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Developing and quality characteristics of some white vermouth wines

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Abstract

The main purpose of this study was to design and characterize some types of white vermouth starting to the dry base wine Sauvignon Blanc by addition of alcoholic macerate, edible alcohol, sugar in the form of syrup in water and citric acid to adjust the total acidity. To develop the aperitif wines, four alcoholic macerated were obtained from herbs, dried fruits, citrus peels and spices. The aliquots of these alcoholic macerates were combined to obtain a mixture used in the vermouth recipes. All types of prepared products fall into the category of aperitif wines, with alcoholic degree of 18% (v/v), sugar content in the range 60-120 g/L and total acidity of 4 g/L H_2SO_4. The storage of aperitif wines for 45 days at room temperature induced some losses in total antioxidant capacity and total phenolics content. These losses were better evidenced in the formulae of vermouths with lower sugar content. It can be said that the addition of sugar in the vermouth recipe could have the potential to protect the antioxidant properties throughout storage. The herbs and spices can offer to the aperitif wines health benefits because of polyphenol compounds brought to the macerate.

Keywords: vermouth, white aperitif wine, antioxidant properties, alcoholic macerates

1. Introduction

Vermouth is defined as a fortified wine with an alcoholic degree in the range 15-21% (v/v) flavored with a mixture of herbs and spices. It can be say that vermouth or aperitif wines consist of grape wine, herb and spice mixture or their alcoholic macerates [1, 2]. Besides these, in vermouth is added sugar or grape must as well as edible ethyl alcohol with alcoholic degree 90-96% (v/v) [3]. Sugar content of vermouth can vary between 40 and 180 g/L. The mixture of herbs or spices can be either added in wine during the fermentation, or as alcoholic macerates.

The term *vermouth* comes from the German world – wermut - for wormwood (*Artemisia absinthium* L.). This very bitter plant, recognized due to its medicinal qualities, is the main responsible for aroma and bitterness specific to vermouth wine. Thus, vermouth is a special wine characterized by a bitter undertone moderated due to the botanicals used in the recipe [2]. Flavored wines have specific characteristics determined by technological characteristics of raw materials as well as the technology used in their preparation [4].

The alcoholic macerates used in the vermouth recipe give to the aperitif wine its unique characteristics in terms of flavor and aroma. Some of the herbs and spices give to the vermouth aromatic flavor while others are responsible for the bitter flavor. The main difference among vermouth wines is because of

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number and types of herbs and spices used in the recipe [5].

The results reported by Amerine *et al.* [1] and Joshi *et al.* [5] reveal that the addition of spices and herbs extract in the recipe increased the total phenols content in vermouth.

The vermouth could be classified into two types, sweet respectively dry vermouth. The Italian type of vermouth is sweet, with an alcoholic content of 15 to 17% (v/v) and the sugar content in the range 120-150 g/L, while the French type is dry, has 18% (v/v) alcohol and 40 g/L sugar [3]. Thus, the American types of vermouths are generally higher alcoholic degree and lower sugar content than the Italian vermouths.

The recipes used for manufacturing of dry type of vermouth contain less spices and herbs than the sweet one. Also, in the formulae of dry vermouth there are larger amounts of wormwood as well as bitter orange peels than in the recipes of sweet vermouths. The vermouth could be directly served, especially in European countries, or it can be served as a part of different cocktails, mainly in America [2].

The traditional technology of vermouth involves the making of base wine, the extraction of selected herbs and spices in wine and brandy mixture, then extract is blended with the base wine followed by the addition of alcohol in order to fortify the base wine up to the desired alcoholic degree and finally, the maturation of the prepared vermouth will be done. The base wine has to be at least 75% (v/v) of the prepared vermouth. Citric acid (lemon salt) is used for the correction of acidity [6].

The quality of alcoholic macerates depend on the grinding degree of herbs and spices, the ratio of the solvent volume and the amount of botanical material, alcoholic degree of the solvent and the maceration time. For this purpose, the different parts of various herbs and spices (leaves, seeds, roots, barks) are used in dry form [1, 4, 7, 8].

