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DEVELOPMENT OF GRAPES AND WINE-MAKING INDUSTRY OF MOLDOVA ON THE BASIS OF MODERN ACHIEVEMENTS OF SCIENCE AND INNOVATIONS

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Abstract: *The wine-growing and wine-making complex of Moldova has come a long way: from metal-intensive technical equipment from unalloyed steels to modern European equipment from stainless, food-grade material. All new vineyard plantings are created from planting of certified material of our own production or acquired in Italy, France and Germany. At the present stage, vineyard plantations in Moldova are 80% occupied by classic European varieties. The rest - are local indigenous varieties. All technological processes in primary winemaking are based on modern biotechnology achievements and innovations: enzymes for clarifying wort, yeast for fermentation and bacteria to reduce acidity in red wines. The well-known preservative - sulfur dioxide is replaced with inert gases (nitrogen, carbon dioxide) and the use of low temperatures. Table wines are exported mainly to Romania, the Czech Republic, Germany, Poland, China, the United States and Canada. All the achievements of viticulture and winemaking in Moldova are based on the latest scientific and technological progress, developed and implemented in the Republic of Moldova by scientists from the Academy of Sciences of Moldova, universities, as well as specialists from the National Office of Grapes and Wine.*

Key-words: *grape-wine-making complex, grape-based secondary products, European grape varieties, local indigenous varieties, wine market.*

Classification JEL: *Q13*

INTRODUCTION

The economy of Moldova is closely connected with its traditional sectors, such as agriculture and food industry. At the same time, in recent years, textile production, the manufacture of cables for the automotive industry, as well as information technologies that operate within the framework of international clusters, have intensified.

Nevertheless, the main industry of the republic remains viticulture and winemaking, in which 25% of the working population of the country is involved. In its progressive movement, this complex has reached a sharp leap in its development over the past 15 years and today is the hallmark of Moldova.

MATERIALS AND METHODS

As materials used for the preparation of this work, we studied the annual reports of the Ministry of Agriculture, the Ministry of Economy, the National Office of Grape and Wine, the Academy of Sciences of Moldova, the National Institute of Grape and Wine, as well as articles from national publications such as "Fruit growing, Viticulture and Winemaking" , "Leader agro", "Academos" and others.

The methods of work were: systematization of the information received, its systematic analysis, determining the priorities for the further development of agriculture and, in particular, the grape and wine-making complex of the Republic of Moldova. Some materials of various international organizations were also analyzed, including Moldova's partners from the European Union, who closely cooperate with the state structures of the republic.

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RESULTS AND DISCUSSION

The value of the grape culture for the Moldovan economy is very significant, since in this country there are centuries-old traditions of cultivation, good soil and climatic conditions and the well-established practice of growing table and technical varieties.

Grapes for fresh consumption in 2019 reached 100 thousand tons. Of this amount, 40% is exported to Romania, Poland, the Czech Republic and Germany.

Today, the Republic of Moldova collects more than 400 thousand tons of wine grape varieties with an annual wine volume of 15-17 million deciliters, which allows it to occupy 10th place in the world in vineyard areas equal to 130 thousand hectares, as well as in total volumes produced wines. [1,6]

The range of products produced from grapes in the Republic of Moldova includes:

- from table grapes - fresh grapes, must (fresh filtered wort), pure grape juice or blend, concentrate with min 65⁰ Brix, listel, wine materials for distillate, etc;

- from technical varieties - table, strong and dessert wines, sparkling (champagne) and sparkling (artificially saturated with carbon dioxide), aromatic wines, distillates for: divins (cognacs), brandy, vodka or pure ethyl alcohol; [7,11]

- grape-based secondary products - ethyl alcohol from yeast and squeeze, grape seeds oil, natural grape dye, tannin, grape seed powder to replace cocoa powder, tartaric acid, vinegar, soft drinks, etc. [10]

On average, grape products in Moldova are estimated annually at 450 - 500 million US dollars and it is an important component of replenishing the country's budget. [5,8]

The grape culture on Moldavian soil has been known since time immemorial. So, in Naslavcha, a village in the north of Moldova found imprints of grape leaves indicating that the vine grew in these parts a million years ago. Today it is the prestigious and main branch of the agriculture and food industry of Moldova. Currently, Moldova has a total vineyard area of 130 thousand hectares. Of these, 121 thousand ha are fruiting. In commodity farms, there are 82.5 thousand ha of grapes, of which fruit-bearing is 76.5 thousand ha. (56.5 thousand ha - European varieties, 7.5 thousand ha - Isabella species *Vitis Labrusca* and 12.5 thousand ha. of Table grape varieties). Viticulture of the Republic of Moldova is 90% in the private sector, so, is privatized. [4,7]

