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LIGHT INDUSTRY AND FOOD INDUSTRY

Production of Non-alcoholic Beverage from Qvevri Saperavi Wine via Thermal Dealcoholization and Investigation of its Properties

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Abstract. This study aimed to develop a method for producing a non-alcoholic beverage based on Saperavi wine made using the traditional Petian Qvevri method via thermal dealcoholization. Medium-toast oak chips (1.0, 2.5, 5.0 g/L) and concentrated grape must were utilized to balance the sensory degradation (thermal notes, harsh acidity) caused by thermal processing. As a result of the experiment, the sample treated with 2.5 g/L oak chips with sugar content increased to 90 g/L exhibited the best sensory balance (residual alcohol 0.2% v/v, titratable acidity 8.4 g/L). The research demonstrated that the combination of oak chips and grape must effectively masks thermal defects, ensuring the production of a full-bodied, harmonious non-alcoholic beverage.
Keywords: *Saperavi, Qvevri, thermal dealcoholization, non-alcoholic beverage, oak chips.*

Wine is one of the oldest products, representing an alcoholic beverage rich in biologically active substances in its composition. According to the Law of Georgia "On Vine and Wine", wine is "an alcoholic beverage of grape origin obtained solely through the complete or partial alcoholic fermentation of grapes, grape must, or pomace." Consequently, any other beverage that fails to meet these criteria cannot be named wine, regardless of how close its production technology is to winemaking.

1. Although the culture and popularity of wine consumption in Georgia are high, in a number of cases, consumers must refrain from alcohol intake. The reasons for this may include:
2. Road traffic safety legislation and driving;
3. Health conditions (various diseases where alcohol is

contraindicated);
4. Administration of medications during treatment that are incompatible with alcohol;
5. Age restrictions;
6. Promotion of a healthy lifestyle and social trends (e.g., temporary alcohol abstinence);
7. Ethnic, religious, or social responsibility.

Considering the above, it becomes relevant to provide consumers with the opportunity to consume an alternative to the traditional product without alcohol, which is enabled by the production of non-alcoholic beverages based on wine. In this regard, wines made by the traditional Kakhetian method (in Qvevri) are particularly interesting, as they are rich in phenolic compounds and extractive substances—an important prerequisite for preserving the body and structure of a dealcoholized product.

Research Aim and Methodology

The aim of the research was to develop a method for producing a non-alcoholic beverage based on wine made from Saperavi grapes that would be as close as possible to traditional wine in terms of organoleptic indicators. For this purpose, we selected Saperavi grapes, from which we first produced wine using the traditional Kakhetian method (in Qvevri), and subsequently derived a non-alcoholic beverage from it.

The simplest and most accessible way to produce a non-alcoholic beverage from red wine is thermal dealcoholization (evaporation of alcohol through heat treatment). However, this method is accompanied by serious technological drawbacks: heating wine to high temperatures partially or completely degrades biologically active compounds (including anthocyanins), evaporates volatile aromatic substances, and induces thermal reactions. As a result, the organoleptic properties of the product deteriorate sharply—the color changes, and undesirable "cooked" notes increase.

In order for the product obtained after thermal dealcoholization to meet consumer demands, it became necessary to include an auxiliary material during the dealcoholization process that would mask the resulting negative aromatic notes and impart a pleasant organoleptic profile to the product.

For this purpose, we used medium-toast oak chips during the dealcoholization process. To determine the optimal dosage of oak chips, we conducted an experiment: Saperavi wine

LIGHT INDUSTRY AND FOOD INDUSTRY

produced using traditional Qvevri technology was divided into 3-liter test samples. Calculated per 1 liter, the control sample was left without oak chips, while medium-toast oak chips were added to the remaining three samples at rates of 1.0, 2.5, and 5.0 g/L.

To conduct the experiment, the following four test samples were prepared:

- **Sample 1 (Control):** Saperavi wine without oak chips;
- **Sample 2:** Saperavi wine + oak chips 1.0 g/L;
- **Sample 3:** Saperavi wine + oak chips 2.5 g/L;
- **Sample 4:** Saperavi wine + oak chips 5.0 g/L.

