New Uses of Hawthorn Fruits in Tonic Wines Technology

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Bulletin UASVM Food Science and Technology 73(2)/2016
ISSN-L 2344-2344; Print ISSN 2344-2344; Electronic ISSN 2344-5300
DOI: 10.15835/buasvmcn-fst:12327

Abstract

Tonic wines are true natural elixirs, having the property to fortify the organism. To achieve a complex product and to supplement the antioxidant properties of the wine, the hawthorn fruits were added. The tonic wine got major active substances by hawthorn fruits maceration in red wine, increasing its medicinal value, while hawthorn fruits are well known for being effective in treating cardiovascular diseases. Hawthorn, honey and rosemary added extra minerals in the total dry extract of the new tonic wine developed. The hawthorn fruits total polyphenols content was determined as being 510.2 mg GAE/100g. The total polyphenols content of tonic wine was about six times higher than for simple wine. Antioxidant capacity increased when hawthorn fruits were added, as they have an important contribution in terms of new product antioxidant properties. The relative density increased due to the substances extracted by hawthorn maceration. The concentration of alcohol slightly increased due to the fermentation, which triggers during maceration. The acidity of the new tonic wine developed here was higher, as compared to the simple wine. Higher acidity also contributed to the palatability, the new tonic wine showing a pleasant refreshing taste.

Keywords: Tonic wines, antioxidant capacity, polyphenols.

INTRODUCTION

Since ancient times traditional medicine based on natural products obtained from various plants was of great importance in the prevention and treatment of various human diseases. The use of herbal medicines and food supplements containing botanical ingredients, as alternative therapy for infectious diseases, has been intensified due to their high content of antimicrobial agents such as polyphenols, flavonoids, tannins, and alkaloids (Sallabanks, 1992). In recent years, polyphenols are very interesting classes of natural compounds, secondary plant metabolites, known for their color (anthocyanins) as well as positive influence on human health due to their antioxidant activity (Levaj et al., 2010). Common hawthorn belongs to the Rosacea family, grows in Europe, Africa and Asia, being in the form of a shrub or small tree with a height of 5-10 m. The fruits are small, dark red (commonly called haw), are harvested during autumn period and they are used in various culinary purposes, such as jellies, jams, syrups, drinks including wine, juice and sauce (Liu et al., 2010). Scientific data had shown that the fruit of hawthorn is a rich source of vitamin such as vitamin B, vitamin C, tannins, tocopherols, anthocyanins, flavonoids, citric acid, tartaric acid, oxalic acid, glucose, fructose, choline, sorbitol, mineral substances and triterpene acids (Liu et al., 2011). The largest share in the hawthorn fruit is represented by procyanidins, antioxidants (contained also by the grapes seeds) that strongly inhibit oxidase activity (Liu et al., 2012; Watson and Preedy, 2012). In the pharmaceutical industry, the extracts of hawthorn are used as sedatives and diuretics to inhibit lipid peroxidation, cardiac...
activity increase and decrease heart rate pressure. Since hawthorn contains a large amount of flavonoids, the extracts of hawthorn significantly increase blood flow and along with phenological variations, they have a remarkable antioxidant capacity (Vaughn, 2015).

Tonic wines are fortified wines that combine the existing benefits of red wine with the enhanced benefits of added therapeutic herbs and spices. They are natural tonics incorporating traditional medicine components recognized for their ability to combat common ailments and alleviate symptoms. Additionally, tonic wines are rich in vitamins and can have beneficial effects on the circulation system and blood pressure (Sekar, 2007). To our knowledge, there is little scientific evidence about the use of hawthorn fruits in wine technology. Their use is moreover related to empirical recipes among Chinese consumers. They believe that the hawthorn wine has health benefits that wine grapes cannot offer or at least not as the same capacity as the hawthorn. It is believed that these benefits are due to complex molecules, called polyphenols, which reduce cholesterol and inflammations, slow the progression of cardiovascular disease and the fight against skin cancer (Trippe, 2014).

Exploiting the compounds found in hawthorn fruits and red wine (polyphenols, acids, sugars), a new product might be obtained - a tonic wine, with positive impact on human health. Consequently, the aim of the paper was to obtain a complex tonic wine product, rich in biologically active principles by using hawthorn fruits and red wine.

**MATERIALS AND METHODS**

**Tonic wines production**

Hawthorn fruits (23% m/v) and red wine (69% v/v) were used as main raw materials for obtaining the tonic wines, while rosemary (1% m/v), lemon peel (5% m/v), sugar (1% m/v) and acacia honey (1% m/v) (as a sweetener) were considered auxiliary raw materials (Figure 1). Due to hawthorn fruits astringency, honey and sugar were added for sweetening purposes. It was assumed that the small amount (less than 1%) of sugar and honey induced no secondary fermentation. Two types of tonic wines were obtained, one made from whole hawthorn fruits and the other from hawthorn crushed fruit, in order to compare the extraction efficiency as affected by fruits pre-processing. Mixing and maceration aimed to extract the bioactive compounds mainly from hawthorn fruits, but also from rosemary, lemon peel and honey. For an effective extraction, the maceration process was held at 20°C for 30 days. During maceration, the product has been

![Fig. 1. Technological flow for obtaining tonic wine with Hawthorn fruits at laboratory scale](image-url)
protected from excessive air contact, to avoid oxidation. The product was stored at 18°C in glass bottles with a capacity of 100, 250 or 500 ml.