Considering that little information seems to be available on this topic, the purpose of this study is to develop and characterize some formulae of vermouth with different sugar content. Also, the antioxidant characteristics of designed aperitif wines were studied in response to 45 days of storage at room temperature.

2. Material and methods

The vermouth preparation

Sauvignon Blanc wine (Recas vineyard, harvest year 2014) was used as a basis for obtaining of aperitif wines. In order to design the vermouth recipe, four alcoholic macerates were prepared used herbs, dried fruits, citrus peels and spices, according to the data shown in Tables 1-4.

The maceration time was 21 days at room temperature (20°C). After this period, the alcoholic macerates have been filtered and in the aperitif wine formulae were used a mixture of 4 macerates, as follows: herbs, dried fruits, citrus peels and spices (20/13.33/40/26.66), v/v.

The raw-material quantities used for preparing of 10 L vermouth were calculated on the based of material balance.

Chemical analysis

Total acidity, alcohol concentration and extract contents

Total acidity, alcohol content, sugar content, total dry extract content and non-reducing dry extract content were determined according to the International Organization of Vine and Wine [9].

Total antioxidant activity assay

The antioxidant activity of aperitif wines was measured following the ferric reducing antioxidant power (FRAP) assay according to Benzie and Strain [10]. In this method, FRAP working solution was freshly prepared using 25 mL acetate buffer pH = 3.6 (300 mM/L), 2.5 mL TPTZ (2,4,6-tripyridyl-s-triazine) solution (10 mM/L) and 2.5 mL $FeCl_3$ solution (20mM/L). Calibration curve was obtained using aqueous Mohr salt solution with concentration in the range 0.05-0.35 μM Fe^{2+}/mL. For this purpose, 0.5 mL of Mohr salt solution was mixed with 2.5 mL FRAP working solution and after 15 min the absorbance value was read at 593 nm, against FRAP reagent used as a blank using the UV-VIS spectrophotometer (Analytic Jena Specord 205). Prior analysis, the aperitif wine was diluted with bidistilled water 1:100 (v/v). 1 mL of diluted samples was mixed with 2.5 mL FRAP working solution and

the absorbance was read in the above mentioned conditions. The total antioxidant capacity was expressed in mM Fe^{2+}/L.

Total phenolics content

Total phenolics content was measured according to the protocol described by Singleton *et al.* [11]. For this purpose, 0.5 mL wine samples previously diluted 1:100 (v/v) with bidistilled water was mixed with 2.5 mL Folin-Ciocalteau reagent (diluted 1:10 with bidistilled water prior analysis). Then, 2 mL of sodium carbonate solution (7.5%) was added and after 60 min, the absorbance value was measured at 750 nm using against a blank sample (0.5 ml bidistilled water, 2.5 mL Folin-Ciocalteau reagent and 2.0 mL sodium carbonate solution). Calibration curve was prepared using gallic acid solution in the range 0.025-0.25 mM/L. The total phenolic content was expressed as mM gallic acid equivalent (GAE)/L.

Table 1. The herbs used for obtaining of alcoholic macerate

No.	Herbs	Weight (g)*
1	Rosemary (*Rosmarinus officinalis L.*)	3.0
2	St. John's Wort (*Hypericum perforatum L.)*	6.0
3	Sweet cherry (*Prunus avium L.*) - tails	10.0
4	Yarrow (*Achillea millefolium L.*)	3.5
5	Hyssop (*Hyssopus officinalis L.*)	10.0
6	Cranberry (*Vaccinium vitis idaea L.*) - leaves	5.0
7	Wormwood (*Artemisia absinthium L.*)	15.4
8	Melilot (*Melilotus officinalis L.*)	6.0
9	Lemon Balm (*Melissa officinalis L.*)	6.0
10	Wild thyme (*Thymus serpyllum. L.*)	5.0
11	Artichoke (*Cynara scolymus L.*)	4.0
12	Milk thistle (*Silybum marianum* L.)	5.0
13	Chamomile (*Matricaria chamomilla L.*)	6.0
14	Mint (*Mentha piperita L.*)	4.0

