SONIC TREATMENT OF BEER WORT STABILIZED WITH SILICAGEL

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Abstract: This paper tackles the effect of ultrasound on the clarification and stabilization of beer wort. It presents the physical-chemical parameters variation depending on dose and sonic treatment time. It discusses turbidity, color stability after Esbach index and ammonium sulphate test. The paper ends with conclusions and practical recommendations.
Key words: beer wort, sonic treatment, frequency, sonic intensity level, silicagel

1. Introduction

Ultrasound technologies [1] are widely applied in biochemical processes favoring , some of them, proteins distortion and hydrolysis, carbohydrates hydrolysis, amino acids synthesis and producing changes in the alcohols, proteins, amino acids absorption bands, some enzymes inactivation, some vitamins changes, facilitating vitamin C oxidation and D2 vitamin production, polymerization and esterification reactions, depending on the used method. Favoring certain biotechnological processes such as: meat maturation, wine and brandy maturation, biological active substances extraction at ambient temperatures, oxygen extraction from beer to achieve superior colloidal stability, filtration and coagulation of colloidal solutions, microorganisms destruction or suppressing some processes as: fermentation for producing wine with low alcohol content, ultrasounds finds more and more application areas. A great interest in this context presents processes involving the application of ultrasounds in clarification and stabilization processes in the beer industry [2]. Analyzing the procedures for applying ultrasounds to beer treatment to ensure its colloidal stability, through air extraction or ensuring biological stability of beer using ultrasounds, applications of ultrasounds treatment on wine (glue) and experiments regarding the influence of dissolved gases in beer on the process of nitrogen substances coagulation, might be considered that beer ultrasonic treatment combined with the use of stabilizers and filtration materials, can lead to a decrease of substances quantity used for processes without ultrasounds, following the effects on biological stability of beer. At the same time treatment with ultrasound of organic technological liquids in cavitational regime is not welcome due to the free radicals formation, which limits the use of ultrasounds in the filtering process. A convenient solution can be the use of air-jet ultrasound generators for clarification and stabilization processes in the beer industry. In this way the role of cavitational bubbles will be achieved by working gas bubbles produced by air-jet generator. This erases the need for cavitational regime [1, 2] or acoustic intensity and high energy consumption.

2. The experimental installation and air-jet generator for sonic treatment of beer wort

Fig. 1. Experimental air-jet ultrasonic generator

To determine the sonic advantages of colloidal clarification and stabilization were experimentally investigated the physico-chemical indicators of beer wort treated with air-jet ultrasonic generator (fig.1) [3]:

We chose the emission regime with low intensity (Table 1) that cavitation does not occur:

Tabel. 1. Emission parameters of experimental air-jet ultrasonic generator [3]

Supply pressure	P, [Mpa]	0.15
Gas mass flow	$\dot{m}_a$, [g/s]	1.35
Gas volume flow	Q_a, [m^3/h]	4.86
Operating frequency	ν, [kHz]	24
Sound pressure level (acoustic intensity)	L ,[dB]	120.0
Acoustic power	W_a , [W]	12.6

The research of sonic treatment (with ultrasounds and simultaneous barbotage) requires certain technical requirements for providing leadership and control of technological processes that are in the hydropneumatic establishment of experimental installation (Fig. 2).Installation [3] can use as an working agent to generate ultrasounds compressed air or carbon dioxide following the technological needs. The air comes from the compressor 1 10÷16 bar pressure, is stored in tank 2, which is designed to eliminate pressure fluctuations generated by the compressor and ensure the desired flow and working pressure during sonic treatment. To maintain pressure in the certain limits is used electrical operated manometer 8, which automatically starts or stops the air compressor electric motor. The tank can clear out regularly through valve V1, ensuring the condensate removing. After opening valve 2, compressed air from the tank passes through pneumatic reducer 3 where its pressure decreases to a level of 0.5 ÷ 1.5 bar, necessary for the sonic generator 7 performance. The precise adjustment of gas pressure at the generator entry is made with needle valve adjustment V3. Generator working pressure control and generator flow (air consumption) is made with high precision manometer 6.

