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ABSTRACT

of the dissertation for the degree of Doctor of Philosophy

IMPROVING OF THE TECHNOLOGY OF CALVADOS PREPARATION

Specialty: **3309.01- Food technology**

Field of science: **Technical sciences**

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GENERAL DESCRIPTION OF THE RESEARCH

Relevance and degree of completion of the topic. In Azerbaijan, as a result of the anti-alcohol campaign that began in 1985 and for other reasons, many very wide grape plantations were rooted and reduced by up to 25 times. In recent years, steps have been taken to develop the industry, laws and programs have been adopted. Due to all the measures taken, it was possible to increase the area of vineyards to 16.5 thousand hectares. From these vineyards, 150-170 thousand tons of grapes are harvested annually. A significant part of the resulting products is aimed at meeting the needs of the country's population for its consumption in fresh form. The rest of the production was not at a level that would meet the demand of winemakers, without covering the potential of the country. On the other hand, during the season, a significant part of the fruit crop is not used for various reasons. The country's fruit and berry raw material base can play a crucial role both in bridging this gap and in increasing the range and competitiveness of beverages produced in the country.

In 2020, 1 million 133.1 thousand tons of fruits and berries were produced in our country. Apples, pomegranates and dates account for more than 60% of the total weight of the fruit produced. It is known that fruit production is seasonal. Mass production, that is, the fact that the supply in many cases exceeds the demand, and ultimately leads to the product being sold lower than the deca, or spoilt and thrown away. At the same time, very small and with various defects (spotted, spotted, damaged, wrinkled, etc.) fruits are either thrown out of use, or does not find full effective use. These disadvantages can be eliminated by organizing the processing of raw materials and focusing on the production of beverages that can be stored for a long time. One of these drinks is Calvados, which has become famous in the world markets.

It should be noted that the basis for the formation of the unique taste of Calvados is the mixing of apple varieties in certain proportions during the production process. Even in many countries, special preference is given to the use of small apples for this purpose. This is not an accident at all. Studies show that the smaller the fruit,

the brighter the flavor of the resulting drink.

Preparation of juices and other beverages from fruits and berries by N.A.Mekhuzly, A.L.Panasyuk, A.M.Litovchenko, K.T.Tyurin, A.A.Nabiev, H.K.Fataliev, T.M.Panakhov, V.Sh.Mikailov, M.A. Magerramov and others. However, the conducted research did not cover the fermented Calvados material from apple varieties grown in Azerbaijan, as well as the technology of making calvados and elements of its improvement. As you can see, the field faces a scientific problem, the solution of which is important.

Purpose and objectives of the study. The aim of the study is to improve the production technology of calvados using apple varieties grown in Azerbaijan.

To achieve this goal, the following tasks are provided::

- evaluation of native and introduced apple varieties for the preparation of fermented apple juice (Calvado material) ;
- research on the production of safe apple juice for calvados;
- study of the fermentation process of apple juice;
- improvement of the technology of wine material (fermented apple wine) for calvados;
- production, storage and cultivation of calvados alcohol and study of the processes occurring at this time;
- improved calvados production technology, its hardware and economic reporting.

Research methods. The object of the study was the juice, crush, wine material, Calvado alcohol, calvados obtained from native and introduced varieties of apples cultivated in our country, the technology of their preparation and processing, the process and hardware of cultivation. The main components of the chemical composition in juice, wine and alcohol (the amount of dry substances in the solution, the determination of sugars, the mass fraction of titrated acids, the volume fraction of ethyl alcohol, the determination of the hardness of ethyl alcohol, etc.) were performed in accordance with standard methods in action. Aromatic compounds were determined by gas chromatography, phenolic compounds, toxins-by high-performance liquid chromatography, metals-by Atomic Emission Spectroscopy.

Main provisions to be submitted for defense:

- selection of local and native apple varieties for calvados and ways to experimentally solve their optimal proportions used in the blend;
- causes of damage to raw materials, contamination with toxins and ways to eliminate them;
- features of changes in the composition and quality of raw materials depending on the variety, processing method, growing conditions;
- solutions for the production of environmentally friendly semi-finished products (juice, fermented wine materials) for calvados;
- scientific justification of the influence of the yeast race and various ingredients on the composition and quality of the wine material;
- solutions for the production of apple wine materials of improved quality using wine-alcohol yeast extract;
- methods for obtaining destilate with a high content and organoleptic characteristics with the addition of yeast autolysate and yeast destilate;
- storage and cultivation of apple destilators and the processes occurring at this time, features of the experimental solution of the dynamics of aromatic compounds.

