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INFLUENCE OF WATER HARDNESS ON THE CLEARNESS AND STABILITY OF VODKA

Ivans Krosnijs, Peteris Kuka*

Department of Chemistry, Faculty of Food Technology, Latvia University of Agriculture, Jelgava, Latvia

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Water is one of the main components of vodka. The ions existing in water, interacting with the components of vodka, influence the taste of vodka, its clearness, stability as well as its change during storage. For preparing water–ethanol solutions for vodka production, use is made of ethanol, obtained from cereals (wheat, rye, tryticale), as well as of the following waters: unprepared water of Riga water–pipe, unprepared water from artesian well (200 m), softened water with cation exchanger Amberlite 252 Na of Riga water–pipe, softened water of Riga water–pipe and then desalted with reverse osmosis plant "ELGA" RO 4 LF, water from artesian well deferrizated and then softened with cation exchange resins Amberlite SR1L Na in system "Eurowater", softened water from artesian well and then desalted with reverse osmosis plant "REAL ACQUA", brands of water distributed on market. The total hardness of the water determined by titrating with Na_2H_2EDTA solution, whereas the clearness and turbidity of vodka – turbidimetrically. The samples of water–ethanol solution were tested for clearness, which is an important indicator of vodka quality. The clearness of the solution before and after filtration through membrane filters (0.20 and 0.45 μm) as well as the changes in clearness of solutions during storage were investigated.

INTRODUCTION

The ions existing in the water influence the taste of vodka, its clearness, and stability during storage, they interact with ethanol and other ingredients used in the production of vodka [Yermolaeva, 2002; Gernet & Krechetnikova, 1999].

The total hardness of water is of particular importance. It is determined by the content of Ca^{2+} and Mg^{2+} ions in the water. The mentioned ions together with HCO_3^- and SO_4^{2-} ions form bicarbonates and sulphates, whose solubility diminishes in water–ethanol solutions. Consequently vodka becomes muddy, the dregs settle in the bottom and on the walls of the bottle. Producing particular vodka brands, using infusions, fruit and berry extracts, Ca^{2+} and Mg^{2+} ions gradually precipitate tanning agents, pectins and organic acids as well. Therefore the water used in vodka industry must meet not only the requirements of the drinking water, but also extra criteria, connected with the peculiarity of the industry [Ryabchikov *et al*., 2002; Belogorskiy *et al*., 2001].

The water must be prepared accordingly to meet the necessary standards [Erokhina, 2003; Prigun, 2002; Samoylov & Yermolaeva, 2001; Centre of water technology "KF Centre", 2001].

In this work, we investigated changes of water hardness depending on the manner of preparation, as well as the influence of water hardness on clearness of water–ethanol solutions.

MATERIALS AND METHODS

In preparing water–ethanol solutions for vodka production, ethanol obtained from cereals (wheat, rye, triticale), as well as the following waters were used: water of Riga water–pipe; water from artesian well; and brands of water distributed on the market.

For the preparation of water–ethanol solution (40 vol. %), ethanol of the following composition was used (average values): ethyl alcohol – 96.7 vol. %; acetaldehyde – 0.15 mg · L^{-1}; methyl alcohol – 1.09 mg · L^{-1}; i-propyl alcohol – 1.53 mg · L^{-1}; i-butyl acetate – 0.19 mg · L^{-1}; and ethyl butyrate – 0.22 mg · L^{-1}.

Methods of water and ethanol analysis: total hardness of water was determined by titrating with Na_2H_2EDTA solution [Medina, 2000]; clearness of water–ethanol solutions was determined turbidimetrically (with turbidimeter HACH 2100P); analysis of ethanol was made with gas chromatograph Agilent "Hewlett Packard 6890" [GOST R 51698 – 2000. Vodka and ethanol. Gas chromatographical method for determination of the content on toxic micro infusion].

RESULTS AND DISCUSSION

The schemes of water preparation for water–ethanol solutions are shown in Figures 1 and 2.

The samples of water–ethanol solutions were tested for clearness, which is an important indicator of vodka quality. The clearness of the solution before and after filtration through membrane filters as well as the changes in clearness of the filtrated solutions during storage are shown in Table 1 and Figure 3, 4 and 5, respectively.

As a result of filtration, the components in colloidal state are separated from the solution.

From the results of the analysis of waters used and the changes in clearness of water–ethanol solutions during stor-

*Author's address for correspondnece: Ivans Krosnijs, Latvia University of Agriculture, Faculty of Food Technology, Department of Chemistry, Liela Str.2, Jelgava LV-3001, Latvia; tel.: (371) 300 56 45; fax: (371) 302 28 29; e-mail: ivans.krosnijs@lb.lv

TABLE 1. The effect of water hardness and filtration through membrane filters on the clearness of water–ethanol solutions (average values).

Water	Total hardness, (mmol · L^{-1})	Clearness after solutions preparation (FNU)	Clearness after solutions filtration (FNU)
Of Riga water–pipe	2.051	0.46	0.09
Softened with cation exchanger Amberlite 252 Na	0.025	0.17	0.07
Desalted with reverse osmosis plant ”Elga” RO 4 LF	0.012	0.11	0.07
From artesian well	3.250	24.8	0.24
Deferrizated and softened with cation exchange resins Amberlite SR1L Na	< 0.005	0.16	0.10
Softened and then desalted with reverse osmosis plant ”REAL ACQUA”	< 0.005	0.10	0.08
Distributed on the market			
Evian	2.950	32.1	0.44
Sudraba	0.650	0.19	0.07
Vendene	0.025	0.12	0.07