At the initial stage, the Qvevri Saperavi wine underwent physicochemical analyses for the content of major components (see Table 1) and its organoleptic evaluation was performed (see Table 2).

Table 1

Physicochemical parameters of the initial Saperavi wine

№	Parameter	Unit	Result
1	Alcohol by volume	% (V/V)	12.9
2	Sugars	g/L	1.5
3	Titratable acidity	g/L	6.1
4	Volatile acidity	g/L	0.24
5	Sugar-free extract	g/L	23.6
6	Copper (Cu)	mg/L	0.15
7	Iron (Fe)	mg/L	1.1
8	Lead (Pb)	mg/L	< 0.1
9	Arsenic (As)	mg/L	< 0.01
10	Cadmium (Cd)	mg/L	< 0.01
11	Mercury (Hg)	mg/L	< 0.005
12	Malvidin diglucoside	mg/L	0.00
13	Citric acid	g/L	0.11
14	Radionuclide: Cs-137	Bq/L	< 20
15	Radionuclide: Sr-90	Bq/L	< 30
16	Free sulfur dioxide	mg/L	7
17	Total sulfur dioxide	mg/L	12

Table 2

Organoleptic parameters of the initial Saperavi wine

Parameter	Organoleptic Characteristic
Color	Dark ruby
Aroma	Vibrant, varietal aroma characteristic of young wine, with pronounced notes of black berries and plum
Taste	Moderately expressed tannins, medium body, lively acidity, and medium finish length

LIGHT INDUSTRY AND FOOD INDUSTRY

Dealcoholization of all four samples was performed under laboratory conditions (via thermal evaporation), after which an initial organoleptic evaluation of the obtained alcohol-removed samples was conducted (see Table 3).

Table 3

Organoleptic evaluation of dealcoholized test samples

Sample	Color	Aroma	Taste
Sample 1 (Control)	Brown	Pronounced "cooked" vegetable notes	Harsh, sharp acidity; unpleasant thermal ("cooked") taste
Sample 2 (1.0 g/L chips)	Brown	"Cooked" fruit and vegetable notes	Harsh acidity, sharp thermal taste
Sample 3 (2.5 g/L chips)	Brown with an orange (brick) hue	Weakly expressed cooked fruit notes with light oak notes	Harsh acidity, full-bodied, pronounced tannins
Sample 4 (5.0 g/L chips)	Brown with an orange (brick) hue	Weak thermal notes; excessive, coarsely expressed oak and caramel aroma	Harsh acidity, full-bodied, excessively harsh tannins and oak taste

Results and Discussion

Based on organoleptic evaluation, Sample 3 (with 2.5 g/L oak chips) was selected for further research, as it exhibited an optimal balance between oak extractiveness and masking of thermal notes (1.0 g/L chips proved insufficient to cover off-aromas, while 5.0 g/L yielded excessive, harsh wood notes).

In the selected sample, the residual alcohol content and titratable acidity were determined, reaching 0.2% (v/v) and 8.4 g/L, respectively.

Following dealcoholization, harsh acidity and coarse tannins derived from oak became distinctly pronounced in the product. To balance these sensory flaws, we used concentrated grape must. Through step-by-step addition of must and tasting, it was established that the best organoleptic balance is achieved when bringing the sugar content of the product to 90 g/L.

Conclusion

As a result of the conducted experiment, it was established that a non-alcoholic beverage can be obtained

LIGHT INDUSTRY AND FOOD INDUSTRY

from Saperavi wine made using the traditional Kakhetian method in Qvevri through thermal dealcoholization. Correction of sensory degradation caused by thermal processing (color change, "cooked" notes, harsh acidity) is effectively achieved through the combined use of medium-toast oak chips (2.5 g/L) and concentrated grape must (90 g/L). The final product obtained features a harmonious taste, preserved body, and possesses high commercial potential for establishing itself in the specific (non-alcoholic) market.

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