**The total phenolic assay**

Total polyphenol content of tonic wines and hawthorn fruits was determined according to the method described by (Mureșan-Cerbu et al. 2012; Semeniuc et al. 2016). An aliquot of 25μL sample was transferred into a glass test tube. Then, 1.8 mL of distilled water and 120 μL of Folin–Ciocalteu phenol reagent were added. After 5 min, 340 μL of sodium carbonate aqueous solution (7.5%, w/v) was added to the mixture. After incubation for 90 min at room temperature, in dark, the absorbance was read at 750 nm, using a Shimadzu UV-1700 PharmaSpec spectrophotometer, against the blank, in which the sample was replaced with methanol. Standard curve was performed using different concentration solution of gallic acid and the results were expressed as mg of GAE/100 g sample.

**Antioxidant capacity assessment by DPPH method**

The antioxidant activity was determined using the 2,2- diphenyl-1-picrylhydrazyl (DPPH) method according to (Mureșan et al. 2014; Odriozola-Serrano et al. 2008). An amount of 30μL of the methanol extract was transferred into a glass test tube with a screw cap, then 270 μL of distilled water and 11.7 mL of DPPH solution in methanol (0.025 g/l) were added. The incubation of the test sample was carried out in dark, at room temperature for 30 min. The absorbance value was read at 515 nm against methanol with a double-beam UV-VIS spectrophotometer (Shimadzu 1700 UV-VIS). The positive control was prepared using a gallic acid solution (0.5 mg/mL). The negative control was prepared using methanol. Results were expressed as percent over standard DPPH absorbance according to Eq. (1).

$$RSA [%] = \frac{A_{DPPH} - A_p}{A_{DPPH}} \times 100 \quad (1)$$

where, $A_{DPPH}$ is the absorbance of DPPH free radical in methanol and $A_p$ – sample is the absorbance of DPPH free radical solution mixed with the sample.

**Relative density assessment**

Determination of density by the pycnometer method was performed by weighing a certain volume of water measured with a pycnometer under conditions well established and weighing an equal volume of wine measured by the same pycnometer under the same conditions. The ratio between the wine sample weight and the weight of the distilled water, was expressed as the relative density of the wine Eq. (2).

Relative density: $$d(15 – 20^\circ C) = \frac{A_2 – A_1}{A_1 – A} \quad (2)$$

where: $A$ – weight of empty pycnometer; $A_1$ – weight of the pycnometer filled with distilled water at 20°C; $A_2$ – weight of the pycnometer filled with the wine sample at 20°C (STAS 6182/8-71).

**Alcoholic concentration**

The alcoholic concentration is the ethanol content (% vol) at 20 °C. The method used for the wine samples relies on distillation and determining the alcoholic concentration using an alcolmeter and a temperature conversion table (STAS 6182/6-70).

**Total acidity**

The total acidity was performed by neutralization with sodium hydroxide solution (0.1 N) in the presence of methylene blue as indicator Eq. (3).

$$\text{Total acidity} = \frac{V_1 \times 0.0075}{V \times 1000} \quad g / l \quad (3)$$

where: $V_1$ – volume of NaOH 0.1N used for titration; $V$ – sample volume in ml; 0.0075 - corresponding amount of tartaric acid 1ml of NaOH 0.1N; STAS 6182/1-79

**Total dry extract**

The total dry extract represented by the colloidal substances, dissolved or non-volatiles, was assessed by product evaporation at boiling water temperature Eq.(4).

$$\text{EUT} = \frac{m_2 - m_1}{V} \times 100 \quad (%) \quad (4)$$
where: EUT – the total dry extract; \(m_2\) – weight of the dry extract and capsule [g]; \(m_1\) – weight of the empty capsule [g]; \(V\) – volume of the sample [ml] (STAS 6182/9-80).

**Ash Determination**

The content of mineral substances was assessed by calcination at 550-600°C

\[
\text{Ash} = \frac{M}{V} \times 100 \text{ (\%)}
\]

where: \(M\) – ashes weight [g]; \(V\) – sample volume [ml]; Ash should represent about a tenth of the total dry extract (Tofană and Mureşan, 2012, STAS 6182/3-70).

**RESULTS AND DISCUSSIONS**

Regarding the alcohol concentration, it was shown a slight increase for hawthorn wine as compared to regular red wine (Table 1). This might be explained by the supplementary fermentation that takes place during the maceration process, the carbohydrates introduced with the honey and hawthorn fruits being transformed into alcohol. Most probably, the fermentation was a spontaneous one, without external intervention, due to naturally occurring yeasts on the surface of hawthorn fruit.

