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Influence of yeast and nutrients on the quality of apricot brandy

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Abstract: Five yeast strains *Saccharomyces cerevisiae* and *S. bayanus* (SB, Top Floral, Top 15, Aroma White and Red Fruit) and two nutrients, diammonium phosphate and Nutriferm Arom, were examined for their influence on young apricot brandies, with a special emphasis on the chemical, volatile and sensory characteristics. Analyses of the major and minor volatiles and sensory analysis of the apricot brandies showed important differences between the samples. The total sensory scores of the apricot brandies ranged between 16.88 for the control sample to 18.35 for the sample produced with the SB yeast strain and diammonium phosphate as nutrient. All the samples of apricot brandies fulfilled EU requirements as regards their content of methanol and other components, such as acetaldehyde, ethyl acetate, and higher alcohols.

Keywords: apricot brandy; yeast strain; nutrients; volatile compounds.

INTRODUCTION

Fruit brandies are a large group of alcoholic beverages the consummation of which is increasing from year to year, especially on the Balkan region. During the last ten years in Serbia, many small distilleries started to work and produce many different types of fruits brandies, such as plum, apricot, Williams pear, quince and apple. In most cases, the producers make fruit brandies in the traditional way without using selected yeast strains, enzymes or other agents. As the culture for the consummation of good quality brandy grew, many producers decided to improve the quality of their fruit brandy.

Apricots (*Prunus armeniaca* L.) are appreciated by consumers all over the world, and are presently cultivated in all Mediterranean countries, in Central and South Asia, South Africa and in North and South America.[1] The main varieties of apricots cultivated in Serbia are Hungarian best, Kecskemét and Ceglédi bibor.

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Selected yeast strains are used in fruit brandy technology to increase the speed of the fermentation process, to kill wild microflora and obtain a clean fermentation. When using a selected yeast strain, it is important to obtain good fermenting condition for yeast growth (temperature, oxygen and pH) and sufficient nutrients to improve the characteristics of the compounds newly formed during fermentation.[2] Depending of the biological predisposition, the conditions and the nutrients available during yeast growth, many minor compounds are formed that impart specific organoleptic characteristics to the final product.[3,4] Aroma is one of the main characteristics that determine an organoleptic quality and style of a brandy. This is the result of the contribution of hundreds of volatile compounds, including higher alcohols, esters, acids, aldehydes, ketones, terpenes, norisoprenoids and volatile phenols that are derived from volatile chemical compounds arising from the fruit, and the fermentation and distillation processes.[5] During alcoholic fermentation, many volatile components are formed and modified by the yeast, and the yeast strain has a great influence on the profile and production levels of these compounds.[6]

Flavor compounds have a range of common chemical group characteristics. The main apricot flavor compounds are esters, some terpenes, alcohols, aldehydes and lactones. In apricot fruit, over 100 flavor compounds were detected.[7]

The first significant studies on apricot flavor were performed by Tang and Jennings utilizing direct extraction, vacuum steam distillation and charcoal adsorption to isolate the volatiles.[8,9] Several studies on the relative importance of some volatile compounds to the typical aroma of apricot were completed. Studies on odor threshold demonstrated that the major contributors to the aroma of blended apricot included β-ionone, linalool, γ-decalactone, β-cyclocitral, phenylacetaldehyde and γ-octalactone.[10] β-Ionone and linalool may be responsible for the floral character and the lactones for the fruity, peach and coconut background aroma.[10,11] Some authors suggested that, in particular, hexanal, (*E*)-2-hexenal, α-terpineol, myrcene, limonene and geraniol should also be considered as key odorants of apricot.[12] Benzaldehyde gives a very strong almond aroma and is also a typical compound found in apricots.[7]

After alcohol fermentation, the fermented fruit pomace must be distilled once or several times, depending on the type of the distillation units and the required final product. Copper distillation units are traditionally used for the distillation of fruit pomace. During distillation, the fermented fruit pomace is heated to boiling and the formed steam containing alcohol, water and volatile compounds is introduced into the condenser where condensation occurs and at the end of the distillation units, condensate is obtained. When simple traditional distillation units (alembic type) are used, first condensate must undergo a second distillation – a redistillation. During the distillation process, the concentrations of alcohol, water and volatile compounds change. From the beginning of the distil-

lation to the end, the concentrations of alcohol and high volatile compounds (aldehydes and esters) slowly decrease and the concentrations of water and low volatile compounds (higher alcohols, acids) increase.[13]

