

UDC 663.25-028.82:634.8-046.48:346.61

## ANALYSIS OF ALTERNATIVE METHODS AND PRICE POLITIC OF ICEWINE PRODUCTION

V. Ostapenko, PhD student\*, *E-mail: ostapenkoviktoriya7@gmail.com*

O. Tkachenko, Doctor of Technical Science, Professor\*, *E-mail: obtkachenko@gmail.com*

E. Iukuridze, PhD (Doctor of Philosophy)\*\*\*, *Email: office@shabo.ua*

\*Department of Wine Technology and Oenology

Odessa National Academy of Food Technologies, 112 Kanatna Str., Odessa, Ukraine, 65039

\*\*«Industrial and Trading Wine Company Shabo», 10 Swiss str., Shabo village, Odessa region, Ukraine, 67770

**Abstract.** The artificial methods of must concentration were discussed in current study: the microwave vacuum dehydration, reverse osmosis and cryoextraction. The main factor of using of alternative ways is deficiently low temperatures in winter period that are necessary for freezing grapes on vine according to the classical technology. The benefits and disadvantages of using of non-classic processes to obtain sweet musts were shown. The physical, chemical and sensory characteristics of wine made from grapes previously frozen by alternative and natural ways were analyzed. Indicators influencing on price of icewines and dessert wines bottle including agricultural climatic, technological and marketing factors were determined. Detailed indicators highlight specificity of used technology and represent consumer preferences. Producers of winemaking regions of Argentina, New Zealand, Israel, Ukraine and Australia adhere to provisions that are inconsistent with the standards of Canada and the European countries regarding the icewine output. These instruments determine the processing of grapes and parameters reflect on parameters of the finished product.

**Keywords:** icewine, dessert wines, alternative methods, price, quality.

## АНАЛІЗ АЛЬТЕРНАТИВНИХ СПОСОБІВ ВИРОБНИЦТВА ТА ЦІНОВОЇ ПОЛІТИКИ КРИЖАНОГО ВИНА

В.А. Остапенко, аспірант\*, *E-mail: viktoriya\_velass@mail.ru*

О.Б. Ткаченко, доктор технічних наук, професор\*, *E-mail: obtkachenko@gmail.com*

Е.Ж. Іукурідзе, кандидат технічних наук, голова правління\*\*, *Email: office@shabo.ua*

\*Кафедра технології вина та енології

Одеська національна академія харчових технологій, вул. Канатна, 112, м. Одеса, Україна, 65039

\*\*ТОВ «Промислово-торгівельна компанія «Шабо», с. Шабо, Одеська обл, Україна

**Анотація.** Розглянуто штучні способи концентрування суслу для виробництва десертних вин типу *icewine*: вакуумна дегідратація, зворотній осмос і криоекстракція. Головним фактором використання альтернативних методів виступають недостатньо низькі температури зимового періоду, необхідні для заморожування ягід винограду на лозі згідно із класичною технологією. Показано переваги та недоліки застосування нетрадиційних способів отримання солодких сусел. Наведено аналіз фізико-хімічних та сенсорних характеристик вин, виготовлених з винограду попередньо замороженого альтернативним і природним шляхами. Визначено показники, що обумовлюють вартість пляшки десертних і крижаних вин, включаючи агрокліматичні, технологічні і маркетингові фактори. Виділені індикатори підкреслюють специфіку використаної технології та представляють уподобання споживачів. Виробники з виноробних регіонів Аргентини, Нової Зеландії, Ізраїлю, України та Австралії керуються положеннями, невідповідними стандартам Канади і країн Європи щодо випуску крижаного вина. Саме ці інструменти впливають на процес переробки винограду і відображаються на параметрах готового продукту.

**Ключові слова:** крижане вино, десертні вина, альтернативні способи, ціна, якість.

Copyright © 2015 by author and the journal "Food Science and Technology".

This work is licensed under the Creative Commons Attribution International License (CC BY) <http://creativecommons.org/licenses/by/4.0>



DOI: <http://dx.doi.org/10.15673/fst.v11i2.507>

### Introduction. Formulation of the problem

The method of production influences on sensory and chemical attributes of wines and in the view of economic value on price per bottle. Such trend reflected on premium wine category icewine is referred to. Icwine is a rare type of wine, the classic technique of which is harvesting of grapes that have been frozen on vine during low temperatures. Aforementioned production is always labor-intensive and risky. For this reason, winemakers essentially from New World have

utilized alternative methods for obtaining musts with high sugar content. Also results of grape concentrating can be divined through regulation of temperatures of used equipment that largely distinguish it from freezing naturally.