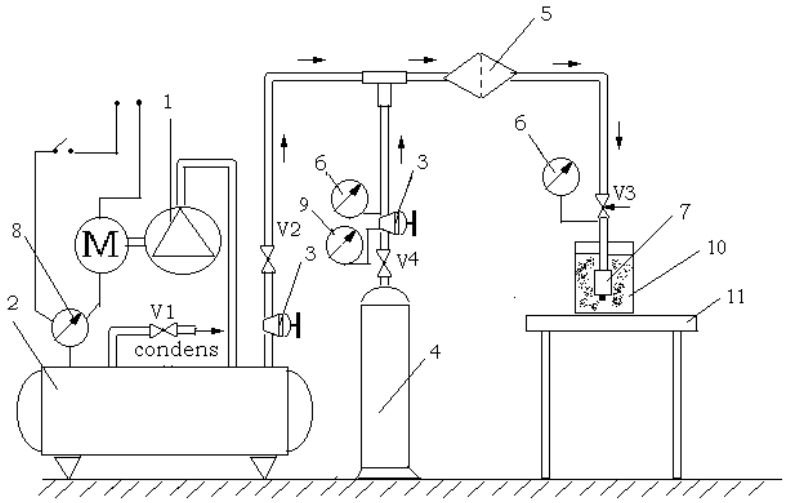

Fig. 2. Experimental installation for sonic clarification and stabilization of beer and beer wort
1-compressor, 2-tank , 3-reducer, 4- CO_2 gas bottle, 5-filter, 6-manometer, 7- air-jet ultrasound generator, 8- electrical operated manometer,
9- manometer ,10- reactor (glass bottle) with working liquid, 11- suport. ,V3- control valve, V4- bottle valve

3. Ultrasounds influence at stabilization with silicagel

In fig.3. are graphically presented turbidity values of beer wort samples [4] treated with silicagel and ultrasounds.

From figure 3 is observed an increase of turbidity at the wort treated with ultrasound compared to the untreated with ultrasound one. The same effect is found for the beer wort treated with silicagel and ultrasounds even after 15 hours of preservation.

In figure 4 are graphically presented turbidity values of beer wort samples treated with silicagel and ultrasounds.

From figure 4 is observed an increase of turbidity at the wort treated with ultrasound compared to the untreated with ultrasound one. The

results are practically identical to those in figure 3.

In fig. 5 are graphically presented color values of beer wort samples treated with silicagel and ultrasounds.

From figure 5 we see no sensitive changes of beer wort color treated with air-jet ultrasound generator. Small differences of color between samples are due to measurement errors.

In figure 6 are graphically presented Esbach index values of beer wort samples treated with silicagel and ultrasounds after 15 hours of preservation. From figure 6 we see no changes at the wort samples treated with ultrasound compared to the untreated with ultrasound one, the control sample and in those treated with silicagel. However, treatment with silicagel led to a considerable improvement in this index due to adsorption of protein fractions from wort. In figure 7 are graphically presented test values of ammonium sulphate of beer wort samples treated with silicagel and ultrasounds. From figure 7 is notice a values

decrease at ammonium sulphate test at beer wort samples treated with air-jet ultrasound generator and doses of silicagel 50 and 100g/hl compared to samples untreated with ultrasounds. This indicates a decrease in the quantities of precursor substances and an increase of stabilizing effect of beer wort. At a higher dose of silicagel 150g/hl stabilization effect disappears, observing even a negative effect, pH remained unchanged at 5.2 value, indicating no effect of cavitation and also impossibility of formation free radicals in beer wort [4].