Scientific novelty of the research. For the production of calvados, the best varieties of apples grown in local conditions were selected and the optimal proportions of the content of the components in the blend were determined. It is experimentally proved that the amount of toxins in the raw material varies depending on the variety, growing conditions and causes of fruit damage. By determining how to extract high-temperature-resistant Patulin, a safe apple juice for calvados was made.

The hardware and technological schemes of production of wine material, destilate and calvados of improved quality with the use of additives that allow to improve the quality (wine-alcohol extract of kedge, yeast autolysate and destilate of the bone) are experimentally justified and developed.

Theoretical and practical significance of the study. Study of the mechanical and physico-chemical properties of various varieties of apples grown in different geographical areas, selection of favorable raw materials for calvados, determination of the blend components and their amount in the blend based on these varieties, production of environmentally safe Calvados material with the removal of toxins, in particular Patulin, production of wine material and improved quality destilate using additives such as wine-alcohol extract, destilate seeds and yeast autolysite. issues of winemaking and fermentation produc-tion technology, in particular, it has theoretical significance for research conducted in the production of fruit and berry drinks.

Of practical importance for the wine industry are the degree of contamination of the resulting juice and wine material, depending on the causes and degree of damage to the fruit, the resulting transformations into raw materials, the determination of the optimal dose of enzymes to increase the yield and quality of products, the determination of the type and dose of additives used in the preparation of Calvados, the development and successful testing of hardware and technological schemes that ensure its implementation.

Approbation and application of works. The main provisions of the dissertation were presented at scientific and practical conferences of the faculty, doctoral students and masters of the Faculty of Agricultural Technology of the Azerbaijan State Agrarian University (Ganja, 2017-2020), the International Scientific Conference on " Current problems of Modern Natural and Economic Sciences" at the Ganja State University (Ganja, 2018), dedicated to the 100th anniversary of the formation of Azerbaijan at the International scientific conference of Teachers, doctoral students and young researchers (Baku, 2018), at the II Republican scientific and practical Conference at the Azerbaijan State University of Economics on the topic "Prospects for the development of the food and textile industry in Azerbaijan and the upcoming tasks" (Baku, 2018), at the international scientific conference at the St. Petersburg State Agrarian University on the topic "Scientific support for the development of JSC in the context of import substitution" (St.

Petersburg, 2020), at the XIII International Scientific and Technical Conference at the Mogilev State Food University on the topic “Technology and Technology in food Mogilev, 2020).

Developed and implemented in JSC “Az-Granata” as part of an improved hardware and technological scheme, the technology that allows you to produce wine material Calvados and Calvados of improved quality. The organization of production of calvados with the use of advanced technology allows you to earn an income of 4004 thousand manats per 7000 dal of finished products per year and a profitability level of 36.4%.

The name of the organization where the dissertation work is performed. The dissertation work was carried out at the department of " Engineering and examination of food products” Azerbaijan State Agrarian University.

The total volume of the dissertation with an indication of the volume of the structural sections of the dissertation separately.. The dissertation work consists of an introduction, four chapters, a conclusion, a list of references in the number of 147 and appendices. There are 22 figures, 62 tables and 2 appendices. The dissertation contains an introduction of 6 pages and 11521 characters, the first chapter 27 pages and 54844 characters, the second chapter 17 pages and 23818 characters, the third chapter 57 pages and 88059 characters, the fourth chapter 24 pages and 39355 characters, conclusions 2 pages and 3633 characters, recommendations for production 1 page and 779 characters, References 147 numbers, 16 pages and 27398 characters. The volume of the dissertation is 159 pages of computerized text, the total volume is 255628 characters (226753 characters excluding the list of references and appendices).

CONTENT OF THE WORK

In the introduction, the relevance of the topic, the problem statement and the general characteristics of the dissertation are given.

First chapter. This chapter is entitled "Analytical review, goals and objectives of the study", which reflects the research conducted in this area, with reference to the selection and first processing of raw materials for cider, production technology of apple wine material

(cider), sources of formation of volatile compounds in dark drinks obtained from fruit.

