

Technology used to increase the quality of fermented beverages from aronia and honey

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Abstract— *In recent years, there has been a global increase in the population concerns about the quality of the food they consume. A new tendency is to include new products that present various health advantages in everyday diets. Honey is an important component for the human diet, due to its use as a sweetener and in the production of sweet foods. Due to its medicinal properties, particularly in the treatment of pulmonary and digestive disorders, it is believed to be one of the products most frequently referenced in ancient traditional medicine documents. Aronia fruits are a rich source of antioxidants, bringing many health benefits. Fermentation is a biochemical reaction that occurs anaerobically and transforms an organic substrate under the action of microbial enzymes. These enzymes are produced by microorganisms such as yeasts, bacteria and fungi. Getting a fermented beverage out of aronia and honey is a way to conserve these products because by using fermentation the nutritional or organoleptic qualities of certain products are transformed and improved.*

Keywords— *fermented beverage, aronia, honey, benefits*

I. INTRODUCTION

Aronia is recognized to be one of the most significant reserves of polyphenols in nature, containing hydroxycinnamic acid, flavanols, and anthocyanins. It has an increased medical effectiveness, being mentioned by many studies as an antioxidant, anti-atherosclerotic, anti-diabetic, anti-inflammatory, antiviral, and antimutagenic agent [1-4]. Regarding the antidiabetic effect, there is research that suggests that the fruit juice from *A. melanocarpa* and its anthocyanins are helpful for both preventing and managing type II diabetes mellitus and the challenges that are caused by it [5]. Improvements in liver structure and function have also been reported following tests performed on mice [6, 7].

Considering the probiotic impact of lactic fermentation products, foods and drinks produced through fermentation represent an essential benefit for the human diet. While fermentation is used to preserve food, it also enhances the sensory qualities and nutritious value of the finished product and may be beneficial for treating certain allergic illnesses, immunomodulation, or even used as a preventative measure for various cancer types [8, 9].

A variety of antioxidant-rich flavonoids and phenolic acids are present in both fruits. In berries the major flavonoid classes are anthocyanins, proanthocyanines, flavanols and catechins. Fruits contain hydroxylated benzoic acid and cinnamic acid, compounds known as phenolic acids.

Compared to other berries such as: blueberries, raspberries, strawberries, blackberries and black currants,

aronia fruits have a higher content of polyphenols, hence the higher antioxidant potential [10].

The components of berries' antioxidants are crucial for sustaining health and preventing from cancer and coronary cardiovascular diseases. These fruits have attracted the attention of researchers, food producers and consumers because fruits that are good for the body-health are expected to become more popular in the years to come.

Aronia has unlike blueberry, cranberry and lingonberry has a significantly higher quantity of anthocyanins, phenolics, as well as antioxidant activity [11]. It is important to note however that, as several studies have shown, the cultivar variety, the soil properties, the tillage technique employed, and the incidence of erosion phenomena can impact the characteristics of the products [12, 13].

TABLE I. Nutritional values for 100 g *aronia melanocarp* fruit [9].

Principles	Nutritional values	RDA Percentage *
Energy	47 kcal	2.5%
Carbohydrates	9.6 g	7%
Protein	1.4 g	2.5%
Total fats	0.5 g	2%
Cholesterol	0 mg	0%
Fiber	5.3 g	14%
Vitamins		
Folates	25 µg	6%
Vitamin A	214 IU	7%
Vitamin C	21 mg	35%
Vitamin E	1.17 mg	8%
Vitamin K	19.8 µg	17%
Electrolytes		
Sodium	1 mg	0%
Potassium	162 mg	3%
Mineral		
Calcium	30 mg	3%
Iron	0.62 mg	8%
Magnesium	20 mg	5%
Manganese	0.646 mg	32%
Zinc	0.53 mg	5%
Micro-nutrients		
Carotene	0 µg	--
Carotene-β	128 µg	--
Lutein-zeaxanthin	118 µg	--

*Recommended daily dose

Since the earliest days of human food culture backgrounds, honey has been utilized as a basic natural product. Nowadays, honey is still a vital component of the human diet and is frequently added to desserts as an alternative to sugar. Due to its therapeutic potential, particularly in the amelioration of pulmonary and digestive illnesses, but also inflammatory and autoimmune diseases, it is one of the ingredients that is most frequently cited in oldest

traditional recipes [14,15].