There is rapid spread and development of winter wine categories in the world including icewine production, but the presence of well-known information about the various ways used by different companies in order to concentrate must for premium sector remains low.

There are not strict rules in grape processing regard to ways of freezing among countries thereby dessert wines are produced by artificial methods. Wine market proposes sweet beverages the price of which is lower compared to true icewines. Such case reflects negatively on producers who freeze grapes during low natural temperatures.

**The aims of study** were 1) to discuss alternative methods of dessert wine production including *icewine*, 2) to explain main factors influencing on price of premium dessert wines.

---

### Production of sweet wines using alternative methods

---

In order to obtain the concentrated grape harvest microwave vacuum dehydration, cryoextraction (freezing in refrigerator) and reverse osmosis are used [1-5]. Should be pointed that cryoextraction is the most utilized way for concentrating [6-8]. Dessert wines from New Zealand and Australia made by alternative methods have the same popularization within market like icewines [2]. Significant differences between parameters of wines produced by various methods were described [3,9-14]. Results of aforementioned artificial operations largely impact on price politics which is different. Reputation indicators, quality signals, brands and awards affect the cost of wines [15-22], but obtainment of must with high sugar depends on conditions of freezing that play the central role in determining of icewine price. Institution of unique solution about icewine regulation requires worldwide acquiescence between producing-countries. Likewise, agreement in controlling of premium technology may influence price fixation inside market

The main factors influencing the use of alternative processes are grape losses associated with lack of frosts to freeze cultivars for obtaining the target sugar level or insufficient low temperatures are appreciated for icewine production. Dominic Rivard [1] concluded that production of wines made by cold concentration is cheaper and easier than to freeze grapes on vine naturally. Additionally, the process concentrates and enhances the natural sugars, acids, phenol compounds and aromatic qualities of the fruit leading to more intense flavor, aroma and richness. Countries which do not possess the low temperatures have increased own production through introduction non-true premium wines where the significant place belongs to sweet wines.

Israel, Argentina, New Zealand and Australia freeze grapes artificially and trademarked *Icewine* on bottles the price of which is significantly different from the price of true product and has an essential influence on the choice of the ordinary consumer. Yet even Germany and Austria underwent climate variations that caused the regular harvest and supply of *Icewine* to be uncertain from year to year. However, it was possible to produce a similar product through artificial means,

often called «fast-freezing» [2].

Iced Riesling wine made its debut in 1995 and was pioneered by Andrew Hood under the Wellington brand in state of Australia Tasmania. The night temperatures of winter in Australia are not cold enough to freeze grapes on the vine, thereby Frogmore Creek has developed a cryoextraction freezing technique, independent from climatic conditions. On the west coast, Margaret River winery Fraser Gallop Estate released its first iced wine – an Ice Pressed Chardonnay. In the Yarra Valley, Redbox Wines produces an Ice Cabernet and Ice Riesling in its range using a freeze reduction technique. This process is used to enable the extraction of the water/ice content from the juice of the selected fruit. Once satisfied with the juice, it is then run through a ferment and stabilization process before bottling. The first winery in Israel which has made wine using alternative process was the Golan Heights Winery in 1998. The centers of dessert wine production of New Zealand are Marlborough and Nelson regions, where Gewurztraminer, Riesling and Muscat are the main cultivars that are utilized for freezing process. Wineries from Argentina *Las Perdices* and *Belasco De Baquedano Antracita* have produced dessert wines since 2010. Iced Malbec is the most popular beverage of special sector. In September of 2015 Company *Shabo* from Odessa region sold first lots of Ukrainian premium wines. Selected Riesling grapes were harvested by hand in 2014, in line with the traditions of the New World using cryoextraction.

Alternative methods to obtain icewine are a microwave vacuum dehydration, reverse osmosis and cryoextraction (freezing in refrigerator). Microwave vacuum dehydration heats all regions of grapes simultaneously, and the vacuum induces moisture to flash rapidly from the fruit tissue at low temperature, avoiding changes caused by heat and extended drying time. As an alternative to rise concentration, grapes can be dehydrated using a microwave vacuum process to concentrate the juice in grapes by removing the free water by nondestructive dehydration [3]. This operation leads to increased alcohol content in finished wines [4].