The analysis shows that the quality of Calvados is determined depending on the raw materials used, the technological parameters of the fermentation process, the yeast used, the fermentation conditions, the mode of destilling, separation and cultivation of Calvados destillate into fractions, the formation of aromatic compounds at various stages, as well as adaptation to local conditions.

Thus, it became relevant to study the influence of individual stages of production of fermented apple wine material and Calvados distillate using native and introduced varieties of apples cultivated in local conditions on the quality characteristics of the final product, which is of scientific and practical interest for fruit and berry winemaking.

On the other hand, apple production around the world is growing dynamically from year to year. Although the bulk of the product produced is used fresh, a significant amount of the product is also processed. In our country, the production of apples is particularly important, its annual production is estimated at 250 thousand tons.The development of effective methods of processing this product is relevant.

Second chapter is entitled It is called It is called "Objects of research and methods of experimental research". Here, first, a brief description of the object of research and raw materials is given. Then the methods of analysis carried out on raw materials, semi-finished products and the main product are given.

The qualitative and quantitative composition of organic acids is determined in the device "Agilent Technologies 1200 Series" (”Agilent", USA) by high-performance liquid chromatography (EMH). In the analysis of the main aromatic compounds, the gas chromatography of the Agilent 7890A brand with a flame ionization detector is used, and in the analysis of minor aromatic compounds, the gas chromatography of the Agilent 6890N brand and the associated mass spectrometer of the Agilent 5975B-MSD brand are used.

The study used native and introduced apple varieties. The apples received at the plant after washing were selected by varieties in the amount of 100 kg from each.

The apples were sampled and grouped by the degree of rotting on them. They are grouped and processed separately in a mold with no rot as a control (0% rot 25% rot, 50% rot and 100%) and with varying degrees of rot.

Third chapter is called "The results of experimental studies and their analysis". Here are the mechanical and physico-chemical properties of the apple raw materials used, damage to the raw materials for various reasons and microbiological infections, as well as the complications caused by this in the product to be processed. The production of calvados-safe juices and wine materials and the factors affecting it were investigated. While the content of Patulin in the juice obtained from apple fruit with 25% rot is 66.5 mg/kg, this indicator increases with an excess of rot (fig.1). In fruits with 50% rot, the content of Patulin was 190.1, and with 100% rot - 237.4 mg/kg.

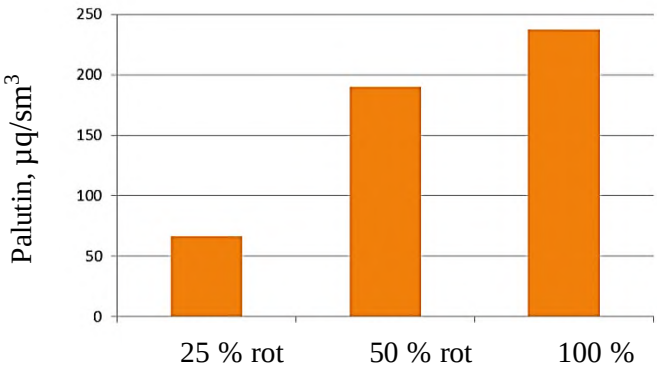

Figure 1. The amount of patulin in apple juice, depending on the percentage of damage.

In the course of research, it was found that various treatments, including hot, do not significantly affect the amount of patulin. Thus, powdered activated carbon was used to reduce the patulin content in apple juice. In the laboratory, apple juice with patulin was made and a trial treatment with activated carbon was carried out (fig.2).

Treatment of apple juice with patulin 25 μq/sm^3 with active carbon in an amount of 17 μq/sm^3 resulted in complete removal of patulin. In cases where the dose of charcoal was reduced, patulin was not completely eliminated. To remove toxins, bentonite, gelatin, as well as various brands of universal polycationite and activated carbon, which are widely used in the rinsing of fruit wines, are used in production. At this time, the optimal amount of adhesives is determined by the pre-conducted sample adhesion. For bentonite, it is 3.0 g/dm^3, gelatin-25 mg/dm^3, and for universal polycatinoite-125 mg/dm^3.