The separation of a certain fraction of the condensate can be made to improve the final condensate and give a product having the characteristics required by the producer. For this reason, it is very important that during fermentation, the yeast produce satisfactory amounts of the volatile compounds that have a positive influence on the final product.[6]

The aim of this study was to identify the relationship between the chemical composition, volatile profile and sensory characteristics of freshly distilled apricot brandy, and the influence of commercial yeast strains on the quality of apricot distillates.

MATERIAL AND METHODS

Yeast strains and apricot

The experiments were performed to obtain apricot distillate using five different strains of selected yeasts and nutrients. For this purpose, the fruits were picked at the stage of full ripeness during July 2012. Hungarian cultivar "Kecskemét apricots" from an apricot plantage in the village Miokovci in central Serbia were used. The fruit was manually selected and transported to the laboratory on the day of collection.

On the day of fruit collection, the pits from the apricots were removed and apricot was pulped. The mashed apricot pomace had the following characteristics: total soluble solids 17 °Bx*, pH 3.3 and titratable acidity 2.21 g L^{-1}.

Alcoholic fermentation

Eleven plastic tanks of 25 L were filled with 20 kg of pulped apricot. Ten of the plastic tanks were inoculated with one of five *S. cerevisiae* and *S. bayanus* commercial wine strain yeast, in combination with one of two types of nutrients. The eleventh tank was the control tank without yeast or nutrients. The dried commercial yeast strains were rehydrated in water at 35 °C for at least 20 min. The nutrients were dissolved in water (1:5, *V*/*V*). Quantity of yeast added to the fruit during the experiments was 0.2 g kg^{-1}. The same amount of nutrients was added. The combination in tanks was that each yeast strain was in two tanks with different nutrients (Table I).

The fermentations were performed at 15–18 °C for 10 days (until the sugar concentration was reduced to below 4 °Bx). At the end of the fermentation, the yeast cells were allowed to sediment naturally for 2 days more. The alcohol content at the end of the fermentation was 7–8 vol. %

Distillation

When the alcoholic fermentations were finished, the fermented fruit mashes were immediately distilled in small copper units by double distillation. The distillation units had a capacity of 25 L. During the first distillation, no fractions were collected. After the first distillation, the obtained distillate contained between 25 and 27 vol. % alcohol. The redistillation was performed using a small copper unit of 5-L capacity. During the redistillation, fractions were collected: the first fraction (head) was 1.5 % by volume, the second fraction

* 1 Bx = 1 g of sucrose in 100 g of solution.

(heart), which contained on average 61 vol. % of alcohol, and a third fraction (tail).[13] All the second fraction distillates were gradually reduced with distilled water to 43 vol. % alcohol.

TABLE I. Nutrients and yeast used in the experiments

Sample	Yeast	Commercial name	Nutrients	Origin
SB1	*S. cerevisiae* ex r.f. bayanus	SB	Diammonium phosphate	EssecoSrl, Italy
TF1	*S. bayanus*	Top Floral	Diammonium phosphate	EssecoSrl, Italy
TOP1	*S. cerevisiae* ex ph.r. bayanus	Top 15	Diammonium phosphate	EssecoSrl, Italy
AW1	*S. cerevisiae*	Aroma white	Diammonium phosphate	EssecoSrl, Italy
RF1	*S. cerevisiae*	Red Fruit	Diammonium phosphate	EssecoSrl, Italy
SB2	*S. cerevisiae* ex r.f. bayanus	SB	Nutriferm Arom	EssecoSrl, Italy
TF2	*S. bayanus*	Top Floral	Nutriferm Arom	EssecoSrl, Italy
TOP2	*S. cerevisiae* ex ph.r. bayanus	Top 15	Nutriferm Arom	EssecoSrl, Italy
AW2	*S. cerevisiae*	Aroma white	Nutriferm Arom	EssecoSrl, Italy
RF2	*S. cerevisiae*	Red Fruit	Nutriferm Arom	EssecoSrl, Italy
CONT	*S. cerevisiae*	Control	–	Wild

All experiments were performed in triplicate, and the ethanol content was determined after the first distillation and redistillation. The major and minor volatile compounds were determined only in samples obtained after redistillation.