Reverse osmosis has also been used to produce concentrated juices for making eiswein-like wines. This technique seems to lack the flavor changes that develop during the long over ripening of grape. Under ordinary conditions water passes from the dilute liquid to the concentrated liquid. By applying pressure on the more concentrated liquid, however, it is possible to reverse the flow and force water molecules through the membrane while other molecules (such as sugar, acids, flavors, etc.) are held back. The process may be thought of as molecular filtration [5].

Cryoextraction is based on a law of physics. Raoult's law states that the freezing point of a solution lowers as the solute concentration increases. When the temperature of a white grape crop is lowered to 0 °C, only the grapes containing the least amount of sugar are frozen. John Tummion [6] presented successive op-

erations using cryoextraction method the main points of which is an explaining the changes of berries and must during increasing concentration. Freeze concentration ensures that all original product characteristics remain in the concentrate [7], but such technique is energy demanding [8].

It was pointed that characteristics of finished sweet wines produced by different freezing scopes have not significant distinctions between samples for degree of Brix %, acid, total hexose, vitamin C, browning index, color, or viscosity [9]. The major advantages of freezing concentration are the minimal losses of aroma and color parameters. Disadvantages of freeze concentration include loss of the liquid food with ice and high operating and capital costs of freeze-concentration equipment [10]. Removing of ice using mechanical separation is implemented by technique or washing columns. The degree of concentration achieved is higher than in membrane process but lower than concentration by boiling. Crystallization requires 151 kJ/kg, where the evaporation requires 2055 kJ/kg water.

Several studies were published about determining of significant differences between true icewines and late-harvest, dessert wines, but only from Riesling grapes. Based on research [3] wines produced by freezing in refrigerator, from grapes concentrated in vacuum dehydration and samples of wine obtained from natural freezing on vine were similar of sensory evaluation but the sugar content, titratable acidity and pH of the wines differed among all treatments. Moreover, wine made from dehydrated fruit exhibited lower citrus/grapefruit, acidity and length of aftertaste than the other two wines that point fact there are bio-chemical reactions inside grapes during time of freezing by true traditional way basically influencing on parameters of finished wines.

According to [11] grape must samples of Meili (*V. vinifera* L.) were determined sensorally and chemically after such procedures: freezing temperature ( $-20$  and  $-10$  °C), freezing time (4 and 6 h), grape state during freezing (must and berry), and thawing methods (microwave and natural thawing). Under the freezing treatments, using  $-20$  °C would enhance wine aroma better than using  $-10$  °C. Fermentation volatile compounds were quantified in total, including 26 esters, 8 higher alcohols, and another 2 carbonyl compounds. The prefermentative freezing process changed the total content of esters and high alcohols little, but some individuals changed significantly. Appealing on study [12] in green Erbaluce dehydrated grapes, alcohols were the predominant volatile components representing 33 % of the concentration of all glycosidically bound precursors. The major varietal compound was 1-hexanol, followed by terpenoids (21 %), norisoprenoids (19 %) such as 3-hydroxy-7, 8-dihydro- $\beta$ -ionol, and benzenoids (18 %) such as homovanillic acid and 3, 4, 5-trimethoxy benzenemethanol. Gold dehydrated

grapes showed a similar volatile profile to green in relation to terpenoids and norisoprenoids whereas the profile was similar to blue grapes in term of alcohols, even if benzenoids, particularly homovanillyl alcohol, were the predominant glycosylated volatile compounds (32 %). Effect of freezing on chemical changes in Cabernet Sauvignon, Grenache and Tempranillo samples were described by Spain researchers [13]. Increasing of titratable acidity and viscosity and decreasing of pH those also agree with previous work [14]. The freezing leads to the rupture of cell wall easing the release of anthocyanins and phenolics from the skin to the must.

Analyzed results reported here emphasize the necessity to compare the bigger amount of icewines and wines made by artificial ways in towards to chemical attributes and peculiarities of used technology based on inputs, burn rates, investments and preference of customers. Also the further researches should be focus on determining of certain differences between alternative methods including the various parameters of freezing spheres, diverse grape varieties.

---

#### Indicators of price determining for premium dessert wines

---

Wine price is often a subject of discussion based on many factors determining the specificity of production and represented the social principles and preferences [15]. To itemize afore written – enology starts in the soil of the vineyard and ends in the consumer's anatomy. Regulation of production especially impacts on obtaining of quality beverages, that then price model is discussed taking into account the whole aspects of wine output.

