Physical treatments effect on fermentation

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Abstract
A method was developed for studying the effects of various treatments in the course of must fermentation. The raw material (must) was treated in different ways: (i) conductive; (ii) microwave treatment; (iii) inoculation with yeast and (iv) their combination. The results of the treatments were compared in the aspect of alcohol concentration, sugar content and acidity. The results suggest that the sugar content of the treated samples rapidly decreased compared to the control sample, and the fermentation time was shorter with 40% in the fastest case. These results are probably caused by the yeast inoculation and the microwave treatment.
Keywords: *microwave radiation, Saccharomyces cerevisiae*

Introduction

The main task of winemaking technology is to optimize of fermentation process in order to suitable production of wine (EPERJESI et al. 1998). Complex processes are take place during the source of must in line with each other, which could influence the process by positive or negative way. However, the controlled fermentation is well directed process with to application of appropriate parameters (CALADO et al. 2002; SABLAYROLLES 2009). During the fermentation the emphasis is mostly on to optimize the alcohol, sugar and acid content (PICKERING et al. 1998; BIACS et al. 2010).

Materials and methods

The experiments were performed with two series of measurements. In the first experimental set the fermentation of four samples were compared. In case of control sample there was not any treatment used. Yeast (*Saccharomyces cerevisiae*) was added to the second sample. The third sample was treated with microwave (50 W, 45 min, 32 °C). In case of the fourth sample a combined treatment (yeast and microwave) was applied.

In the second measurement series the fermentation were compared with six different treatments: (i) No treatment was applied on control samples; (ii) hot plate heated (32 °C); (iii) microwave-treated (50 W, 45 min, 32 °C); (iv) yeast supplementation (*Saccharomyces cerevisiae*) is received; (v) yeast inoculation under hot plate is heated (32 °C.); (vi) microwave treatment and yeast supplement. The must fermentation was carried out at 15-16 °C in these experiments.

During the experiments we determined the alcoholic content by Malligand-device, the sugar content of must with spectrophotometer, and acidity by titration (with NaOH). The measurements were performed with three repetitions.

Results and discussion

The difference between untreated and treated samples was visible after eight days of fermentation process. The sugar content of the control samples was decreased slower compared to the treated ones. Based on these results it can be stated that the fermentation is significantly influenced by the treatments.

Figure 1 shows that samples treated with microwave and yeast supplementation reaches the lowest value of sugar content on 16th day of fermentation. The sample having only yeast supplementation and only microwave-treatment reduced the sugar content faster. These samples reach the minimum value on 20th day of fermentation, while by the microwave treated sample occurs this phenomenon just on 24th day.

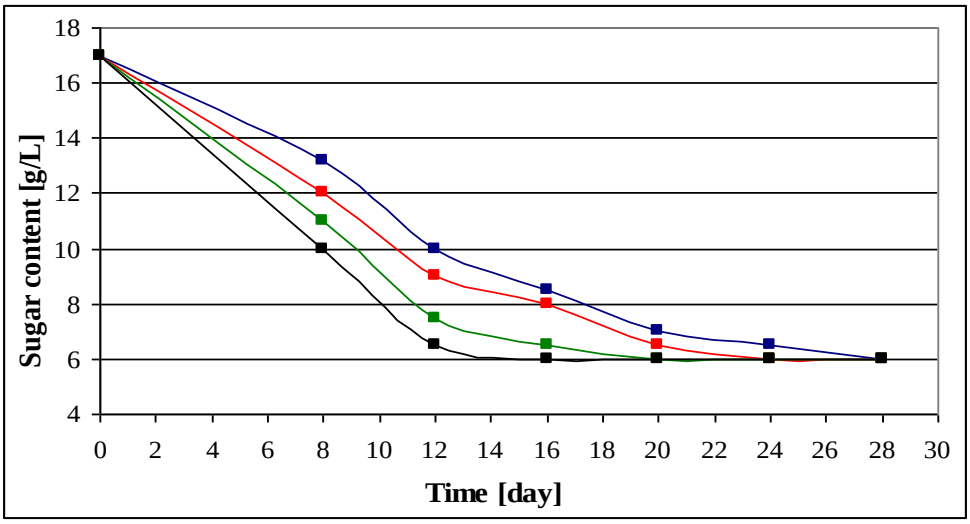

Figure 1. Changes the sugar content of the must during the fermentation of the control(■), the microwaves(■), the yeast (■) and the yeast and microwave treated (■) samples

The alcohol content (*Figure 2*) of the control samples was increased slower than in treated samples. Furthermore, the control sample gained the alcohol content (11.6%) at the end of the fermentation process.