Analytical methods

Total soluble solids, sugar content, pH, titratable acidity and ethanol. The total soluble solid and the sugar contents of the apricot fruits were determined using a hand refractometer (Carl Zeiss Jena Model 711849, Germany) with an attached thermometer. The pH was measured by a 320 pH meter (Mettler Toledo). The titratable acidity was determined by titration with sodium hydroxide to pH 8.1 using phenolphthalein as an indicator. Ethanol was determined after distillation using an Alcoholmeter Guy–Lussac Classe II calibrated at 20 °C.

GC analysis of the major volatile compounds. The major volatile components were analyzed on the basis of the European Community Reference Methods for the Analysis of Spirits using gas chromatography (GC) with a flame-ionization detector (FID).[14] The main components, including methanol, acetaldehyde, 1-propanol, ethyl acetate, 2-methyl-1--propanol, 1-butanol, amyl alcohols and 1-hexanol, were identified by comparing their retention times with those of authentic compounds. For quantitative evaluation, the internal standard method was applied, with a known amount of 4-methyl-1-pentanol as an internal standard (IS). Thus, an ethanol solution containing 5 g L^{-1} 4-methyl-1-pentanol was added to 10 mL of each sample. The concentration of each volatile was determined with respect to the internal standard from the relative response factors (*RRF*), which were obtained during

calibration under the same chromatographic conditions as those of the sample analysis.[15] The GC analysis was performed with an HP 5890 gas chromatograph equipped with a flame ionization detector (FID) and a split/splitless injector. A capillary column (30 m×0.25 mm i.d., 0.25 μm film thickness) coated with HP-5 (5 % biphenyl and 95 % dimethylpolysiloxane) was used. The column oven temperature was programmed from 50 °C to 285 °C at a rate of 4.3 °C min^{-1}, and the injection port and detector temperatures were maintained at 250 °C. Hydrogen was used as the carrier gas at a flow rate of l.6 mL min^{-1} and the split ratio was 60:1. The sample volume was 1 μL.

Extraction and concentration of minor volatile constituents. Fifty milliliters of distillate was mixed with 100 mL of ultrapure water, 20 mL 1 mg mL^{-1} internal standard (methyl 10--undecenoate) added and then extracted with 40 mL of dichloromethane. NaCl (10 g) was added, and the mixture was stirred magnetically during 30 min. Layers were separated in a separator funnel, and the organic layer was dried (2 h) over anhydrous sodium sulfate. The extract was concentrated to 1.0 mL under nitrogen and directly analyzed on GC/MS.

GC/MS analysis of minor volatile compounds. Gas chromatographic analysis was performed using the same gas chromatograph and the same conditions as were employed for the analysis of the major volatile compounds, except the oven temperature was held at 50 ° C for 6 min before heating to 285 °C, the detector temperature was 280 °C and the injection mode was splitless. GC/MS analysis was performed using an Agilent 6890 gas chromatograph coupled with Agilent 5973 Network mass selective detector (MSD) operated in the positive ion electron impact (EI) mode. The separation was achieved on an Agilent 19091S-433 HP--5MS fused silica capillary column, 30 m×0.25 mm i.d., 0.25 μm film thickness. The GC oven temperature was programmed from 60 to 285 °C at a rate of 4.3 °C min^{-1}. Helium was used as the carrier gas, the inlet pressure was 25 kPa, and the velocity was 1 mL min^{-1} at 210 °C. The injector temperature was 250 °C and the injection mode was splitless. The MS scan conditions were source temperature, 200 °C; interface temperature, 250 °C; energy of electron beam was 70 eV and the mass scan range was 40–350 amu (atomic mass units). The identification of the components was based on retention indices and comparison with reference spectra (Wiley and NIST databases). The percentages (relative) of the identified compounds were computed from the GC peak areas.