A long-term reputation plays one of the main roles to appoint a significant price of premium wines thus consumers consider such reputation to be a better indicator of quality [16,17]. Such statement is true also for icewine from Canada and Germany where production of elite wines is more developed versus another countries engaging in obtaining of rare alcoholics. Thus, Icewine from these countries are considered the most expensive that are sold at 70 dollars and at 40 Euro per 0,375 dm<sup>3</sup> bottle in average. But given the fact that the technology of production of icewine is a quite labor-intensive, successful finished product which depends on many factors, the leading ones are favorable agricultural climatic conditions. Lack of low temperatures in winter, the instability of grapes to the first frost, and the lack of berries to protect the birds from eating mainly affects the yield of the finished product, which may even lead to the loss of the harvest for a rare type of wine. In addition, the processing of the must in the wine adds complexity winemakers. These factors mainly influence the formation of the price of a bottle of icewine (Figure1).

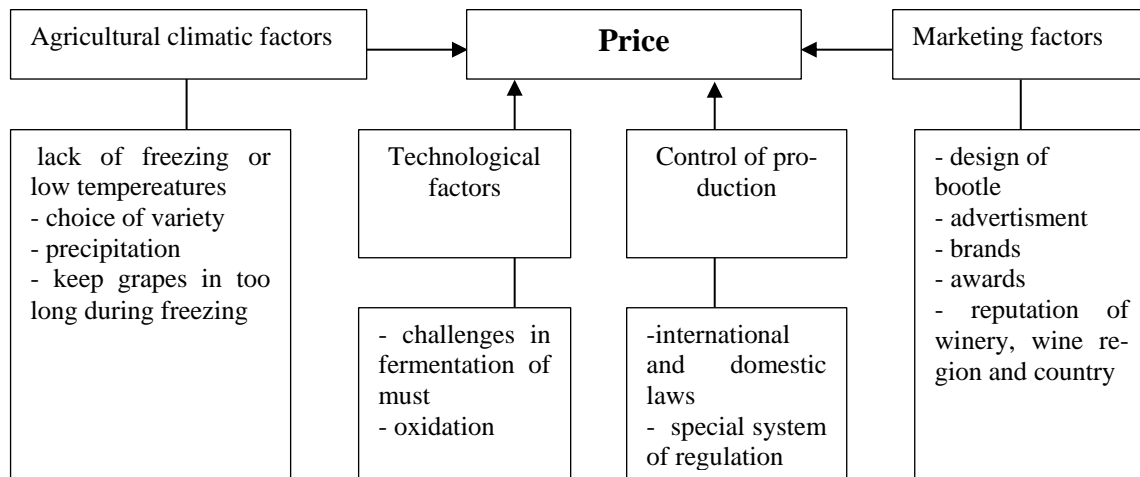


Fig. 1. Factors influencing on price of icewine bottle

Also for wines sensory signals are one of the important indicators, which is a highly differentiated good with quality lights [18]. Objective (impartial) quality measures are difficult to define, because determining of sensory parameters is exceedingly subjective. In addition, labels, bottle design and growing regions may also increase or hinder wine sales [19]. Hence, aged Icewine from wine variety Vidal Canadian Company «Inniskillin» was defined as the best sweet wine of 2002. Grand River Valley icewines have won many awards, and Debonne Vineyards' 2013 Vidal Blanc Icewine was just named best dessert wine at the 2015 *San Francisco Chronicle* Wine Competition, one of the largest such contests in the United States. These Michigan wineries have received awards for their Icewine in local and national wine competitions: Black Star Farms, Brys Estate Vineyard and Winery, Burgdorf's Winery, Chateau Aeronautique, Chateau Chantal, Cody Kresta Vineyard and Winery, Fenn Valley Vineyards, Lemon Creek Winery and Mackinaw Trail Winery.

Attending wine exhibitions for the purpose of receiving prestigious awards that are recognized and appreciated by the clientele appears to be a basically promising strategy for producers [20]. The main determining allocation of brand is a global reputation expressing through emergence of diverse competitive awards that also impact on pricing of bottles. In order to obtain any medal or prize the product should be analyzed by experience judges according to confirmation of assessment methods. Despite the recent forward to global market icewine is awarded by majority of world wine commissions [21].