*1400 ml of aqueous solution 45% (v/v) of absolute alcohol were added to the herbs

Table 2. The dried fruits used for obtaining of alcoholic macerate

No.	Dried fruits	Weight (g)*
1	Sea buckthorn (*Hippophae rhamnoides L.*)	15.0
2	Raspberries (*Rubus idaeus L.*)	5.0
3	Bilberriers (*Vaccinium myrtillus L.*)	5.0
4	Blueberries (*Vaccinium corymbosum L.*)	5.0
5	Blackberries (*Rubus fruticosus* ***L.***)	5.0
6	Rose hips (*Rosa canina L.*)	15.0

*550 ml of aqueous solution 45% (v/v) of absolute alcohol were added to the dried fruitS.

Table 3. The citrus peels used for obtaining of alcoholic macerate

No.	Citrus peels	Weight (g)*
1	Orange peels	108.9
2	Lemon peels	102.0

*1000 ml of aqueous solution 45% (v/v) of absolute alcohol were added to the mixture.

Tabel 4. The spices used for obtaining of alcoholic macerate

No.	Spices	Weight (g)*
1	Cloves (*Syzygium aromaticum L.*)	10.0
2	Cinnamon (*Cinnamomum cinnamomum L.*)	10.0
3	Coriander (*Coriandrum sativum L.*)	15.0
4	Marjoram (*Majorana hortensis L.*)	8.0
5	Thyme (*Thymus vulgaris L.*)	8.0
6	Caraway (*Carum carvi L.*)	5.0
7	Fennel (*Foeniculum vulgare L.*)	5.0

*550 ml of aqueous solution 45% (v/v) of absolute alcohol were added to these spices.

3. Results and discussion

As a base wine it was used dry Sauvignon Blanc wine with an alcohol content of 12.5% (v/v) and a total acidity 4.0 g/L H_2SO4. It showed no undesirable changes in terms of organoleptic characteristics or physico-chemical properties. In the manufacturing recipe, the base wine represents 80% (v/v) of the prepared vermouth. The alcoholic macerate participates in the proportion of 2% (v/v) from the prepared aperitif wine. The obtained vermouths have a sugar content of 120, 100, 80 and 60 g/L, alcoholic degree of 18% (v/v) and total acidity of 4.0 g/L H_2SO_4.

The citric acid was used to adjust the total acidity to the value of 4.0 g/L H_2SO_4. Also, edible ethyl alcohol with alcoholic degree of 96% (v/v) was used to increase the alcohol content of vermouth up to 18% (v/v).

The materials used to obtain the aperitif wines were calculated on the basis of material balance and shown in Table 5. Thus, from the mass balance equations (total and partial in alcohol and sugar) were obtained the amounts of materials required to obtain 10 L of the four types of vermouth, as follows: I – vermouth with 120 g/L sugar; II – 100 g/L sugar; III – 80 g/L sugar and IV – 60 g/L sugar.

Table 6 presents the values of chemical parameters (alcohol content, sugar content, total acidity, total dry extract content and non-reducing dry extract) for newly developed formulae of vermouth.

Table 5. The materials used to obtain 10 L of vermouth

Materials	Vermouth			
	I	II	III	IV
Sugar (kg)	1.2	1.0	0.8	0.6
Ethyl alcohol 96% v/v (L)	0.833	0.833	0.833	0.833
Wine Sauvignon Blanc (L)	8.0	8.0	8.0	8.0
Alcoholic macerate (L)	0.200	0.200	0.200	0.200
Water (L)	0.226	0.346	0.470	0.594

Table 6. The chemical characteristics of vermouth

Parameter	Vermuth			
	I	II	III	IV
Sugar content (g/L)	120.0	100.0	80.0	60.0
Alcohol content (%, v/v)	18.0	18.0	18.0	18.0
Total acidity (g/L H_2SO_4)	4.0	4.0	4.0	4.0
Total dry extract content (g/L)	138.41	118.34	98.25	78.14
Non-reducing dry extract content (g/L)	18.41	18.34	18.25	18.14