Quantitative descriptive analysis

An expert panel composed of three expert testers (all males) performed the quantitative descriptive analysis. The panelists were recruited according to their years of experience as expert tasters for fruit brandy. The evaluation was conducted anonymously using the modified Buxbaum method, which is the worldwide-accepted method for sensory evaluation of strong alcoholic drinks.[16,17] The maximum numbers of points was 20. After tasting, the results of all testers for each sample were summarized and the mean value was calculated.

RESULTS AND DISCUSSION

Volatile compounds in apricot brandy

The heart fraction results of gas chromatography analysis of major volatile compounds are given in Table II. These results show the concentrations of acetaldehyde, ethyl acetate, methanol and six higher alcohols. The concentrations of these compounds and their ratios have a large influence on the final impression of the taste and smell of a sample. The results of the experiments showed signi-

ficant differences between the samples. The results of the GC/MS analysis of the minor volatile compounds in the heart fraction are presented in Table S-I of the Supplementary material to this paper.

TABLE II. Chemical composition in apricot brandies (mg L^{-1}, mean±*SD*, unless otherwise indicated)

Sample	AW1	AW2	RF1	RF2	TF1	TF2	SB1	SB2	TOP1	TOP2	CONT.
Acetalde-	80	41	39	49	39	46	47	51	59	52	62
hyde	±1.2	±0.7	±0.6	±0.9	±0.7	±0.9	±0.8	±1.0	±1.1	±1.1	±1.2
Ethyl	343	161	174	338	287	236	297	489	303	329	367
acetate	±5.3	±3.1	±3.4	±6.3	±5.3	±4.3	±4.6	±7.2	±3.5	±4.1	±4.3
Methanol	1928	1048	1462	1562	2485	2254	2146	1921	2014	1460	1441
	±10.2	±11.3	±12.1	±11.2	±16.2	±16.1	±15.2	±13.2	±11.3	±16.2	±10.9
1-Propa-	1404	1406	1359	1380	1161	1208	1535	1466	1758	1548	1112
nol	±9.2	±10.1	±11.3	±13.2	±12.4	±14.1	±12.8	±13.2	±14.2	±13.4	±10.9
2-Methyl-	253	267	209	223	296	274	203	213	227	199	247
-1-propa-	±3.4	±3.2	±2.9	±2.6	±3.1	±3.0	±3.2	±1.9	±2.1	±2.1	±2.3
nol											
1-Butanol	16	16	15	18	18	14	17	16	19	17	16
	±0.9	±0.9	±0.5	±0.8	±0.7	±0.5	±0.8	±0.6	±1.0	±0.9	±0.8
Amyl	527	585	509	562	487	517	501	538	585	526	553
alcohols	±5.3	±5.7	±6.3	±6.4	±7.5	±8.1	±5.8	±5.6	±5.7	±4.9	±4.7
1-Hexanol	12	13	15	14	15	17	13	12	16	15	17
	±0.2	±0.2	±0.3	±0.4	±0.1	±0.3	±0.2	±0.3	±0.4	±0.3	±0.3
Ethanol,	43.1	43.2	43.0	42.8	43.3	43.1	42.9	43.1	43.0	43.2	43.1
vol. %	±1.1	±1.2	±1.2	±1.4	±1.3	±1.7	±1.4	±1.5	±1.2	±1.1	±1.0

Alcohols

Alcohols are the most significant and dominate group of volatile compounds in fruit brandies and they have important influences on the sensory characteristics and quality of the products. Primary, they are formed by yeast from amino acids *via* the Ehrlich metabolic pathway.[4] The second way of their formation is by yeast through the reduction of the corresponding aldehydes.[18] The odor threshold of alcohols is considerably higher than that of the corresponding aldehydes, so alcohols are normally less important to the flavor profiles.[7]