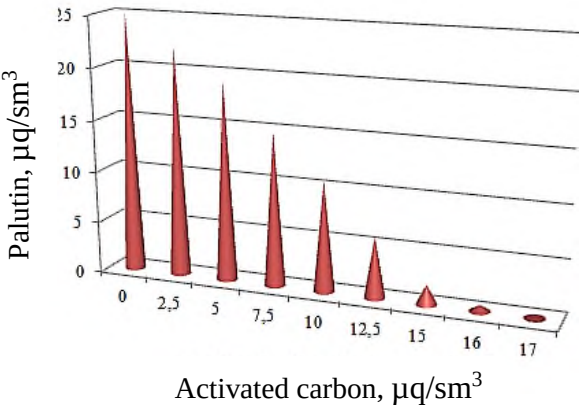

Figure 2. The effect of activated carbon on the amount of patulin.

The content of phenolic compounds in the juice obtained from the apple variety Golden Delishes, grown in areas located at different altitudes above sea level, was studied. In apple juice samples, 10 pics were found for phenolic compounds. The sum of the identified and recognized ones is shown below (fig. 3).

When looking at the composition of the main phenolic compounds by region, it becomes clear that they are represented by chlorogenic acid, epicatexin, flureting glycoside, fluorocytisine, and p-Coumaric acid. P-Coumaric acid was found in the lowest amounts (4.4-4.9 mg/l), and chlorogenic acid was found in higher amounts (126.5-132.6 mg/l). After chlorogenic acid in the intermediate position,

epicatexin (39.3-41.0 mg/l), floretinglycosite (13.7-15.0 mg/l), and fluoridzine (11.4-13.0 mg/l) successively decreased in quantity.

The amount of phenolic compounds in apple juice showed a difference depending on the year of harvest. The number of phenolic compounds in apple juice for 2017-2019 is shown below (table 1).

Apparently, the number of phenolic compounds was not stable over the years. Chlorogenic acid was highest in 2018 (195.4 mg/l), epicatexin in 2019 (96.3 mg/l), fluorescent glycoside in 2017 (22.6 mg/l), and fluoridzine and p-Coumaric acid in 2017 (14.6 and 9.3 mg/l, respectively).

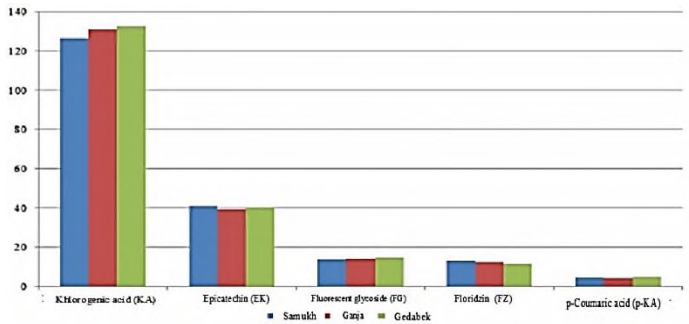

Figure 3. Changes in phenolic compounds in Golden Delishes apple varieties by region, mg/dm^3.

The amount of phenolic compounds also varied depending on the variety.

Table 1. The amount of phenolic compounds in apple juice, depending on the year of harvest

Phenolic compounds	Quantity by year of harvest, mg / l		
	2017	2018	2019
Khlorogenic acid (KA)	162,3	195,4	186,8
Epicatechin (EK)	70,5	79,7	96,3
Fluorescent Glycoside (FG)	22,6	19,3	21,7
Floridzin (FZ)	14,6	14,1	14,5
p-Coumaric acid (p-KA)	9,3	7,7	6,4

The Gold Ahmad apple variety was distinguished by the fact that the content of phenolic compounds in it was higher than in other varieties. In this respect, the dwarf apple variety is closer to it. In the

Fuge variety, the content of p-Coumarinic acid, fluoridzine, and fluretinglycoside was less than in the yellow sour apple variety; while the amount of chlorogen and epicatexin was more than ten.

The influence of various ingredients on the quality of wine material was studied (table 2).