The sugar addition in vermouth formulas induced a corresponding increase of the values recorded for total dry extract content. The high content of sugar in the vermouth I and II is responsible for a slower perception of specific bitter taste corresponding to the alcoholic macerate. The bitterness was better evidenced in aperitif wines III and IV. Also, a moderate sugar content gave to the vermouth a sweet

taste that was harmoniously assembled with the specific bitternes of the alcoholic macerate. Our results were consistent with those reported by Burns and Noble [12], who stated that the increasing of sweetness decreased the intensity of bitterness in vermouths.

Figures 1 and 2 depict the total phenolic content and antioxidant capacity of aperitif wines after obtaining and in response to storage at room temperature (20°C) for 45 days. As it was previously reporded by Fernández-Pachón [13], it can be seen that the antioxidant activity of wines was related to their polyphenolic content. Most of the antioxidant activity of vermouth has been assigned to the natural antioxidant compounds belonging to the class of polyphenols provided by the alcoholic macerated used in the formulae [14].

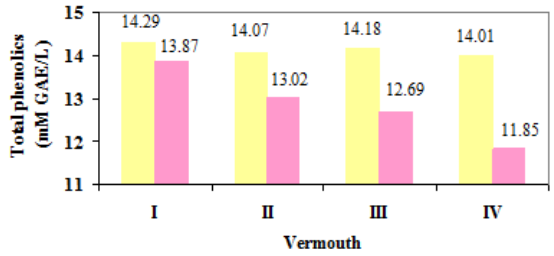

Figure 1. The changes in the total phenolics content of vermouth after 45 days of storage

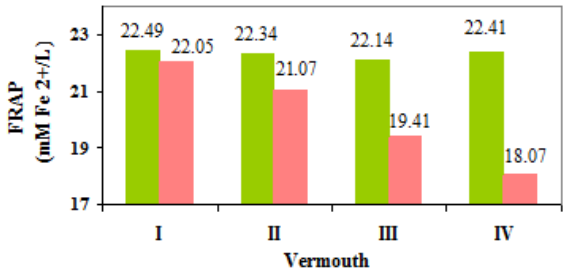

Figure 2. The changes in the total antioxidant activity of vermouth after 45 days of storage

It can be seen that by increasing of sugar content in the vermouth recipe, the content of total phenolics and antioxidant capacity are retained in a higher measure.

Therefore, the highest losses of antioxidant characteristics were recorded in vermouth IV with lowest sugar content (60 g/L sugar). For aperitif wine I (120 g/L sugar) it was registered a loss in total phenolics of about 3% of the initial values as a result of 45 days of storage. The loss becomes 15% of the initial value for vermouth IV. In a similar manner, for aperitif wine with 120 g/L sugar has been recorded a loss in total antioxidant activity of about 2% of the initial value in response to storage. It reaches 19% in the case of vermouth sample with 60 g/L sugar.

4. Conclusion

It could be concluded that the special wines obtained in this study fall into the category of aperitif wine, flavored by alcoholic macerate obtained from herbs, dried fruits, citrus peels and spices, fortified with edible ethyl alcohol up to an alcohol content of 18% (v/v) and having a sugar content between 60 and 120 g/L. The antioxidant characteristics of wines, quantified on the base of antioxidant capacity and total phenolics content, were similar immediately after preparation. After 45 storage at 20°C there were recorded some losses in antioxidant properties in connection to the sugar content of the vermouth. These losses were higher for aperitif wines with a lower sugar content. Our data highlights that the addition of sugar in the recipe could have the potential to protect the antioxidant properties of vermouth during storage. This information could be useful in optimizing the vermouth formulae in order to improve the antioxidant properties of these products.

Compliance with Ethics Requirements. Authors declare that they respect the journal's ethics requirements. Authors declare that they have no conflict of interest and all procedures involving human / or animal subjects (if exist) respect the specific regulation and standards.

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