Samples treated with microwave and yeast and inoculated only with yeast samples reached the highest alcoholic content (12.6%, 12.2%) on 20th day of fermentation, which implies that the treatment significantly influence the speed of fermentation.

In simple microwave treated sample achieved the highest alcohol content on 24-28th day of fermentation (12.1-12.2%).

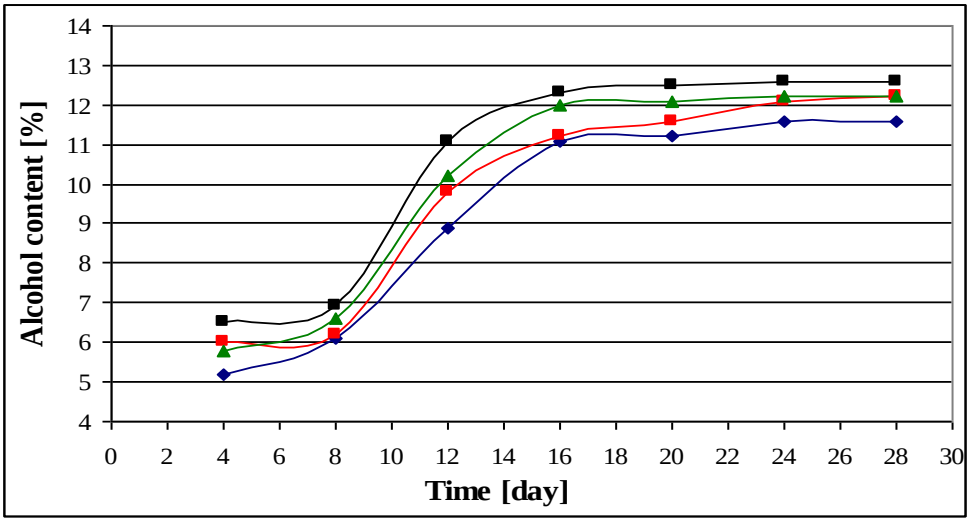

Figure 2. Changes of alcohol content of the must during the fermentation of the control(■), the microwaves(■), the yeast (■) and the yeast and microwave treated (■) samples

At the beginning of the fermentation acidity was increased for a while and then decreased, as it is written in other studies (KÁLLAY 2010). This can be clearly seen in our measurements (*Figure 3*).