European wineries producing rare premium wines always represent own products. Consequently, Icewine from the Czech company «Znovín» harvest Riesling 2010 was awarded by a gold medal at the World Wine Competition in San Francisco, the title of King Czech wines, a gold medal at Terravino in Israel, and the gold medal in Montreal and Hungarian company «Bodren» was obtaining six gold medals Decanter

World Wine Awards in London during 5 years. Laški Rizling Icewine 2012 Ptujška Klet's winery from Podravje, Slovenia won International Trophy [22]. Producers of icewines from Asia also took part in international contest Château Fenhe of Heilongjiang Luyuan Winery from China won medal 'Best Sweet Asia over £15' in a Chinese wine in Decanter competitions [21]. The Russian company «Phanagoria»: Icewine Riesling and Icewine Saperavi, which received the silver medal in the tasting contest and the International Exhibition of wines «China Wine Awards 2012».

Besides the number of icewine medals, prices are different among countries per bottle, however awarded producers indicate the higher prices than other. Hence, the Royal DeMaria 2000 Chardonnay Icewine is recognized as the most expensive Icewine in the world, retailing at \$ 250,000 a bottle. Australian sweet wines are cost 20 dollars per 0,375 l per bottle in average. However, company Znovin located in the Czech Republic sells their wines with price that is similar to icewine bottle made by non-traditional way.

Figure 2 highlights the important phases in icewine production including differences associated with technology, cultivars, regulation and prices between countries that make premium wines naturally and by alternative ways. To determine considerable discrepancies between true and artificial wines in towards composition, the further researches should be conducted and explained by producers from various countries.

To conclude the findings, it should be emphasized that there are no specified average prices for icewine between countries. This fact can be explained according to the different detectors: agricultural climatic conditions that primarily define the probability and amount of crop, technological tasks directly related to the release of the finished wine and the market indicators formed the final price. The legislation of regulating of the elite wines production contributes to confirmation of production of high quality beverages, which in turn attract customers and guarantee them a real product. A large number of awards received by icewine

producers also show the development and expansion of this wine type inside market. Such situation to some extent dictates a considerable increase of prices on the premium segment brands. But with the rapid spread of icewines the percentage of producers who freeze grapes artificially is growing. Unfortunately, even among countries that produce true icewines there is no agreed universal act regulating the production including the exact harvest time and temperature, sugar level of must and definitive quality requirements of finished wines. To determining of the price tax policies of each country, advertising campaign of certain enterprises and the current state of the wine industry in every country should also take into account.

**Conclusion**

The main peculiarities of alternative methods were reported, the usage of which significantly impacts on price per bottle. The New World wine producers including estates from Australia, the New Zealand, Israel, Ukraine and Argentina focus on non-classical technology related to premium category. The price model of special wines described here consists of number indicators that make possible to determining true icewines and dessert wines. The question with realization wines obtained artificially is unsettled completely and it is still actual among producing-countries. To solve question associated with better and economically sound method to obtain crop for wines of premium rank next international consideration should be cycle on all characteristics of production by naturally and factitious process of grape freezing.