In the case of tonic wine samples made from crushed hawthorn the alcoholic concentration was higher as compared to the sample obtained from whole fruits. This is explained by the destruction of fruits, so that fermentable carbohydrates are easily available to the yeasts.

The final dry extract was higher when adding the hawthorn fruits, rosemary and acacia honey; the final product contains a higher quantity of substances that are dissolved or dispersed in a colloidal manner. Relative density increased also when the tonic ingredients were added, due to the substances extracted in the final product, mainly polyphenols, as will be further demonstrated.

The acidity represents a quality element that is part of wine conservation, preventing bacterial illness. Both excess and insufficient acidity directly influence the wine’s taste. If acidity is low, the wine is flat, anemic, with an unpleasant taste, prone to disease, while a high level of acidity gives the wine a sour taste, being inconsistent and slowing down the aging process (Mudura et al., 2015). As shown in the Table 1 tonic wine acidity increased by approximately 0.3g/l, meaning a supplementary extraction of organic acids from the tonic ingredients. The higher acidity gave the wine a pleasant taste, being in harmony with the astringency given by the phenolic compounds.

As shown in Table 1, the addition of crushed hawthorn fruits, as well as the other tonic ingredients (lemon peel, honey and rosemary) determined a high increased of the ash content. The ash content of the product represents a quality index and may include essential minerals.

The amount of polyphenols in the hawthorn fruits tonic wine was about six times higher than the one obtained for regular red wine (Table 2). As shown during this study, hawthorn fruit is a product rich in polyphenols (510.2 mg GAE/100g), which determined also the increased value of polyphenols for the tonic wines samples.

**Tab. 1.** The content of alcoholic concentration, total dry extract, relative density, content in ash and total acidity of wine and tonic wine

<table>
<thead>
<tr>
<th>Sample</th>
<th>Alcoholic concentration, % vol</th>
<th>Total dry extract, %</th>
<th>Relative density, g/cm³</th>
<th>Ash Content, %</th>
<th>Total acidity, g tartaric acid/l</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wine</td>
<td>9.73 ± 0.02</td>
<td>2.18 ± 0.05</td>
<td>1.006 ± 0.03</td>
<td>1.72 ± 0.04</td>
<td>6.70 ± 0.05</td>
</tr>
<tr>
<td>Tonic wine from whole hawthorn</td>
<td>9.83 ± 0.01</td>
<td>6.52 ± 0.02</td>
<td>1.008 ± 0.01</td>
<td>3.14 ± 0.03</td>
<td>6.77 ± 0.03</td>
</tr>
<tr>
<td>Tonic wine from crushed hawthorn</td>
<td>9.93 ± 0.03</td>
<td>9.18 ± 0.04</td>
<td>1.019 ± 0.02</td>
<td>7.26 ± 0.06</td>
<td>7.02 ± 0.04</td>
</tr>
</tbody>
</table>
Another observation was made in the case of tonic wine made from crushed hawthorn where the amount of polyphenols was higher, meaning that there was a better extraction, the pulp being thus in direct contact with the alcohol, improving polyphenols extractability. As shown in Table 2, tonic wine samples contained a large amount of polyphenol compounds and high antioxidant capacity, the fruits of hawthorn having a significant contribution in terms of antioxidant properties of the final product.

As expected and compared to the simple red wine, the antioxidant capacity increased in the hawthorn tonic wines samples due to bioactive substances contained by hawthorn and extracted during the maceration (Table 2).

CONCLUSIONS

A new composition was developed by exploiting the polyphenols found in hawthorn fruits, more precisely, the hawthorn fruits tonic wine - a complex product which may show a positive impact on human health. The new tonic wines samples obtained showed improved characteristics by their higher antioxidant capacity as compared to simple red wines.

Acknowledgements. The authors thank the laboratory work performed by eng. Dumitru GLIGA.

REFERENCES


Tab. 2. Total polyphenols and antioxidant capacity of hawthorn fruits, red wine and tonic wines

<table>
<thead>
<tr>
<th>Sample</th>
<th>Total polyphenols, mgGAE/100g</th>
<th>Antioxidant capacity [%]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hawthorn fruits</td>
<td>510.23 ± 0.62</td>
<td>52.02 ± 0.12</td>
</tr>
<tr>
<td>Wine</td>
<td>31.24 ± 0.22</td>
<td>7.41 ± 0.08</td>
</tr>
<tr>
<td>Tonic wine from whole hawthorn</td>
<td>174.13 ± 0.31</td>
<td>47.35 ± 0.15</td>
</tr>
<tr>
<td>Tonic wine from crushed hawthorn</td>
<td>183.88 ± 0.37</td>
<td>47.94 ± 0.17</td>
</tr>
</tbody>
</table>


15. Vaughn B (2015). Hawthorn: The tree that has nourished, healed, and inspired through the ages, Yale University Press.


17. *** STAS 6182/8-71 Vin. Determinarea densității.

18. *** STAS 6182/9-80 Vin. Determinarea extractului sec total.

19. *** STAS 6182/1-79 Vin. Determinarea acidității totale.

20. *** STAS 6182/6-70 Vin. Determinarea concentrației alcoolice.