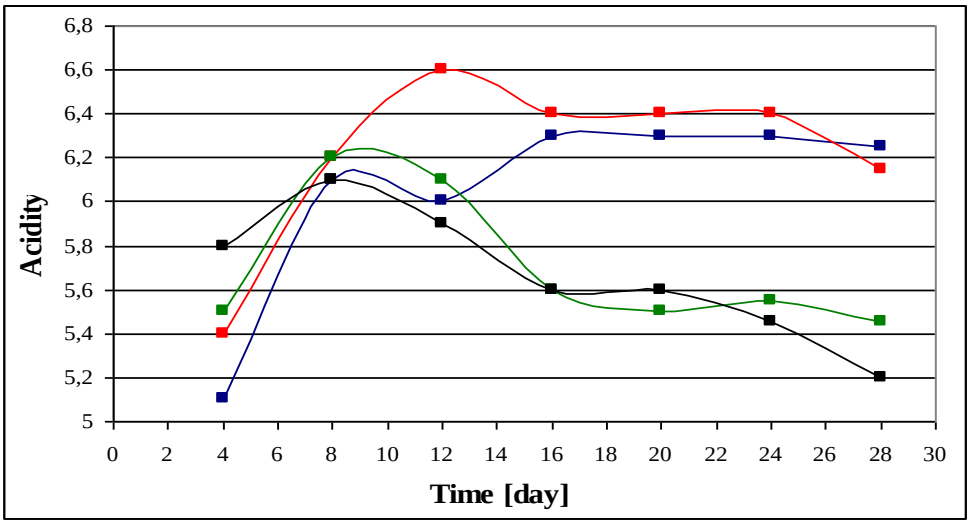

Figure 3. Changes of acidity of the must during the fermentation of the control(■), the microwaves(■), the yeast (■) and the yeast and microwave treated (■) samples

In case of second measurement series were experienced similar results of the sugar content as in the first measurement (*Figure 4*).

It can be noted that samples of yeast treated on hot-plate and samples of yeast treated with microwave reached the lowest sugar content on 14th day of fermentation (23 days total fermentation), while the remaining samples occurred at a later time.

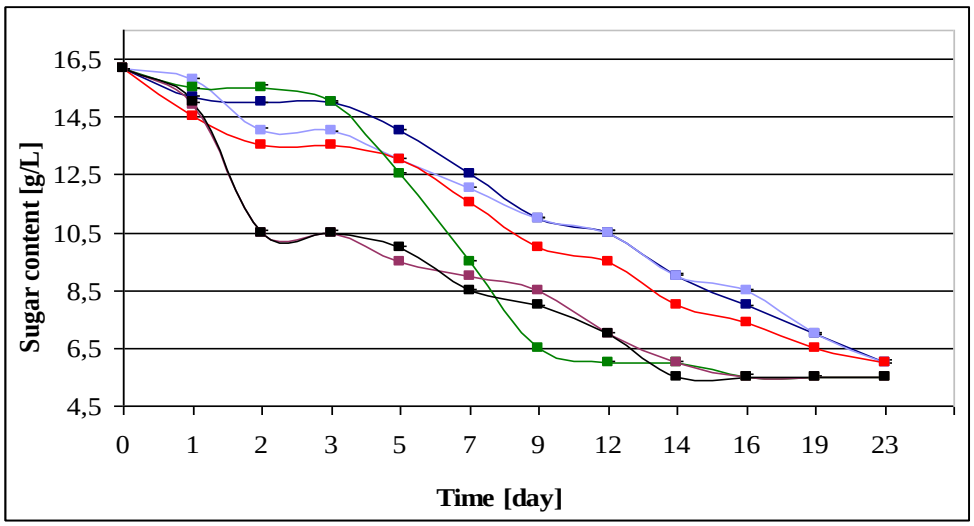

Figure 4. Change of the sugar content of the must during the fermentation of the control (■), the hot plate heated (■), the microwave-treated (■)), the yeast inoculated (■), the hot plate + yeast (■), and wiht microwave and yeast (■) treated sample

Distinctly, the fermentation was started on the second day of the measurement. There was a significant difference between the alcohol content (*Figure 5*) of the control sample (0.4%) and the treated samples (1 to 3.1%).

The alcohol content of the combined treated samples reached the highest level (10.4% and 10.2%) on 14th day of fermentation. These treatments also influence the speed of the fermentation. The alcohol content of the must samples were treated only with yeast inoculation or hot plate reached the highest level on the 18th day of fermentation (10% and 9.8%).