Because the extraction of honey is a major economic activity in Europe, the development of honey-based goods promises to be a viable option for supplying customers with cutting-edge alcoholic drinks while also improving the profitability of the beekeeping sector.

Of the world's production of honey, 90% is consumed as a meal and only 10% is distributed in the food sector, for the production of other derived goods, cosmetics and pharmaceuticals [16].

Bees create honey from the nectar of flowers and fruits, as well as from the excretion of insects such as aphids, and has long been the only natural sweetener and a significant source of carbohydrates.

It has demonstrated success in treating acute and chronic gastric inflammation, burns, and other injuries, and as an antibacterial agent [17,18]. Honey's perceived ability to heal seems to be connected to both its physical and chemical characteristics [19].

Due to their abundance in vital nutrients, fruit juices are regarded as a suitable medium for the production of high-valuable functional drinks, such as probiotic supplements. Consumption of such plant-based products is also linked to a healthy lifestyle, which further reduces the risk of chronic illnesses [20-22].

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II. MATERIAL AND METHODS

To obtain aronia fermented drinks from aronia, starting from aronia juice, as well as from aronia juice mixed with honey, fermentation will be carried out with brewer's yeast.

A beverage, in order to be called and marketed as a fermented alcoholic beverage, must satisfy the condition that ethyl alcohol comes exclusively from the alcoholic fermentation of sugars which are found in the natural composition of products.

Raw materials used

1. **The aronia juice** used for the experiment (Figure 1) was an organic juice produced in Romania, purchased from a supermarket.



Fig. 1. Aronia juice

The quality characteristics of this aronia juice are given in Table 2.

TABLE II. Quality characteristics of aronia juice

Parameter	Value
Carbohydrates	13g/100ml
Sugars	6.8g/100ml
Fats	< 0.5g/100ml
Fiber	< 0.1 g/100ml
Protein	< 0.1 g/100ml
Soluble dry matter	15,403 ⁰ Brix

2. Honey

The honey used in obtaining the fermented beverage is a 100% natural polyfloral honey, extracted in June 2021.

The determined content of soluble dry matter for this honey was 80,135⁰Brix.

3. Yeast

The brewer's yeast used was SaAle™ WB-06 produced by Fermentis (France) represents a strain of superior fermentation yeast *Saccharomyces cerevisiae* var. *Diastaticus*, which the beverage's offers a fruity and phenolic character, varying depending on the conditions of fermentation. In the beer industry, this yeast is used in the production of wheat beer assortments, being a yeast with a low sedimentation capacity.



Fig. 2. Yeast for beer used in the process [16].

The recommended fermentation temperature for this active dry yeast is 18-26°C, which is also the field in which we have chosen to make the fermented drink from aronia and honey.

The chosen inoculation method was the direct one, without rehydration, through which the active dry yeast was introduced directly into the fermentation vessel, at the surface of the wort, at the fermentation temperature (about 25°C). The yeast was sprinkled progressively, making sure that it covers the entire surface of the wort, in order to avoid clumps.

The process of obtaining the fermented beverage from aronia juice and honey

The stages of the process of obtaining the fermented beverage of aronia and honey were as follows

Obtaining the fermentation base (sweet leaven).

Since the sugar content of the juice is only 7%, it was decided not to dilute the juice, but only to ferment the juice, respectively the juice mixed with honey, as such.

The sweet leaven for the second assortment was obtained by adding to the aronia juice of 45g of honey, so that the soluble dry matter content was 21,629⁰Brix.

In the end, the total volume in both fermentation vessels was 480ml.



Fig. 3. Dosage of sweet leaven in fermentation vessels

2. Inoculation with yeast

Both samples were inoculated with 0.4 grams of SaAle active dry yeast™ WB-06.

3. Fermentation

Fermentation lasted 2 days at a temperature of 25-26°C. Although after 2 days (about 48 hours) of fermentation it was found that in both products there was still sugar, based on the organoleptic analysis it was decided to stop fermenting them, so that the fermented beverages, at least the one obtained exclusively from aronia juice, are not totally devoid of flavor.