Table 2. Influence of various ingredients on the quality of wine material

Indicators	Wine material (w/m) and added ingredients			
	Control (without additives)	W/m + rectified ethyl alcohol	W/m+raw alcohol	W/m +apple jelly extract
Sugar, g/dm^3	3	2	2	2
Alcohol, x %	7,1	10,5	10,4	11,6
Amine nitrogen, mg/dm^3	31	31	43	48
Grain alcohols, mg/dm^3	180	166	241	302
Methyl alcohol, mg/dm^3	110	122	141	19,4
Polysaccharides, mg/dm^3	205	146	151	148
Esters boiling at low temperatures, mg/dm^3	61	73	64	81
Esters boiling at high tempera-tures, mg/dm^3	21	118	148	157
Tasting price, honey	7,2	7,5	7,5	7,8

Apparently, in comparison with the control, the aroma-forming compounds are increased in the wine samples with the addition of apple jam extract, rectified alcohol and raw alcohol. The resulting assimilation enriches the bouquet of wine and has a positive effect on the formation of taste.

The resulting wine samples acquire a richer taste, aroma and richness. Experimental samples of wine are characterized by a lower tendency to oxidation, having a higher content of the extract. The organoleptic evaluation showed that the wine materials fermented with a high initial sugar content of the juice, after the introduction of

additives, were evaluated by 0.3-0.5 points higher than the control sample of wine with better transparency, pure fruit tone, rich soft taste. At that time, samples with the addition of an extract of wine-alcohol jelly were superior to other samples both in flavor and taste. Using this method in production is not difficult, it eliminates time-consuming and expensive operations and allows you to make the process smooth.

Based on the conducted research, a hardware and technological scheme for the production of Calvados wine material of improved quality has been developed. The difference between the scheme and its analogues is the return to the reproduction of kcal taken from the compressor and going for disposal. The agitator is fed from the compressor to a mixing tank with a screw conveyor. A 25-30% wine-alcohol extract is added to it from the dispenser and the blender is started. After the process is completed, the mass in the tank is squeezed out, and the resulting wine-alcohol extract is added to the wine material in an amount of 3-5%. More extractive wine material, obtained in improved quality, is collected in the collector.

Studies show that the best calvados can be obtained not from one variety, but from a mixture of varieties that differ in taste and composition. Taking this into account, some local and introduced apple varieties that are widely distributed in the country in the course of research are grouped by certain indicators. At this time, the fruit was mainly divided into sweet, sweet-sour and sour varieties.

Among the studied varieties, the varieties "Gold Ahmedi", "Golden Delicious", "Yellow Sour", "Simirenko Reneti", "Fujet" and Jirhaj were selected that meet the requirements of these groups in terms of composition. As you know, the apple varieties Golden Delicious, Simirenko Renety and Fuje, represented among these varieties, are widely distributed in our country, although they are introduced varieties. Along with these varieties, wine materials made separately in accordance with the technological scheme from the local varieties mentioned above were studied, and then their blending was carried out. The components of lentils, indicators of the composition of the blend and the proportion of components in the blend are shown in the table below (table 3).

Apparently, in addition to ethyl alcohol and sugars, titratable acids are also present in the composition of apple wine, and the main source of its formation is also fruit raw materials. And some, as you know, are formed in the process of reproduction.

Table 3. Composition and blend of wine materials from different varieties

Blend components (wine materials)	Composition indicators					The number of com-ponents in the blend, %
	Brought extract, g/dm^3	Spirt, h%	Sugar, g/dm^3	Titratable acidity, g/dm^3	Volatile acidity, g/dm^3	
Golden Ahmed	21,2	8,5	15	5,1	0,820	10
Golden Delicious	15,4	5,1	21	5,5	0,930	30
Yellow acidic	17,1	6,2	15	8,5	0,850	10
Renety Simirenko	17,3	6,0	12	9,2	1,050	20
Jirhaj	18,7	7,3	17	4,8	0,792	10
Fujet	16,2	6,4	19	8,2	0,991	20
Wine material after blending	16,8	6,5	18	7,3	0,922	-

They give the wine material a pleasant individual taste. Based on their number, you can get an idea of the naturalness and ripeness of the drink. If the titrated acids are larger than the norm, this indicates their acidification and occurs as a result of storage in unfavorable conditions. In the studied samples, the content of titrated acids varied in the range of 4.8-9.2 g/dm^3, depending on the raw material. The highest acidity was observed in the wine material obtained from the apple variety "Simirenko Reneti", and the lower acidity-in the wine material Jirhaj.