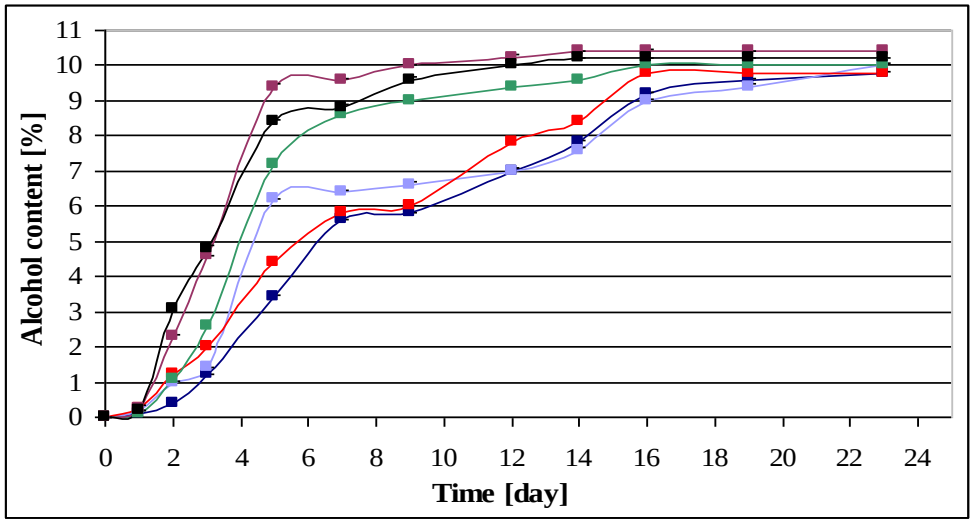

Figure 5. Change of the alcohol content of the must during the fermentation of the control (■), the hot plate heated (■), the microwave-treated (■)), the yeast inoculated (■), the hot plate + yeast (■), and wiht microwave and yeast (■) treated sample

Concerning acidity (*Figure 6*) it can be concluded that the complete treated samples have the largest acidity. The acidity change is not as uniform as the sugar and alcohol content change.

It can be stated that the average acidity difference between 0 days (must) and 23 days (wine) was 23.31%. And the difference was found between maximum and minimum acidity by 28.44%.

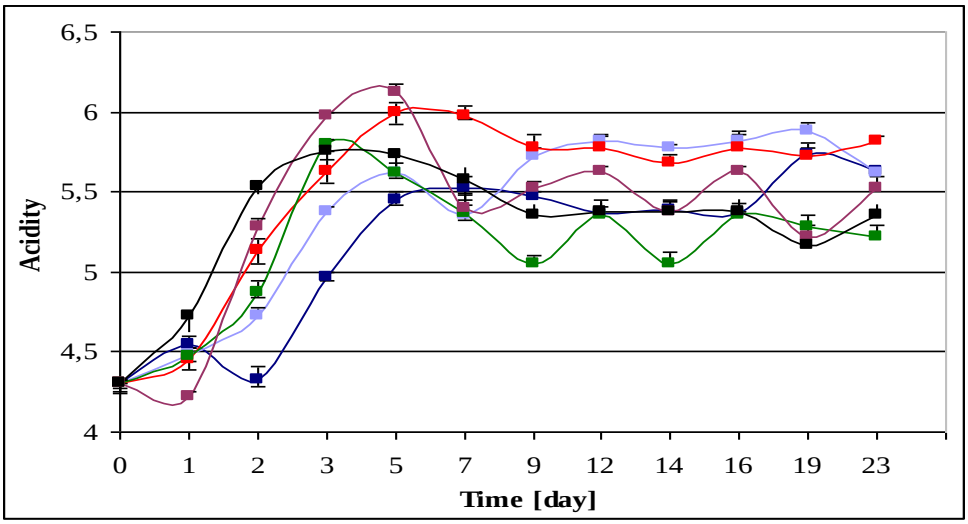

Figure 6. Change of acidity of the must during the fermentation of the control (■), the hot plate heated (■), the microwave-treated (■)), the yeast inoculated (■), the hot plate + yeast (■), and wiht microwave and yeast (■) treated sample

Conclusions

Both measurement series gave similar results. The sugar content of the treated samples rapidly decreased compared to the control sample and the fermentation time was shorter by 40% in the fastest case. These results were probably caused by the yeast inoculation and the microwave treatment.

The statistical analysis showed on the first attempt not significant difference between each sample. In this case the non-thermal effect of microwave is not prevail or has no effect on the results. The second series of measurements did not give significant difference between each sample as regards the alcohol content during the whole fermentation. In the first third of fermentation was verifiable different between the samples.

It was stated that a short-term heat treatment prior to fermentation until 32 ^{o}C influences the parameters of the fermentation in a positive way by using yeast. The fermentation time was reduced while the alcohol yield increased.

References

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