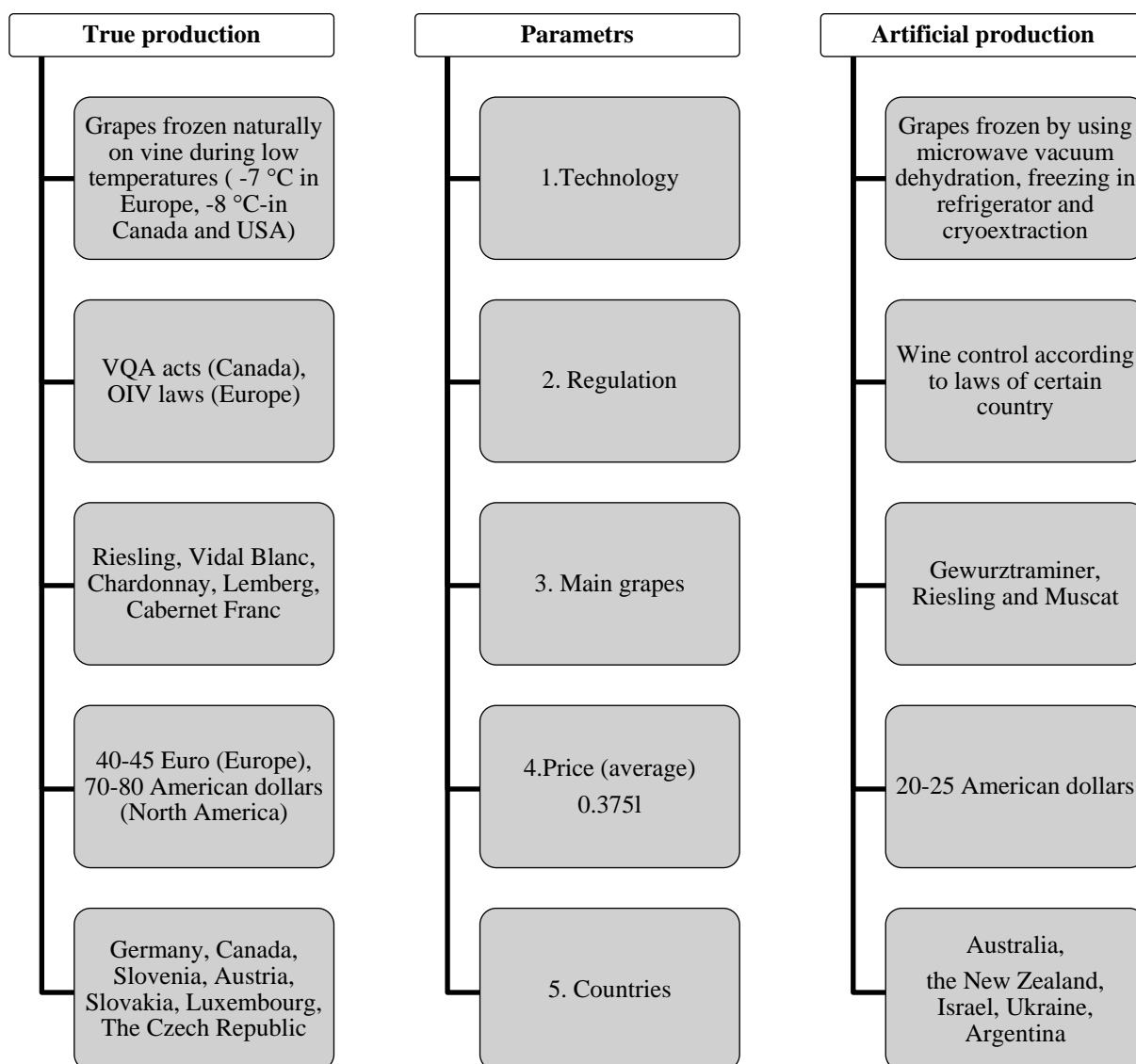


Fig. 2. Differences between true and artificial icewine production

## References

1. Jones G, Hirasawa J. Inniskillin and the Globalization of Icewine. *Reproduction*. 2011; (Mba 2005): 1–27.
2. Rivard D. Challenges and Solutions for Icewine and Cryo Wine Production. Presentation.
3. Clary C, Gamache A, Cliff M, Fellman J, Edwards C. Flavor and Aroma attributes of Riesling wines produced by freeze concentration and microwave vacuum dehydration. *J Food Process Preserv*. 2006; 30: 393-406.
4. Pascal Ribe´reau-Gayon, Dubourdieu D, Done`che B, Lonvaud A. *Handbook of Enology Volume 1 The Microbiology of Wine and Vinifications*. 2nd ed. Wiley; 497.
5. Desrosier NW, Tressler K. Donald. *Fundamentals of Food Freezing*. Springer Netherlands; 1977.
6. June G. Freeze Fractionating Grape and Fruit Juices for the Production of Ice-style Wines. *K-W Winemakers Guild*. 1999: 1-2.
7. Grainger K, Tattersall H. *Wine Production: Vine To Bottle*. Blackwell Publishing Ltd; 2007.
8. Andrew G. Reynolds. *Managing Wine Quality. Volume 2: Oenology and Wine Quality*. Andrew G. Reynolds, editor. Woodhead Publishing; 2010.
9. Rahman MS, editor. *Handbook of Food Preservation*. 2nd ed. Taylor & Francis Group; 2007.
10. Peng C, Wen Y, Tao Y, Lan Y. Modulating the Formation of Meili Wine Aroma by Prefermentative Freezing Process. *Journal Agric Food Chem*. 2013;61:1542-53.
11. Luca Rollea, Manuela Giordanoa, Simone Giacosa, Simone Vincenzib, Susana Rio Segadea, Fabrizio Torchioa, Benedetta Perronea VG. Parameters of white dehydrated grapes as quality markers according to chemical composition, volatile profile and mechanical properties. *Anal. Chim. Acta*; 2012;(1):105-13.
12. Santesteban LG, Royo JB. Variety and storage time affect the compositional changes that occur in grape samples after frozen storage. *Aust J Grape Wine Res*. 2011;17(May):162–168.
13. Panova EP, Katceva GN, Burda VE. The influence of low temperatures on physicochemical property of must. *Sci Notes Taurida V Vernadsky Natl Univ*. 2010; 23(62): 208–17.
14. Costanigro M, McCluskey JJ, Mittelhammer RC. Segmenting the Wine Market Based on Price: Hedonic Regression When Different Prices Mean Different Products. *J Agric Econ*. 2007;(February):1-41.
15. Graça A, Pessanha M. Increasing efficiency in production management of a wine enterprise: the project I.C.O.N.E. 2011.
16. Werdelmann T. Quality and Value Creation on the Premium Wine Market. *J Appl Leadersh Manag*. 2014;3:47-72.
17. Schamel G. Individual and collective reputation indicators of wine quality. *Policy Discuss Pap*. 2000;(9):1-22.
18. Schamel G. Geography versus Brands in a Global Wine Market. *Agribusiness*. 2016;(June):1-17.
19. Orth UR, Krska P. Quality signals in wine marketing: the role of exhibition awards. *Int Food Agribus Manag Rev*. 2002; 4: 385-97.
20. Ostapenko V. Icewine as a modern global brand. *Zbirnyk tez dopovidei Mizhnarodnoi naukovo-praktychnoi konferentsii [«Kharchovi tekhnologii, khliboprodukty i kombikormy»]*. 2016; 117-119.
21. China ice wine excel in 2016 Decanter World Wine Awards [Elektronnyi resurs]. Available at: <https://www.decanterchina.com/en/news/china-ice-wine-excel-in-2016-decanter-world-wine-awards>
22. Wine AWArds. Decanter World Wine Award 2015 winners; 2015.