The contents of alcohols in the tested samples varied significantly, as evidenced by the results obtained for major compounds. The highest content of 1-propanol, which has a pungent and alcoholic odor, was found in the sample TOP1 (1758 mg L^{-1}) and the smallest content contained sample CONT (1112 mg L^{-1}). The quantity of 1-butanol ranged from 19 mg L^{-1} in sample TOP1 to 14 mg L^{-1} in sample TF2. The highest amounts of 2-methyl-1-propanol, with a sweet musty odor,[19] were found in samples TF1 and TF2 (296 mg L^{-1} and 274 mg L^{-1}, respectively) and the smallest content was found in sample TOP 2 (199 mg L^{-1}). The content of amyl alcohols, with a mild and characteristic alcoholic odor,[20]

ranged from 585 mg L^{-1} in samples AW2 and TOP1 to 487 mg L^{-1} in sample TF1. The largest amount (17 mg L^{-1}) of 1-hexanol, with herbal and fruity odor, was present in samples TF2 and CONT and the yeast SB in sample SB2 produced lowest amount of this alcohol (12 mg L^{-1}). Concentration of methanol varied from 1048 mg L^{-1} in the AW2 brandy to 2485 mg L^{-1} in TF1 brandy. This study showed that all five tested yeast varieties produce a small quantity of methanol irrespective of the nutrient.

Esters

Esters are mainly produced during alcohol fermentation by yeast in the reaction between alcohols and acids.[21] Typically they have a "fruity" and "floral" descriptor, and contribute to fruity, sweet, apple, pineapple and floral odor in brandies.[22] Ethyl acetate is the most common and typical ester in fruit brandy.[20] In small concentrations, they have floral notes but at high concentration, they can be very repulsive with the odor of solvent. The largest concentrations of ethyl acetate were found in sample SB2 (489 mg L^{-1}) and in CONT (367 mg L^{-1}) and the smallest amounts were present in sample AW1 (161 mg L^{-1}) and sample RF1 (174 mg L^{-1}). The presence of ethyl acetate makes a significant contribution to the volatile profile and taste impression of fruit brandies.[15] Ethyl octanoate, which has a cooked fruit-like aroma,[22] was detected in high concentrations in sample CONT, TF2 and TOP1 and smallest concentration in sample TF1 and AW1. Sample RF2 and TF1 contained higher concentrations of ethyl palmitate (ethyl hexadecanoate) (1.33 and 1.27 mg L^{-1}). Ethyl lactate (ethyl (*S*)-2-hydroxypropanoate) with a creamy and coconut profile[22] was found in high concentrations in the samples CONT, TOP1 and TF2 (2.87–3.04 mg L^{-1}).

Acids

Volatile acids in brandy arise through the fermentation conditions, the nutrients levels and the yeast used.[3] Among the identified acids, relatively high amounts of decanoic acid, dodecanoic acid, hexadecanoic and octanoic acid were present. Acetic acid, a product of the oxidation of acetaldehyde and ethanol,[23] was found in highest concentration in sample TF1 (0.59 mg L^{-1}) and the smallest concentration was found in sample RF1 (0.03 mg L^{-1}). A significant difference in the concentrations of decanoic acid, which imparts a fatty odor,[20] was found in sample TOP2 with 5.8 mg L^{-1} and sample AW1 with 1.9 mg L^{-1}. The highest content of octanoic acid was found in sample TOP2 (3.2 mg L^{-1}).

Aldehydes and ketones

Aldehydes play an important role in providing the flavor characteristics of a wide range of food. The unsaturated aliphatic aldehydes tend to produce stronger aromas. Moreover, ketones are compounds rich in flavor.[7] In alcoholic beverages, aldehydes and ketones arise by yeast promoted decarboxylation of pyru-

vate during alcoholic fermentation.[24]. In this study, the employed yeast strains produced average amounts of acetaldehyde and benzaldehyde. Acetaldehyde is commonly present in many alcoholic beverages and in small concentrations has a fresh "fruity" odor.[13] The highest content of this compound was found in sample AW1 (80 mg L^{-1}) while the other samples were characterized by a fairly uniform level of this compound (39–62 mg L^{-1}). Yeast SB in sample SB1 and yeast Aroma white in sample AW2 produced the highest level of benzaldehyde (0.15 and 0.14 mg L^{-1}, respectively). This compound has an almond-like odor.[20]