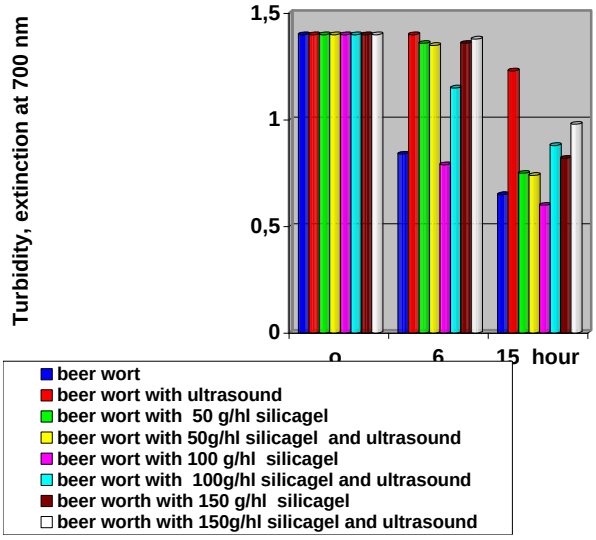

Fig. 3. The turbidity of beer wort treated with silicagel and ultrasound with the acoustic intensity level L = 120 dB and frequency of 24kHz., for 10 seconds with air

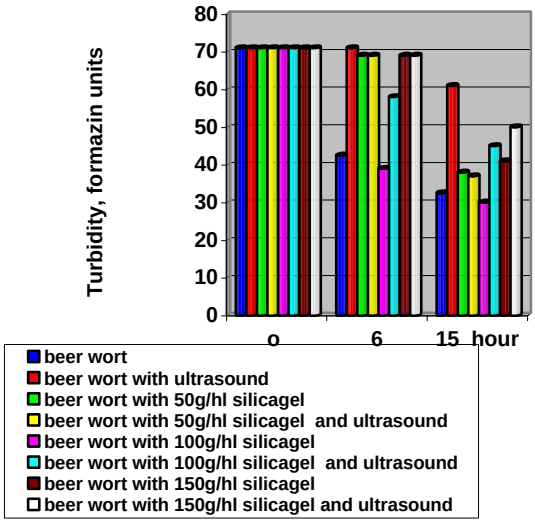

Fig. 4. The turbidity of beer wort treated with silicagel and ultrasound with the acoustic intensity level L = 120 dB and frequency of 24kHz., for 10 seconds with air

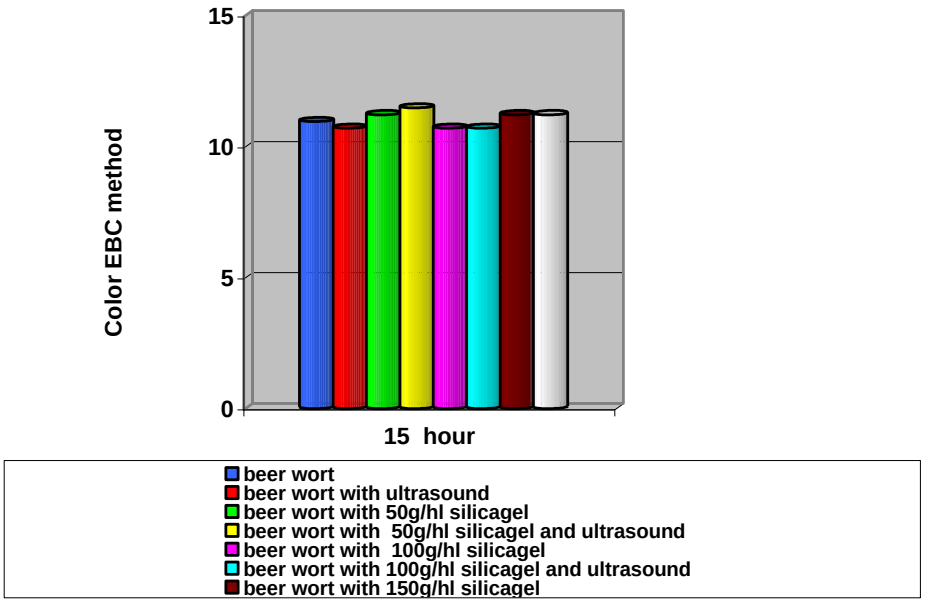

Fig. 5. Color of beer wort treated with silicagel and ultrasounds with the acoustic intensity level L = 120 dB and frequency of 24kHz., for 10 seconds with air.

