://doi.org/10.1016/j.jfoodeng.2005.03.004
50. Зуева Т.А. Разработка малоотходной технологии переработки семян винограда и получение на их основе лекарственных и косметических средств: автореф. дис. канд. фарм. н.: 15.00.01: защ. 26.04.2004 / науч.руков. Андреева И.Н. Пятигорск: ПГФА, 2004. 23 с. URL: https://static.freereferats.ru/_avtoreferats/01004064437.pdf (дата обращения: 12.12.2020)
51. Масло из косточек винограда – перспективное сырье для фармацевтической и косметической продукции / Бокшан Е.В. и др. // Провизор. 2000. № 5. С. 42-43. URL: www.provisor.com.ua/archive/2000/№ 5/oil.php (дата обращения 1.12.2020)
52. Отходы виноделия – перспективное сырье для получения биологически активных веществ / Назарько М.Д. и др. // Известия вузов. Пищевая технология. 2011. № 1. С. 7-9.
53. Садовой В.В., Селимое М.А, Аралина А.А. Получение пищевой добавки из виноградных выжимок // Известия вузов. Пищевая технология. 2011. № 5-6. С. 41-43.

54. Pedroza M.A., Carmona M., Salinas M.R. Use of dehydrated waste grape skins as a natural additive for producing rose wines: Study of extraction conditions and evolution // Journal of Agricultural and Food Chemistry. 2011. Vol. 59, Issue 20. P. 10976-10986. https://doi.org/10.1021/jf202626v
55. Influence of the addition of grape seed procyanidins to Port wir in the resulting reactivity with human salivary proteins / Mateus N.et al // Food Chemistry. 2004. Vol. 84, Issue 2. P. 195-200. https://doi.org/10.1016/S0308-8146(03)00201-2
56. Кондратьев Д.В., Щеглов М. Г. Способы получения экстракта из виноградных выжимок и возможности его использования в пищевой промышленности // Известия вузов. Пищевая технология. 2009. № 1. С. 62-64.
57. Катрич Л. И. Разработка технологии производства биологически активных продуктов из виноградной выжимки: автореф. дис. … канд. техн. наук: 05.18.05; Ялта. НИВВ «Магарач». 2014. 20 с.
58. Chemistry and biochemistry of plant pigments / ed. T.W. Goodwin. London: Academic Press. 1976. 870 p.
59. Соколенко С.І. Кластери в глобальній економіці. К.: Логос, 2004. 848 с.