Fourth chapter is called "Improving the hardware and technological scheme of production based on research results". Based on the conducted research, an improved hardware and technological scheme for the production of calvados was developed. In accordance with this scheme (fig.4), the wine material for collecting apples is fed from the storage tank-1 through the pump-2 to the distiller-3. Alcohol fractions 3, separated during the distillation process on the distillation apparatus, are collected in the collector of the head and

tail fractions-4 and in the collector of calvados alcohol-5. Calvados alcohol is pumped into the tank-8, designed for blending strong calvados alcohol. Here, through the dispenser-9, lentil distillate and yeast autolysate are added in an amount of 1-2%.

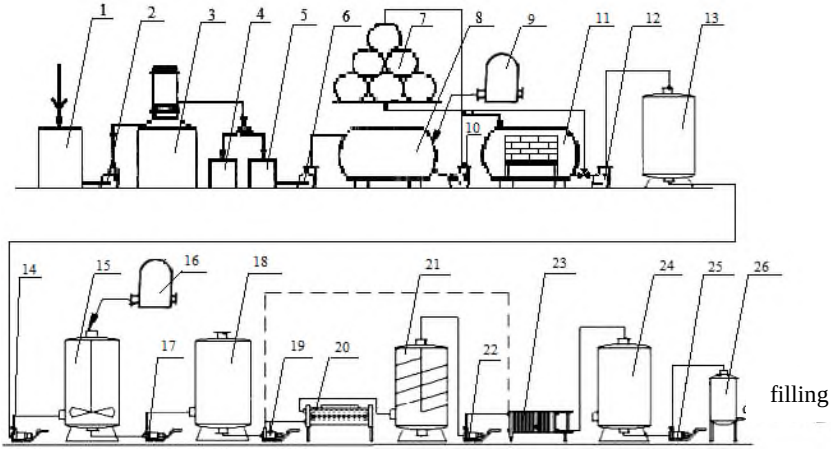

Figure 4. Hardware and technological scheme of calvados production:

1-storage tank; 2, 6, 10, 12, 14, 17, 19, 22, 25-pumps; 3-float device; 4-collector of the head and tail fraction; 5-collector of Calvados alcohol; 7-oak barrels; 8-tank for filling young Calvados alcohol; 9-dispenser for ingredients; 11-metal tank for diluting Calvados alcohol; 13-tank for collecting alcohol; 15-blending tank; 16-dispenser for ingredients; 18-tank for tempering the blend; 20-device for working with cold; 21-thermal accumulator; 23-filter-compressor; 24-storage tank; 26-cartridge filter for control filtration before filling.

Here, a blended and conditioned batch of alcohol is pumped into 10 oak barrels-7 or into a metal tank with an oak board-11. Calvados alcohol, stored and grown in sufficient quantities, is pumped from oak barrels or metal tanks lined with oak-12 inside to the alcohol collection tank-13. Calvados alcohol is taken by the pump-14 from the storage tank and fed to the blending tank-15. Here, a blend of Calvados alcohol is made with the addition of softened water, sugar syrup and other ingredients from the dispenser-16 as needed. By pump-17, the material taken from the blending tank is fed to the tank-18 for the release of the blend. After installation at rest, the

pump-19 is pumped from the refrigeration unit-20 to the thermos tank-21. From there, the purified blend collector-24 is pumped through the pump-22 to the filter-compressor-23. For the control filtration of the calvados, before filling, the material taken by the pump-25 from the collector tank is fed to the cartridge filter-26. A drink that meets all the requirements is focused on the filling.

The composition of the alcohol fractions of the obtained apples is analyzed. A pungent odor with a high content of aldehydes and esters was observed in the head fraction. Esters contained in Calvados destil are formed as a result of the interaction of alcohol and fatty acids, as well as biochemical processes that occur as a result of the vital activity of yeast. It should also be noted that esters play an important role in dehydration as aroma-forming substances (table 4).