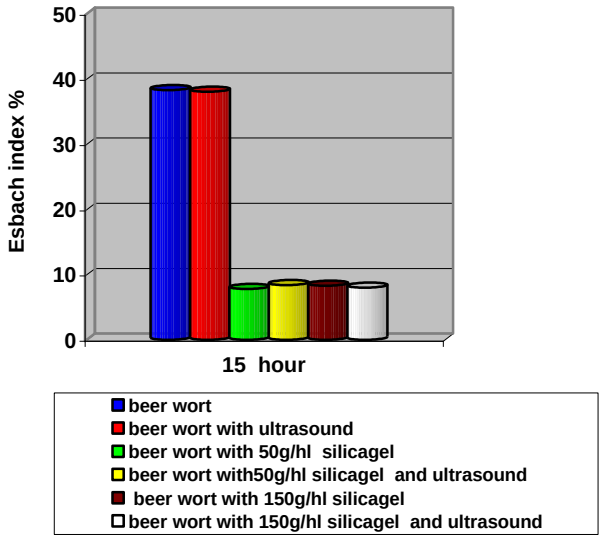

Fig. 6. Esbach index of beer wort treated with silicagel and ultrasound with the acoustic intensity level L = 120 dB and frequency of 24kHz., for 10 seconds with air

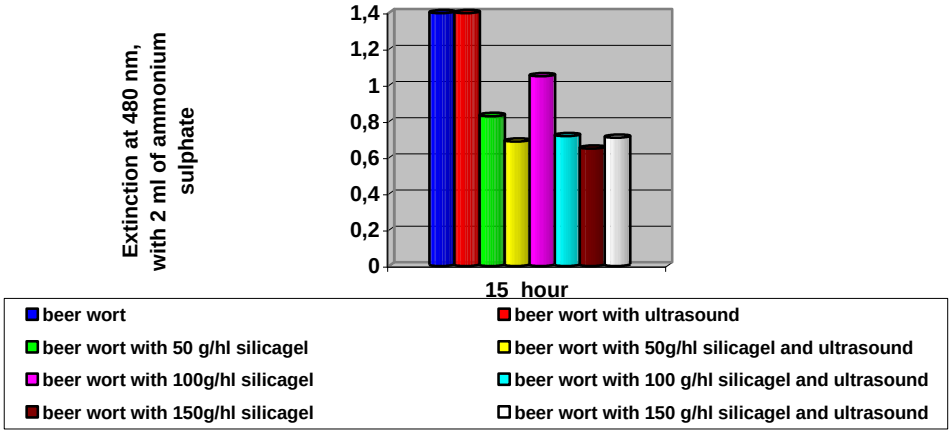

Fig. 7. Ammonium sulphate test of beer wort treated with silicagel and ultrasounds with sound intensity level L = 120 dB and frequency of 24kHz., for 10 seconds with air

4. Conclusions and recommendations

At sonic treatment of beer wort stabilized with silicagel we can see a decrease in turbidity at doses of 50 g / hl. Also the color does not change and neither Esbach index. In his turn at ammonium sulphate test is observed a decrease of values at doses of 50 g / hl, confirming increased stability. pH remained unchanged at 5.2 value, indicating no effect of cavitation and also impossibility of formation free radicals in beer wort.

Most of stabilizing substances studied causes turbidity increasing except one substance – silicagel, which provides simultaneous stabilization and clarification. That is why presents great interest a deeper understanding of the phenomenon, that can serve as targets for further research. Also, the application of the process under industrial conditions [4, 5] remains at technological choices and advantages this technology brings are: turbidity reduction of 18 ÷ 19%, increased stability approx. 20% and small doses of used substance (50 g / hl) at a short time of processing (20 s / l beer wort for a generator unit).

Acknowledgements

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