In the fruitful 2019, about 300 thousand tons of grapes were processed at the wineries. Of these: 265 thousand tons of European varieties, 18 thousand tons of Isabella species and 17 thousand tons of substandard (non-standard) table varieties. The latter are processed into juice, concentrate or distillate. [1]

In the season of 2019, more than 90 enterprises were involved in the processing of grapes. Moreover, 40 of them had their own vineyards, and 50 enterprises purchased grapes from private winegrowers. Over 40 thousand tons of table grapes were exported from this year's crop. About 40 thousand tons of table grapes were sold on the domestic market (from July of the harvest year until May of the following year). This grape was stored in industrial refrigerators. The Republic of Moldova provides 100% of its needs for table grapes and grape juice. [3]

Unfortunately, 70% of all sold wines are sold in bulk, so the average price of Moldovan wines for export is about 1 euro / l. But the current production potential of the viticulture and winemaking industry allows us to conquer individual markets in which this price will increase by more than 2-3 times. The country has developed the state strategy "Vino-2030", which provides for the further development of the industry based on the introduction of the results of world scientific and technological progress, innovations and new materials - products for the effective protection of vineyards from cold, disease, pests and the harmful effects of drought.

The grape assortment in the Republic of Moldova is approved by the Ministry of Agriculture on the submission of information by scientists from the National Institute of Grape and Wine after 5 years of successful testing of varieties in various soil and climatic conditions.

The republic has its own nursery base in viticulture where they produce their own certified planting material that meets international requirements for virus-free and bacterial-free seedlings.

Today in Moldova, European white grape varieties are cultivated for industrial processing - Aligote, Chardonnay, Sauvignon, Riesling Rhine, Muscat Ottonel, Pinot white, Pinot gris, Rkatsateli, as well as varieties of a new selection - Viorica, Bianca, Legend, etc. Among the red grape varieties for wine production, Moldova traditionally cultivates Cabernet Sauvignon, Merlot, Pinot Noir, Malbec, Saperavi, as well as Sangiovese, Shiraz, Colombarb Senso and others imported in recent years. [9]

Wines from local grape varieties such as Feteasca albă, Feteasca gegală, Viorica (white), Feteasca neagră, Codru and Rara neagră (red) are in special demand.

Based on innovative developments on plantations of vineyards of predominantly red varieties, new industrial forms of bush forming and vine trellis forming are being introduced, which are suitable for harvesting grapes with combines. [11,13]

Complex amploecological studies of the main micro zones of the viticulture of the Republic of Moldova with the mapping of heat supply are also innovative.

On their basis, projects of new vineyards are created with the resolution of specific varieties of this long-standing and traditional culture. In this multifaceted work, Moldavian scientists, such as academician B. Gaina, prof. N. Taran, prof. A. Balanutsa, Dr. G. Arpetii, Dr. I. Prida, Dr. K. Olaru and others work closely with their colleagues from Romania (Dr. A. Ranka - NIISVV), France (Prof. J-P. Mercier (-Vandee), Ukraine (Academician V. Vlasov - Research Institute V. C) and Russia (prof. T. Guguchkina - SKZNIISV). [14,15]

A new trend in the viticulture of Moldova is the original system of maintaining grape bushes of the Pergola system, developed in Italy and improved for the conditions of Moldova. The cultivation of table varieties according to this system made it possible to sharply improve the quality of grapes and expand its export zones in Russia, Romania, Poland, the Czech Republic and Germany. [2]

The quality of Moldovan wines has increased at the level of ensuring competitiveness in the markets of the European Union, as well as countries from the Commonwealth of Independent States. These achievements are based on innovations of recent years, which can be listed:

- the use of special races of yeast selected in Moldova in the course of many years of research work on their screening; the best of them are used in the technology of natural table wines with a varietal or complex aroma;

- the use of new biological products (bacteria malolactic fermentation from the genus *Leuconostoc oenos*), providing a qualitative biological decrease in acidity in red table wines, giving them a full and harmonious taste;

- the use of the best grades of bentonite for clarifying wort and colloidal stabilization of wines, providing a high flocculating effect while maintaining a low concentration of ions Ca^{2+} in the finished wines;

- the introduction of effective preparations of enzymes with pectolytic action in the technology of clarification of grape must, ensuring the complete destruction of colloidal particles and the subsequent comprehensive stabilization of wines;

- line up of technological lines for grape processing, conditioning and bottling of wines with new European equipment, ensuring the protection of wort and wines from oxidation by atmospheric oxygen, excluding metal corrosion or enrichment with phthalates derivatives;

- introduction of the best oak species of the *Quercus* family (*robur*, *petrae*, etc.) into the production for the production of oak barrels or chips and liquid extracts, providing a type of "boise" for high-quality wines, especially red table wines;

- use of low temperatures and inert gases (CO_2 , nitrogen, etc.) and minimum doses of SO_2 (60-70mg/l) to protect the wort and white wine from oxidation by atmospheric oxygen. [12]

The economy of the grape-growing complex of the Republic of Moldova is closely connected with its material and technical base, with human resources and markets.