## АНАЛИЗ АЛЬТЕРНАТИВНЫХ СПОСОБОВ ПРОИЗВОДСТВА И ЦЕНОВОЙ ПОЛИТИКИ ЛЕДЯНОГО ВИНА

В.А. Остапенко, аспирант\*, E-mail: [viktoriya\\_velass@mail.ru](mailto:viktoriya_velass@mail.ru)

О.Б. Ткаченко, доктор технических наук, профессор\*, E-mail: [obtkachenko@gmail.com](mailto:obtkachenko@gmail.com)

Е.Ж. Иукурдзе, кандидат технических наук, глава правления\*\*, Email: [office@shabo.ua](mailto:office@shabo.ua)

\*Кафедра технологии вина та энологии

Одесская национальная академия пищевых технологий, ул. Канатная, 112, г. Одесса, Украина, 65039

\*\*ООО «Промышленно-торговая компания «Шабо», с. Шабо, Одесская обл, Украина, 67770

**Аннотация.** В данной статье рассмотрены искусственные методы концентрирования суслу для производства десертных вин типа *icewine*: вакуумная дегидратация, обратный осмос и криоэкстракция. Главным фактором использования альтернативных методов выступают недостаточно низкие температуры зимнего периода, необходимые для замораживания ягод винограда на лозе по классической технологии. Показаны преимущества и недостатки применения нетрадиционных способов получения сладких сусел. Приведен анализ физико-химических и сенсорных характеристик вин, изготовленных из винограда, предварительно замороженного альтернативным и естественным путями. Определены показатели, влияющие на стоимость бутылки десертных и ледяных вин, включая агроклиматические, технологические и маркетинговые факторы. Выделенные индикаторы подчеркивают специфику используемой технологии и представляют предпочтения потребителей. Производители из винодельческих регионов Аргентины, Новой Зеландии, Израиля, Украины и Австралии руководствуются положениями, несоответствующими стандартам Канады и стран Европы относительно выпуска ледяного вина. Именно эти инструменты обуславливают процесс переработки винограда и отражаются на параметрах готового продукта.

**Ключевые слова:** ледяное вино, десертные вина, альтернативные способы, цена, качество.

## References

1. Jones, G. Inniskillin and the Globalization of Icewine [Text] / G. Jones, J. Hirasawa // Harvard Business School. – 2011. – P. 1–27.