Table 4. Components of apple alcohol fractions

Name and number of components, mg/dm^3	Fractions of raw alcohol		
	Main	Average	Tail section
1-butanol	54,6	111,3	36,5
1-propanol	154,9	163,7	75,8
2-propanol	1,3	1,1	0,3
Iso-pentanol	1280,0	2260,0	136,9
Iso-butanol	286,5	273,2	14,1
Methanol	1,3	1,0	2,2
Methylacetate	81,2	6,7	-
Acetic aldehyde	2336,4	215,2	9,3
Ethyl Acetate	4289,7	520,7	6,3

Apparently, the head fraction, in comparison with other fractions, is marked by a high content of ethyl acetate, mainly acetic aldehyde, and methyl acetate. The tail fraction does not contain methyl acetate, 2-propanol, or in fairly small amounts. But the amount of methyl alcohol is higher than that of other fractions. It is noteworthy that the average fraction contains less methyl alcohol. It turns out that in the tail fraction, aroma-forming substances are weaker than aldehydes, esters and essential oils. In the further research process, it was considered appropriate to use the average fraction. In order to further enrich this fraction in terms of composition and quality, 1-2% destilate and yeast autolysate were

added to the alcohol samples before being stored and grown. Storage and cultivation of Az-granat was carried out in production conditions at the enterprise for processing juice and wine. The blended calvados was grown by storing in destilyt oak barrels. The composition of the components of young and one-year-old Calvados alcohol is shown in table 5.

Table 5. The effect of growing apple alcohol on the composition indicators

Composite components	Mass density of components, mg/dm^3		
	Source material	Grown distillates	Example added to distillate lentils
Methylacetate	5,1	14,2	14,9
Ethyl Acetate	251	409	421
Ethylbutyrate	215	212	216
Acetic aldehyde	165	170	179
Benzaldehyde	1,01	1,81	1,93
2-propanol	0,911	2,011	2,302
2-butanol	0,576	0,031	0,031
1-propanol	116,0	122,1	124,7
Iso-butanol	135,1	156,4	168,1
1-butanol	118,3	125,1	129,2
Iso-pentanol	1109,3	1166,3	1248,9
1-pentanol	2,9	2,7	2,9
1-hexanol	22,8	27,1	31,3
2-phenylethanol	18,2	46,4	57,8
Organoleptic evaluation, honey	7,1	7,6	7,9

Apparently, when storing and growing apple alcohol in oak barrels, there are significant changes in the qualitative composition of the components. Thus, there was an increase in the amount of esters, including methyl acetate, more than 3 times, and ethyl acetate-almost 2 times. For some indicators, there was a decrease in the amount of alcohols, and for others-an increase. In the samples added to the lentil distillates, these transformations were seen to be more intense. This sample outperformed another sample grown due to its high organoleptic performance and was rated 0.3 points.

During the one-year follow-up, an increase in phenolic compounds was observed in all the alcohol samples studied. This is also due to the fact that the extraction of phenolic compounds from oak wood is a gradual process.

Transformations of the lignintanin complex from oak wood to form aromatic aldehydes (with the formation of jasmine, synapse, coniferyl, and vanilla) were characteristic of all specimens, regardless of the variety. But in some varieties, these quantities showed variability. Compared to the initial samples, there was a significant decrease in the content of methyl alcohol in the stored and grown destil. This was shown more clearly in the example of the blend. The decrease in methyl alcohol was associated with the essential fermentation processes occurring during cultivation, and a softening of the taste and aroma was noted.

Results

1. During the study of apple varieties grown in different geographical areas, it was found that the apple varieties Golden Delishes and Simirenko Reneti had a sugar-acid potential (SHTP) of 14.6-15.3 and an acid phenol index (TFG) of 6.9-7.8; and the varieties Carhaci and Golden Ahmedi ranged between TFP 20-25 and tfg 5.2-5.8. Their use in the blend was considered appropriate, since obtaining a full-fledged wine material in the case of a TFG of more than 6.0 is controversial.

2. To increase the juice yield, preservatives and new-generation enzyme preparations were used, and in this case, the fructose-P (FP) enzyme preparation at a dose of 20 mg / kg provided a greater conversion of biopolymers, including polysaccharides and pectin substances, and a higher juice yield. The use of enzymes within the normal range did not negatively affect the quality of the future product.

3. While the Brix index, hydroxymethylfurfural, and acidity showed an increase from healthy to complete decomposition when processing applesauce with different amounts of FP with different degrees of rot, the highest limit was in incomplete decomposition. A similar situation was observed with an increase in the dose of AF

(50, 100 and 150 mg/kg) and the storage time in crushing (0, 20, 40, 60 min).