Terpenes and C_{13}-norisoprenoids

Terpenes and C_{13}-norisoprenoids have a very pleasant aroma and a very low olfactory threshold but are rich in flavor.[7] This means that they are readily perceived, even at low concentrations.[22] Due to this, they have a large influence on the organoleptic impression of brandy. In this study, many of these compounds were found, such as citronellol, eugenol, geraniol, limonen-10-ol, linalool, α-terpineol, β-pinene and γ-decalactone. According to Issanchou *et al.*, β-octalactone in apricot gives a fruity taste.[25] The concentrations of linalool, which is perceived as sweet, floral, petitgrain-like, were in the range between 3.79 mg L^{-1} in sample TOP2 and 5.77 mg L^{-1} in sample SB2. The highest content of geraniol was detected in sample TF1 in a quantity of 2.28 mg L^{-1}. α-Terpineol has a pleasant odor similar to that of mint[21] and the highest concentration was found in sample TF1 (4.15 mg L^{-1}), while the lowest concentration was found in sample CONT. γ-Decalactone, which has an intensive peach flavor, was detected in uniform concentrations that ranged from 2.33 mg L^{-1} in sample AW1 to 2.93 mg L^{-1} in sample SB2. In general, terpenes and C_{13}-norisoprenoids are released from their non-odorous precursors (in the form of glycosides) in wine making from grapes. Their content in brandies are reported to be connected to the activity of β-glycosidase in the yeast strain.[21] A large variation of these compounds among the tested samples probably indicated that the β-glycosidase activity varied significantly across the tested yeast strains.

Quantitative descriptive analysis of young apricot brandies

A professional tasting commission of three members made the tasting of all the obtained samples and the points they assigned are given in Table III. The attributes used by the tasting commission to define and classify the samples were taste, smell, color, clarity and distinction. The maximum score in the evaluation was 20 points.[17] The best tasting results is a consequence of good balances of the quantities of aromatic compounds.

The Aroma white strain in combination with simple nutrients, sample AW1, and complex nutrients Nutriferm Arom, sample AW2, gave intermediate results in both cases. Sample AW1 on taste was clean with bitterness and small astrin-

gency and obtained 17.10 points and the eighth place. Sample AW2 was devoid of taste with astringency and bitterness and some unclean smell, which could be the result of a high content of benzaldehyde and pentanol. The tasting commission gave it 17.06 points and ninth place. In this case, it could be concluded that the type of nutrient did not have a large influence on the final products of fermentation with Aroma white strain.

TABLE III. Sensory assessment of the apricot brandies

Sample	Member of tasting commission			Average grade	Range
	1	2	3		
AW1	17.10	17.00	17.20	17.10	VIII
AW2	17.20	17.00	17.00	17.06	IX
RF1	17.25	17.30	17.30	17.28	VI
RF2	17.70	17.95	18.00	17.88	V
TF1	16.90	16.75	17.00	16.90	X
TF2	17.90	17.95	17.90	17.91	IV
SB1	18.40	18.35	18.30	18.35	I
SB2	17.95	18.05	18.05	18.02	II
TOP1	17.25	17.20	17.20	17.21	VII
TOP2	17.85	18.00	18.00	17.95	III
CONT	17.00	16.80	16.90	16.88	XI

Red fruit strain with diammonium phosphate, sample RF1, gave an average quality sample and took sixth place with 17.28 points. The sample had a clear note with some astringency. Better results were obtained with the complex nutrients Nutriferm Arom, sample RF2, even though the concentrations of ethyl acetate and amyl alcohols were the highest compared with the concentrations in the other samples, and the sample occupied fifth place with 17.88 points. The sample was with a clean typical smell and soft taste that could be a result of the high content of ethyl palmitate.