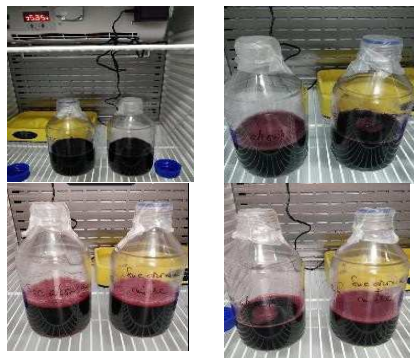


Fig. 4. Fermentation process at various stages

4. Filtering

After fermentation, a coarse filtration was carried out through a filter paper with high porosity, to separate the sediment from the deposited yeast.



Fig. 5. Fermented alcoholic beverage after filtration

After obtaining the fermented beverages, the following analyzes were performed at the Institute of Food Chemistry (ICA):

1. Determination of soluble dry matter

The determination of the dry matter was carried out by refractometric method. This technique involves measuring the sucrose content in an aqueous solution, with the same reflective index as the good being tested, under predetermined pretreatment and temperature settings.

To perform this measurement, the Abbemat 550" refractometer (Méthod Brix) at 20 °C was used. On the lens of the refractometer add 1 ml of the sample to be analyzed. The reading is made directly to the refractometer to be expressed to 3 decimal places.

2. Determination of alcoholic concentration

This analysis shall be carried out by the method of densimetric using the hydrostatic balance.

Preparation of the sample for the determination of alcoholic strength considered the phases:

The sample to be analyzed, was brought at a temperature of 20°C. Has been placed in a volumetric flask to the mark, then poured into the distillation flask.

The flask was washed with distilled water 5 to 10 ml of distilled water three times. Each portion of water as added to the distillation flask.

Added about 5 ml of 2M calcium hydroxide.

Added a few drops of antifoam and about 2 ml of cold demineralized water to the collecting flask, and mount to the distiller.

Distillation was carried out by collecting the distillate in the flask.

The level was filled with distilled water, when the temperature reached 20 °C, the stopper and mix thoroughly was attached, avoiding air bubbles.

The sample to be analyzed was moved into the measuring cylinder to the mark. The float and thermometer were immersed in the cylinder and the alcoholic strength displayed was read on the apparatus.

The alcohol content was expressed as a percentage by volume (% v/v) to two decimal places.

The alcoholic strength was determined with a single turntable hydrostatic balance with a sensitivity of 0,00005 g. This is based on Archimedes' principle that a body immersed in a liquid is pushed to the surface by an amount of liquid equal to the weight of the dislocated liquid [23, 21].

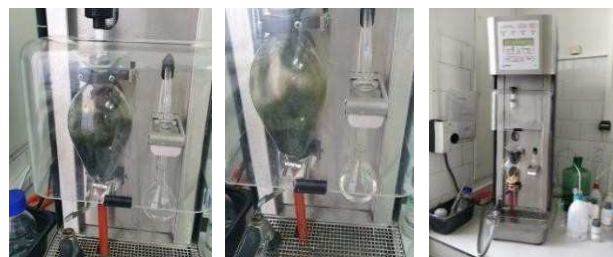


Fig. 6. Sample distillation

III. RESULTS AND DISCUSSIONS

The evolution of the soluble dry matter content, i.e., its decrease, is shown below:

The soluble dry matter content decreased throughout the fermentation period; the fermentation process being initiated immediately after sowing. Thus, a decrease is observed even after 6 hours, which reflects the fact that the yeast used, even if it is intended for another fermentation substrate, namely malt wort, had a satisfactory fermentation capacity even on aronia juice substrate [25, 26]. For both samples, a linear decrease in the soluble dry matter is observed.