In recent years, there has been a movement of specialists and workers from the country to Germany, Spain and France to work, as a rule, in the agricultural sector, including in the viticulture and winemaking sector.

This phenomenon created a large shortage of working hands in viticulture at the peak of the season of technological operations such as trimming and gartering of bushes, protecting plants from pests and diseases, harvesting and processing, etc. This phenomenon is especially pronounced in the cultivation of table grape varieties, where the proportion of manual labor is very big.

In the markets of the European Union and the CIS, as well as China, where mainly Moldovan wines are sold (about 70-75%), competition with wines from France, Italy, Spain, Austria, Chile and Argentina is growing.

In this regard, winegrowers and winemakers, united in the framework of the National Office of Grapes and Wines of Moldova, have adopted tactics to increase the competitiveness of Moldovan wines by reducing production costs and improving the quality of finished products. For example, experts began to introduce mechanized pruning of bushes on industrial plantations of vineyards, followed by manual adjustment of the bush. This increases overall productivity by 2–3 times. To protect the vineyards from hail, the country has created an anti-hail system that is functioning successfully.

The control of pests and diseases of a grape plant is often carried out by the classic drugs of the Bordeaux mixture ($\text{CuSO}_4 + \text{Ca}(\text{OH})_2$ and rosin sulfur (S), replacing very expensive systemic drugs that can be characterized by increased environmental toxicity.

The National Office of Grape and Wine tested for the first time a new system for recognizing the phytosanitary status of bushes (and entire vineyard plantations) using drones equipped with special spectrophotometers for detecting diseases of Nois and Flovecence d'ore, etc. [7]

In order to better organize work in the field of viticulture and winemaking in the Republic of Moldova, its entire territory is divided into four zones with a protected geographical indication: Sodru (Center of the Republic), Valul lui Traian (South), Ștefan Vodă (Southeast) and Divin (North). Comprehensive studies of soil composition, climatic conditions, and grape cultivation technologies are being carried out in each zone, which allow these factors to be optimized in order to ensure high quality grapes and obtained wines. The legal status of these zones was approved by a decision of the government of the republic with the name "Association of Producers of High-Quality Wines" and hereinafter: "Codru", Ștefan Vodă", etc.

The association includes both large enterprises (for example, "Vinăria din Vale" with more than 1.2 thousand hectares of vineyards), as well as small and medium-sized enterprises (20-60 hectares). In total, 40 small and medium enterprises of viticulture and winemaking have been created and are successfully operating in Moldova. The whole republic produces an average of 15-17 million decalitres of wine, which are exported in more than 90%. Unfortunately, 70% of them are exported in bulk. The volume of sparkling wines produced in Moldova reaches 14-15% of the total volume of wines in the country.

The qualities of Moldovan wines are highly appreciated at various prestigious international competitions in Paris and Bordeaux, Brussels and London, Milan and Bergamo, Ljubljana, Bucharest, Moscow, Krasnodar, Chisinau and Yalta, etc. Many wines and divins (cognacs) of Moldova were awarded the highest international Grand Prix award.

Two enterprises of Moldova were determined by the decision of the Government as "National Cultural and Wine-Making and Heritage". This is the Cricova Vintage Wine Factory and the Mileștii Mici Vintage Wine Factory - both with wonderful cellars and wine collections of millions of bottles. Wine collection "Mileștii Mici", which has about 2.0 million bottles, is listed in the world Guinness Book.

Moldova has a well-established international grape-growing route. About 100 thousand tourists, wine connoisseurs, experts and journalists visit it annually.

CONCLUSIONS

Currently, the economy of the Republic of Moldova is based on IT technologies, the achievements of the country's agricultural sector and the results of other industries (food, textile, HO-RE-CA). Scientific and technological progress in the grape-growing complex of Moldova has become the basis for its re-equipment with new biologics (yeast, NMB bacteria, enzymes, activators of biomass growth), inert gases and low temperatures. A harmonious combination of classic varieties and new hybrids of interspecific selection (Legend, Viorica, Bianca, Solaris, etc.) allows us to ensure high quality of wines produced in the Republic of Moldova, as well as guarantee an increasing demand for wines from local grape varieties (Fetasca white, Fetasca regale, Black fetash, Rara neagre, Codru, etc.).

The competitiveness of Moldovan wines on the world market is ensured by the following factors: high quality of grown grapes, improvement of its processing technologies, application of hygienic biological fermentation processes and, finally, a reasonable quality / price ratio.

Further expansion of the Moldovan wine markets, which have gained a good reputation and received high awards at international wine contests, seems appropriate in China, Singapore, the USA, Canada and Great Britain. The development of these markets has already begun successfully and there is currently an increase in the supply of these products.

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