The yeast strain Top floral gave a low quality distillate using diammonium phosphate, sample TF1, which obtained 16.90 points in the tasting test (tenth place). On taste, the sample was without an intensive typical apricot smell, with herbal notes, which can be the results of high quantities of 2-methyl-1-propanol and geraniol. Using Nutriferm Arom, sample TF2 gave a middle quality distillate assessed with 17.91 (fourth place). On taste, this sample had a good balance between acidity and softness with less smell.

The gas chromatography analysis showed that Yeast strain SB with the simple nutrient diammonium phosphate, sample SB1, gave the lowest quantity of some compounds, such as esters and higher alcohols, in the distillate. On taste, this sample was clean, typical, with a slight impression of a sharp odor that was the consequence of a higher amount of benzaldehyde. The same yeast strain with complex nutrients Nutriferm Arom, sample SB2, gave a high amount of the vola-

tile compound, especially of ethyl lactate, ethyl butanoate, 1-butanol, isoamylalcohol (3-methyl-1-butanol), citronellol and linalool. In terms of sensor, this sample had a soft taste, good and rich typical smell, and the impression was that this was a very complex sample. The good balance of the volatile compounds ensured that these two samples were rated with the highest grades, first and second place, in the tasting test.

The yeast strain Top 15 with simple nutrients, sample TOP1, gave an intermediate result with the highest quantities of amyl alcohol and 1-propanol. This sample had some medicinal odor and a not good balance in taste. This distillate was on seventh place with 17.21 points. On the contrary, strain Top 15 with complex nutrients, sample TOP2, gave a high quality distillate with 17.95 points and was on third place. With high content of linalool, this sample had a very complex odor with floral notes and good balance.

Sample CONT was among the worst with higher concentration of ethyl acetate, 1-butanol, 1-hexanol and amyl alcohols. The sample had a hard taste with untypical notes on smell. The presence of wild microflora, which contained wild yeast, bacteria and fungi, resulted in this impression.

CONCLUSIONS

This paper presents an investigation of the influence of the yeast and nutrients on the total quality of apricot brandy. All chemical parameters for the quality of the obtained experimental apricot brandies complied with the standard of quality as prescribed by the regulations for alcoholic drinks quality.

The sensory qualities of the assessed apricot brandies indicated that the quality depended on the combination of yeast and nutrients. Nutriferm Arom, as complex nutrient, gave in all combinations better results than diammonium phosphate, a simple nutrient. The exception was the yeast strain SB that with simple nutrients gave the lowest amounts of some compounds, such as esters and higher alcohols, in the distillate and with better sensory results than the other sample. The best results were obtained with yeast strain SB with both nutrients and yeast strain Top 15 only with complex nutrients, which gave a high content of linalool. The control sample with no nutrients and selected yeast gave a distillate that was evaluated as having the worst quality with higher concentration of ethyl acetate, 1-butanol, 1-hexanol and amyl alcohols. This means that using selected yeast and nutrients in the production of apricot brandy gave better results than production without using selected yeast and nutrients.

SUPPLEMENTARY MATERIAL

Concentrations of the minor volatile compounds in the apricot brandies are available electronically from http://www.shd.org.rs/JSCS/, or from the corresponding author on request.

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И З В О Д

УТИЦАЈ КВАСАЦА И ХРАНИВА НА КВАЛИТЕТ РАКИЈЕ КАЈСИЈЕВАЧЕ

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Пет сојева квасаца *Saccharomyces cerevisiae* и *S. bayanus* (SB, Top Floral, Top 15, Aroma White и Red Fruit) и два хранива, диамонијум-фосфат и *Nutriferm Arom*, испитивани су кроз њихов утицај на свежу ракију кајсијевачу, са посебним освртом на хемијске, испарљиве и сензорске карактеристике. Анализе главних и мање заступљених испарљивих компонената и сензорска анализа ракије кајсијеваче показују значајне разлике између узорака. Резултати сензорског оцењивања су рангирани између 16,88 за контролни узорак и 18,35 за узорак произведен са SB сојем квасаца и диамонијум-фосфатом као хранивом. Сви узорци ракије кајсијеваче испуњавају захтеве ЕУ у погледу садржаја метанола и других једињења као што су ацеталдехид, етил-ацетат и виши алкохоли.

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