4. Depending on the causes of the lesion and the species composition of microorganisms, the degree of contamination of fruits with toxins and ways to eliminate it are justified by experimental studies. Thanks to the extraction of high-temperature resistant patulin, a sophisticated technology has been developed to produce a safe juice for calvados and at the same time extract toxins.

5. For calvados, the optimal quantitative ratios of components in the blend belonging to varieties representing different groups in composition and quality are determined. It turned out that from a blend of wine materials Golden Ahmedi (10%), Golden Delishes (30%), Yellow sour (10%), Simirenko renety (20%), Fuji (10%) and Fuje (20%), a material with a high content and organoleptic qualities is obtained.

6. A technological scheme for the production of Calvados wine material of improved quality, with high viscosity, optimal composition and organoleptic characteristics, with the addition of 3-5% wine-alcohol yeast extract and 0.5-1.0% yeast autolysate to the fermented wine material of the yeast races "Universal" and "Apple" 5.

7. The head fraction obtained by boiling and distilling in Charente-type apparatuses is characterized by a higher density of ethyl acetate, acetic aldehyde and methyl acetate compared to other fractions. The tail fraction had almost no methyl acetate, 2-propanol, and the middle fraction had significantly less methyl alcohol than the others. The production of higher-quality calvados destilate with the addition of kedge destilate and yeast autolysate (1-2%) to the average fraction is justified.

8. Apple alcohol was grown at the Az-Granata enterprise by storage in oak barrels. It turned out that during the year of storage, there was an increase in the content of esters, including methyl acetate, by 3, and ethyl acetate-almost 2 times. The decrease in the amount of methyl alcohol became noticeable and had a positive effect on the quality.

9. A technology has been developed that ensures the production of Calvados wine material and calvados of improved quality with the use of additives, and a hardware and technological scheme that allows it to be implemented in production. The organization of production of calvados with the use of the proposed technology and scheme allows you to earn an income of 4004 thousand manats for 7000 dal of finished products per year and a profitability level of 36.4%.

Recommendations for manufacturing

- for the production of calvados, do not use apples collected at the stage of technical maturity and stored for 15 days;
- for calvados, do not use autumn apple varieties with a phenol acid index higher than 6 in the blend;
- technology that ensures the elimination of toxins, in particular patulin, from fruit juice;
- application of the quantitative ratios of apple varieties established in the blend, representing different groups for calvados;
- use in the production of calvados wine material of improved quality with the addition of selective yeast races and extract of wine-alcohol hops;
- technology and hardware for the production of calvados with improved quality with the addition of yeast autolysate and yeast destilate in the medium fraction destilate.

The main provisions of the dissertation are reflected in the following published articles:

1. Baloglanova, K. V. Fataliev, Kh. K. Research of production of raw materials and wine materials for calvados // Azerbaijan Agrarian Science, No. 4, 2017, pp. 161-164.
2. Mammadov, B. A. Device for processing wine material by cryotherapy. Utility model U 2019 0056, Center of Patents and Trademarks of the Azerbaijan Republic public legal entity / K.V. Baloglanova, F. K. Fataliyev, R. T. Khalilov.
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lopment of the food and textile industry in Azerbaijan and the challenges ahead", Azerbaijan State Economic University, Baku, April 25, 2018. - p. 91-93.

4. Baloglanova, K.V. Study of the mechanical and physico-chemical properties of some of the introduced varieties of apples // the Azerbaijani agricultural science. - 2018, No. 1. - p. 100-104.

5. Baloglanova, K.V. Research of safe raw materials for calvados Ifalina // Actual problems of modern natural science and economic science, International Scientific Conference. Ganja State University. - Ganja, 2018. - p. 348-349.

6. Baloglanova, K. V. Fataliev, Kh. K. Research of fruit wine consumption // Materials of the international scientific conference of the faculty, doctoral students and young researchers dedicated to the 100th anniversary of the formation of the Azerbaijan Democratic Republic, Azerbaijan University of Architecture and Construction. - Baku, April 26-27, 2018. - pp. 180-181.

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17. Baloglanova K.V., Gadimova N.S., Fataliev Kh. K. The study of the content of flavoring substances in calvados depending on the apple variety. Proceedings of the XIII International Scientific and Technical Conference, April 23-24, 2020, Volume 1, Mogilev, MGUP, pp. 89-90.

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