2. Rivard, D. Challenges and Solutions for Icewine and Cryo Wine Production [Text] / D. Rivard // Presentation. – 2007. – P. 23.
3. Clary, C. Flavor and Aroma attributes of Riesling wines produced by freeze concentration and microwave vacuum dehydration [Text] / C. Clary, A. Gamache, M. Cliff, J. Fellman, C. Edwards // Journal of Food Processing and Preservation. – 2006. – Vol. 30 – P. 393–406.
4. Pascal Ribéreau-Gayon. Handbook of Enology. The Microbiology of Wine and Vinifications. 2nd ed. [Text] / Pascal Ribéreau-Gayon, D. Dubourdieu, B. Douché, B. Lonvaud // Wiley. – P. 497.
5. Desrosier, N.W., Fundamentals of Food Freezing [Text] / NW. Desrosier, K. Tressler, Donald // Springer Netherlands. – 1977. – P. 629.
6. June, G. Freeze Fractionating Grape and Fruit Juices for the Production of Ice-style Wines [Text] / G. June // K-W Winemakers Guild. – 1999. – P. 1–2.
7. Grainger, K. Wine Production: Vine To Bottle [Text] / Grainger K, Tattersall H. // Blackwell Publishing Ltd. Food industry briefing series – 2005. – P. 130.
8. Andrew, G. Reynolds. Managing Wine Quality. Volume 2: Oenology and Wine Quality [Text] / G. Andrew Reynolds // Woodhead Publishing. – 2010. – P. 624.
9. Rahman, MS., editor. Handbook of Food Preservation. 2nd ed. [Text] / MS. Rahman // Taylor & Francis Group. – 2007. – P. 1031.
10. Peng, C. Modulating the Formation of Meili Wine Aroma by Prefermentative Freezing Process [Text] / C. Peng, Y. Wen, Y. Tao, Y. Lan. // Journal Agric Food Chem. – 2013. – P. 1542-1553.
11. Rollea, L. Parameters of white dehydrated grapes as quality markers according to chemical composition, volatile profile and mechanical properties [Text] / L. Rollea, M. Giordano, S. Giacosa, S. Vincenzib, SR. Segadea, F. Torchio, B. Perronea // Anal. Chim. Acta – 2012. – P. 105–113.
12. Santesteban, LG. Variety and storage time affect the compositional changes that occur in grape samples after frozen storage [Text] / LG. Santesteban, JB Royo // Australian Journal of Grape and Wine Research. – 2011. – P. 162–168.
13. Panova, EP. The influence of low temperatures on physicochemical property of must [Text] / EP. Panova, GN. Katceva, VE. Burda // Sci Notes Taurida VVernadsky Natl Univ. – 2010. – P. 208–17.
14. Costanigro, M. Segmenting the Wine Market Based on Price : Hedonic Regression When Different Prices Mean Different Products [Text] / M. Costanigro, JJ. McCluskey, RC Mittelhammer // Journal of Agricultural Economics. – 2007. – P. 1–41.
15. Graça, A. Increasing efficiency in production management of a wine enterprise: the project I.C.O.N.E. [Text] / A. Graça, M. Pessanha // Conference paper. – 2011. – P. 12.
16. Werdelmann, T. Quality and Value Creation on the Premium Wine Market [Text] / T. Werdelmann // Journal of Applied Leadership Management. – 2014. – P. 47–72.
17. Schamel, G. Individual and collective reputation indicators of wine quality [Text] / G. Schamel // Policy Discuss Paper. – 2000. – P. 1–22.
18. Schamel, G. Geography versus Brands in a Global Wine Market [Text] / G. Schamel // Agribusiness. – 2016. – P. 1–17.
19. Orth, U.R. Quality signals in wine marketing: the role of exhibition awards [Text] / U.R. Orth, P. Krska // International Food Agribusiness Management Review. – 2002. – P. 385–397.
20. Ostapenko, V. Icewine as a modern global brand [Text] / Ostapenko V. // Zbirnyk tez dopovidei Mizhnarodnoi nauково-praktychnoi konferentsii «Kharchovi tekhnologii, khlіboprodukty i kombikormy», (Odesa, 13-17 veres. 2016 r.) / Odes- ka nats. akad. kharch. tekhnologii. – 2016. – P.117-119.
21. China ice wine excel in 2016 Decanter World Wine Awards [Elektronnyi resurs].- Available at: <<https://www.decanterchina.com/en/news/china-ice-wine-excel-in-2016-decanter-world-wine-awards>>
22. Wine AWARDS. Decanter World Wine Award 2015 winners [Text] / Decanter magazine.– 2015. – P. 240.

Отримано в редакцію 06.04.2017  
Прийнято до друку 18.05. 2017

Received 06.04.2017  
Approved 18.05. 2017