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FERMENTED FOOD PRODUCTS FROM RASPBERRIES AND BLACKBERRIES - A NEW FORMULATION FOR FUNCTIONAL BEVERAGES

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Introduction

The healing effect of wines and vinegars from fruits with high amount of natural antioxidants is well known and scientifically confirmed in treatments of anemia, diabetes, hypertension, arteriosclerosis and other cardio vascular and cancer diseases [1]. However, the most powerful natural pigments such anthocyanins, proanthocyanins and condensed tannins are presented in raspberry and blackberry fruits [2]. In addition, anthocyanins and proanthocyanidins are the most stable antioxidants in an acidic environment (pH=2-4) such as vinegars and wines. Production of healing wines and vinegars by technology of interrupted fermentation and a maximum of 5-6% alcohol has been developed as a new technology for production of healthy functional beverages [3, 4].

Results and discussion

The amount of D-glucose+D-fructose in berry wines 0.5 g/L, while the amount of sucrose was less than 0.85 g/L (Table 1). The level of total phenols was higher than 850 mg/L in vinegars, the amount of higher molecular proanthocyanidins was over 1115 mg/L, while the amount of lower proanthocyanidins was 800 mg/L (Table 2). The level of total anthocyanins was over 950 mg/L expressed as cyanidin-3-*O*-glucoside. This new technology of interrupted fermentation is promising for production of high-valuable functional beverages due to the facts that 5% of alcohol was sufficient for extraction of all phenolic compounds and natural antioxidant presented in raspberries and blackberries.

Table 1. Physicochemical characterization of berry wines

		Raspberry wines	Blackberry wines
Organic acids			
acetic acid	g/L	0.37±0.02	0.29±0.01
citric acid	g/L	0.03±0.00	0.08±0.01
D-gluconic	g/L	0.05±0.01	0.23±0.01
lactic acid	g/L	0.03±0.00	0.03±0.00
malic acid	g/L	0.90±0.02	1.86±0.02
Sugars			
D-glucose & D-fructose	g/L	0.36±0.03	0.48±0.04
sucrose	g/L	0.43±0.02	0.80±0.05
pH		3.41±0.02	3.43±0.01
Total acidity	g/L	25.45±0.05	14.66±0.04
Color			
A420		7.00	4.43
A520		9.90	9.18
A620		4.17	0.67
free SO_2	mg/L	27.00±2.65	26.67±1.15
total SO_2	mg/L	65.33±2.08	54.67±2.08

Table 2. Polyphenolic profile of berry wines

		Raspberry wines	Blackberry wines
Polyphenols			
Total polyphenols	mg/L	340.67±6.11	844.83±11.5
Total anthocyanins	mg/L	729.00±12.1	3786.67±10.9
Low molecular procyanidines Catechin mg/L	mg/L	575.33±6.05	797.03±11.13
High molecular procyanidines Cyanidin mg/L	mg/L	753.20±11.8	1116.47±12

During alcoholic fermentation by autochthonous yeasts, the ethanol level in vinegars steadily increased, which happened up to day 24 (Fig. 2). As a consequence of the loss of metabolic activity by yeasts as ethanol concentration in the fermentative medium increases, the subsequent time period (from 24th to 41st day) was characterized by the consumption (decrease) of ethanol and concomitant production (increase) of acetic acid by the autochthonous yeasts which typically became dominant as the spontaneous fermentation proceeds and at the expense of the disappearance of viable yeasts over the fermentation time [2].

Fig. 2. Production of raspberry and blackberry vinegars by spontaneous fermentation

Materials and Methods

Raspberries and blackberries were collected and pressed, separately. In order to completely squeeze the liquid from the fleshy part of the fruit. During pressing, 6 g/100 kg of fruit $K_2S_2O_5$ was added. The fermentation liquid was separated and subjected to fermentation (Fig. 1).

Fermentations were performed in one liter glass fermentation vessels in triplicate for each treatment. Yeast (20 g/hL), Lalvin ICV D80 (Lalemand, France) was rehydrated in water (38–40 °C for 30 min) by adding 45 g/hL (Go-ferm protect, Lallemand, France) in medium for rehydration. After starting fermentation, treatments were performed in triplicate.

Yeast nutrient was added, 10 g/hl (FERMAID E, Lallemand, France), to prevent slow fermentation. During alcoholic fermentation, the temperature was controlled and maintained between 14-18 °C.

Sampling and analyzes of wine metabolites were performed after fermentation (6) immediately after SO_2 addition. After fermentation, an addition of 50 mg/l SO_2 was made, the wine was collected from the lees and stored until sensory evaluation. Wine samples for chemical analysis of polyphenols compounds were frozen at -20°C before analysis (Fig. 1).

For the production of homemade fruit vinegars, the fresh fruits were selected, washed, dried and cut with removal of the seeds (whenever necessary). About 1400 g of each fruit were then macerated for 1–3 min (Bosch MMB65, Gerlingen, Germany) to expose the chemical constituents as polyphenols, amino acids, oxidative and degradative enzymes, polyphenol oxidase enzyme, lipids, etc. The puree of each fruit was then distributed into 5–6 L glass vessels and 4.8 L of water and 500 g of sucrose were added. The fermentation process was conducted at room temperature, ranging between 21 and 26 ◦C, for a time period of 41 days in the absence of starter cultures like yeasts and acetic acid bacteria. Once the acetic fermentation was completed (41 days), the experimental vinegars were filtered, pasteurized (15 min at 80 ◦C) and transferred, under aseptic conditions, into 100 mL glass airtight containers to reduce the risk of microbial contamination (Fig. 2).

Fig. 1. Wine-making and production of raspberry and blackberry wines

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References:

1.Kostadinović Velickovska, S., Wilkens, A., Stefova, M., Ivanova, V., Vojnoski, B., Winterhalter P. 2012. Stilbene levels and antioxidant activity of Vranec and Merlot wines from Macedonia: Effect of variety and enological practices. Food Chemistry 135 (4), 3003-3009, https://doi.org/10.1016/j.foodchem.2012.06.118.

2.Cocevska, M., Jancovska Seniceva, E., Kostadinovic Velickovska, S., Naumova-Letia, G., Mirceski, V., Rocha J.M.F., Esatbeyoglu T. 2021. Electrochemical Determination of Antioxidant Capacity of Traditional Homemade Fruit Vinegars Produced with Double Spontaneous Fermentation. Microorganisms. 9(9), 1946, https://doi.org/10.3390/microorganisms9091946

3.Kurt-Celebi, A., Colak, N., Hayirlioglu-Ayaz, S., Kostadinović Veličkovska, S., Ilieva, F., Esatbeyoglu. T., Ayaz, F.A. 2020. Accumulation of Phenolic Compounds and Antioxidant Capacity during Berry Development in Black 'Isabel' Grape (*Vitis vinifera* L. x *Vitis labrusca* L.). Molecules. 25(17):3845. https://doi.org/10.3390/molecules25173845.

4.Ilieva, F., Kostadinović Veličkovska, S., Dimovska, D., Spasov, S. 2016. The impact of some wine-making practices on the quality of Vranec red wines from Macedonia produced by the newly-selected local strain "F-78". Food Chemistry, 194, 1123-1131, https://doi.org/10.1016/j.foodchem.2015.08.088.