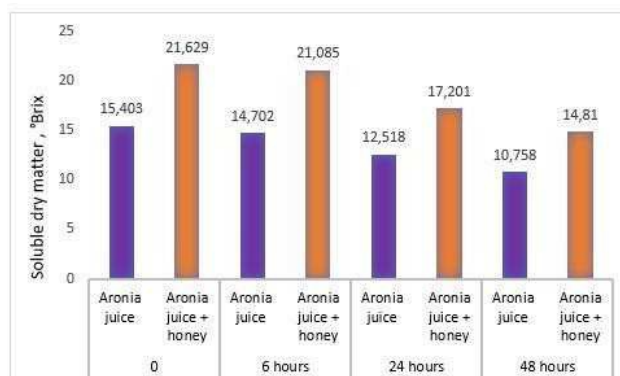


Fig.7. Decrease in soluble dry matter

As was normal, in the case of the leaven obtained from aronia juice mixed with honey, the alcohol content was higher, due to the fact that it had an initial sugar content, respectively soluble dry matter, higher than in the case of aronia juice.

Another aspect observed during the fermentation tests is that the leaven based on aronia juice had a faster fermenting start than in the case of the lung obtained from aronia juice mixed with honey. Probably the cause is the same, respectively the initial content of lower sugar, which in the case of the leaven obtained from aronia juice mixed with honey can represent a greater stress for the yeast.

Figure 11 shows increases in alcohol concentrations after 30 and 40 hours after inoculation.

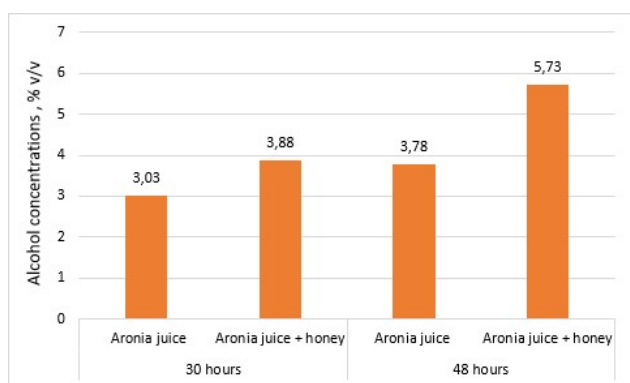


Fig. 8. Variation in the alcohol content of fermented beverage samples

The last analysis carried out was the organoleptic analysis shown in Table 3.

TABLE III. Organoleptic analysis of samples

Sample/Characteristics	Aspect	Color	Smell	Taste
Fermented drink from aronia juice	Opalescent liquid, homogeneous, without impurities, without sediment	Red-purple	Specific to the product, fermentation, without foreign odor	Specific, sweet-sour, with astringent - bitter shades
Fermented drink from aronia juice + honey	Opalescent liquid, homogeneous, without impurities, without sediment	Red-purple	Specific to the product, fermentation, without foreign odor	Specific, aromatic, sweet-sour, with astringent - bitter shades

IV. CONCLUSIONS

Current market trends indicate that fermented fruit drinks (fruit-based wines) will occupy a large part of the winemarket in the future, especially in areas where the grape crops are not specific.

Since fermented fruit drinks have a lower alcohol content than most domestic table wines, they can reduce the negative effects of excessive alcohol consumption.

The use of newer antioxidants, the use of techniques such as sterile filtration, pasteurization, the use of screw caps, packaging that facilitates storage. Effective use, avoiding the need to consume the product shortly after opening are some of the innovations of the fermented beverages industry.

Most of the research has indicated that the properties of the fruit are preserved to a large extent also in the fermented beverages obtained.

As for the fermented drink from aronia fruits, the conclusions are:

This fermented drink obtained from the juice of aronia and honey as raw material presented original organoleptic characteristics, with a pleasant tinge of bitterness and the astringence specific to the fruit of aronia. By comparison, the fermented drink obtained exclusively from aronia juice, although attractive overall, is devoid of the harmony of that obtained by the addition of honey.

Both products, characterized by low residual sugar content and specific astringent, may be suitable for consumption on summer days, as an alternative to other fermented beverages.

The technological solution adopted allowed to obtain in a very short time some products with sensory characteristics and of adequate quality, which recommends its application and in the case of fermentation of juices obtained from other fruits.

The SaAle™ WB-06 brewer's yeast has proven to be more suitable for the production of this drink because it offers more pronounced flavors.

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