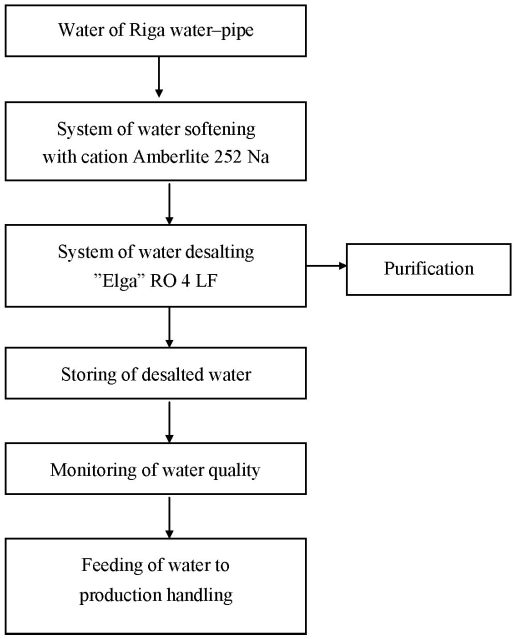

FIGURE 1. Preparation of water of Riga water–pipe for water––ethanol solutions.

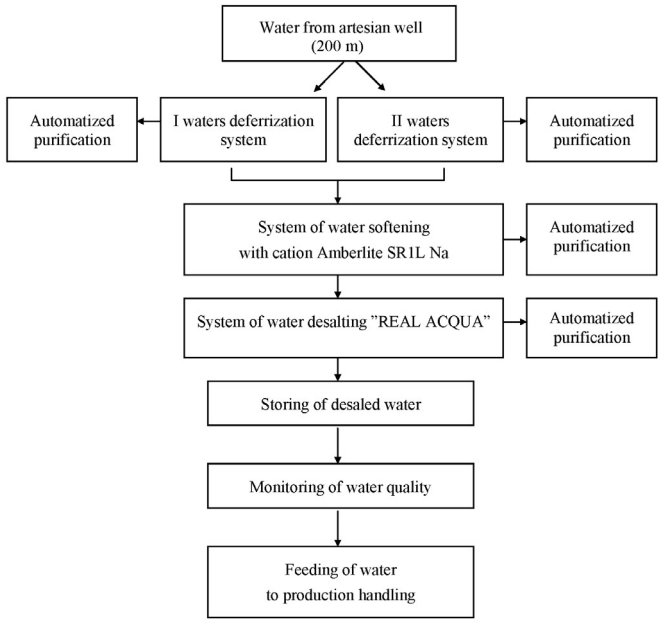

FIGURE 2. Preparation of water from artesian well for water–ethanol solutions.

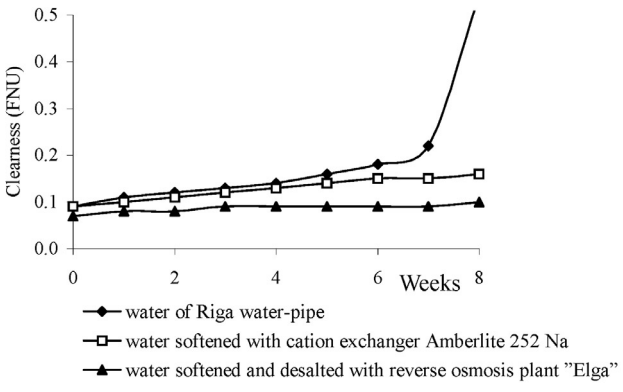

FIGURE 3. Changes in clearness of water–ethanol solutions during storage (water of Riga water–pipe).

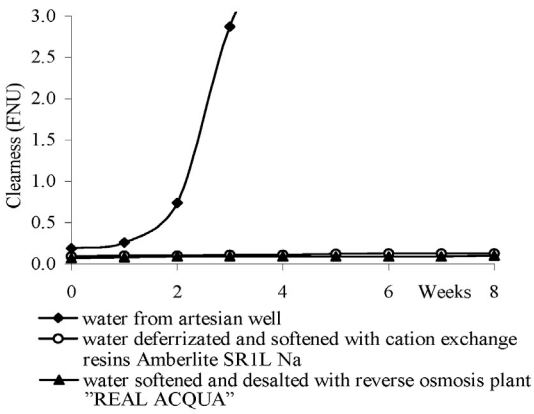

FIGURE 4. Changes in clearness of water–ethanol solutions during storage (water from artesian well).

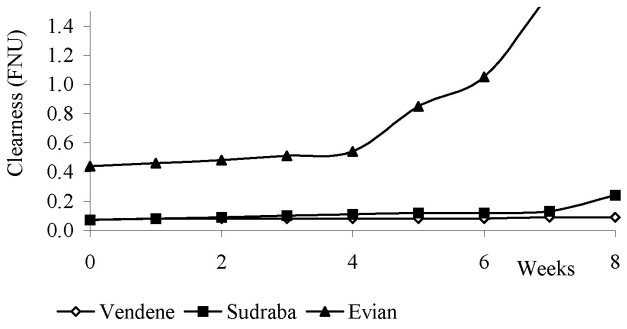

FIGURE 5. Changes in clearness of water–ethanol solutions during storage (brands of water distributed on market).

age it becomes apparent that the total hardness has the most important impact on the clearness of water–ethanol solutions.

Softening and desalting of water provides necessary norm (smaller than 0.1 mmol · L^{-1}) of water general hardness [Erokhina, 2003; Prigun, 2002; Ryabchikov *et al.*, 2002].

CONCLUSIONS

1. Clearness of water–ethanol solutions (vodka) depends on the water used and the ways of its treatment.
2. Clearness and stability of water–ethanol solutions is mainly affected by the hardness of the water.
3. Clearness and stability of water–ethanol solutions (after their preparation) is increased by filtration through membrane filters.
4. The turbidity of water–ethanol solutions (decrease in stability and clearness) increases during storage.

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