A STUDY CONCERNING THE INFLUENCE OF THE NATURAL PRESERVATIVES UPON THE COLOR OF THE LACTO-FERMENTED BEETROOT JUICE♦

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Abstract: The purpose of this study is to point out the transformations that the color of beet root juice undergoes during the lactic fermentation in the presence of some additional elements that have a preservative and diluting function. The juice was obtained through the processes of chopping and pressing of the red beetroot, then it was diluted up to 5/1 with black radish, parsnip and celery juice. Other two samples have been preserved with sodium benzoate and garlic. The inoculation was made with brine inoculums with 10^5 cells/mL lactic bacteria mixture. The lactic acid fermentation was performed in a thermostat at 27±2 °C, during 7 days. Meanwhile the color intensity, the *pH* and the titrable acidity have been determined. There has been noticed a lowering of the color intensity for all the samples. In comparison with the approval sample, the samples that have been preserved with sodium benzoate and garlic were more stable as far as the color is concerned with an extinction of E_{SB} = 0.275 respectively E_{SU} = 0.295. There has been noticed a prominent alteration of

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the color intensity in case of the samples diluted with black radish, parsnip and celery juice (E_M = 0.220, E_{ST} = 0.170, E_{SP} = 0.180, E_{SR1} = 0.210, E_{SR2} = 0.180).

Keywords: *beetroot juice, stability betalains, lactic fermentation, color intensity*

INTRODUCTION

Beta vulgaris contain calcium, sulfur, iron, potassium, choline, beta-carotene, and vitamin C, therefore is famous for their ability to cleanse the blood. It is an excellent source of vitamin A, of soluble and insoluble dietary fiber and it is used against constipation. Beets are also high in minerals that strengthen the liver and gall bladder, and are the building blocks for blood corpuscles and cells. It is also an important source of boron which is useful for the secretion of sexual hormones. The sugar content of the beetroots (6.76 g/100 g) is superior to that of carrots (5 g/100 g).This is why the beetroot juice can be an excellent substratum for the lactic bacteria during the lactic fermentation [1].

The pigments found in the beet root are called betalains and they are classified into two categories: the betacyanins that have a red-violet color and the betaxanthins which have a yellow-orange color [2, 3]. Betalains are reported to exhibit anti-inflammatory effects and to have antiradical and antioxidative activities [4].

The color of the beet root juice is given by the betacyanins. As the beet root juice is very concentrated it is diluted and then exposed to the lacto-bacillary fermentation. In order to reduce to a minimum or even to replace the synthetic preservatives we have used a series of vegetable juices which contain substances that have a preservative function.

The conversion of carbohydrate to lactic acid plus carbon dioxide and other organic acids occurs under the action of the lactic bacteria. These two bacteria belong to two groups: the homofermenters and the heterofermenters. The homofermentative bacteria produce only lactic acid through the Embden–Meyerhof route and the heterofermentative bacteria produce ethanol, CO_2 and other volatile compounds besides the lactic acid the 6-phosphoglucanate/phosphoketolase route.

The stability of the beetroot juice depends on a series of factors: pigments structure and concentration, pH value, water activity, light, temperature, metal cations and decolorizing enzymes and betalain-stabilizing compounds [5-8].

MATERIALS AND METHODS

In order to obtain the needed juices there have been used the beet root, the black radish, the celery, the parsnip, and the dilutions were 5/1. There have been used 7 samples. Besides the samples with admixture of vegetable juice we have also studied the influence of the sodium benzoate and of the garlic upon the coloring intensity of the lacto-fermented juice. The juices where then supplied with a brine inoculums with 10^5

cells/mL lactic bacteria mixture. The brine was obtained by a 3 day lactic acid fermentation of a mixture of chopped vegetables (carrots/cabbage) prepared with 2.5% NaCl. In the next study we did the following notes:

M- red beetroot juice (the approval sample);
ST- beetroot juice diluted with celery;
SP- beetroot juice diluted with parsnip;
SR1- beetroot juice diluted up to 5/1 with black radish;
SR2- beetroot juice diluted up to 5/2 with black radish;
SU- beetroot juice with an admixture of garlic;
SB- beetroot juice with an admixture of sodium benzoate.

The lactic acid fermentation was performed in a thermostat at 27±2 °C.
The acid lactic fermentation lasted seven days. In order to establish the color there has been used a Spekol spectrophotometer. The characteristic wavelength, known as X max has been determined by a spectrophotometrical method whose principle consists in the graphic representation of the extinct variation according with the wavelength, within a range of 400-700 nm, obtaining the so-called spectral or absorption curves. In this case $\lambda_{max.} = 535$ nm.
The *pH* determination was realized with an electronic pH-meter - the HACH type. The acidity has been determined by the titrimetric method in the presence of the bromothymol blue.

RESULTS AND DISCUSSIONS

If we analyze the results obtained it can be noticed - as shown in figure 1 - that the most prominent transformations are visible in the case of the samples that were diluted with celery juice, parsnip and black radish 5/1 and especially in the case of the 5/2 dilution.

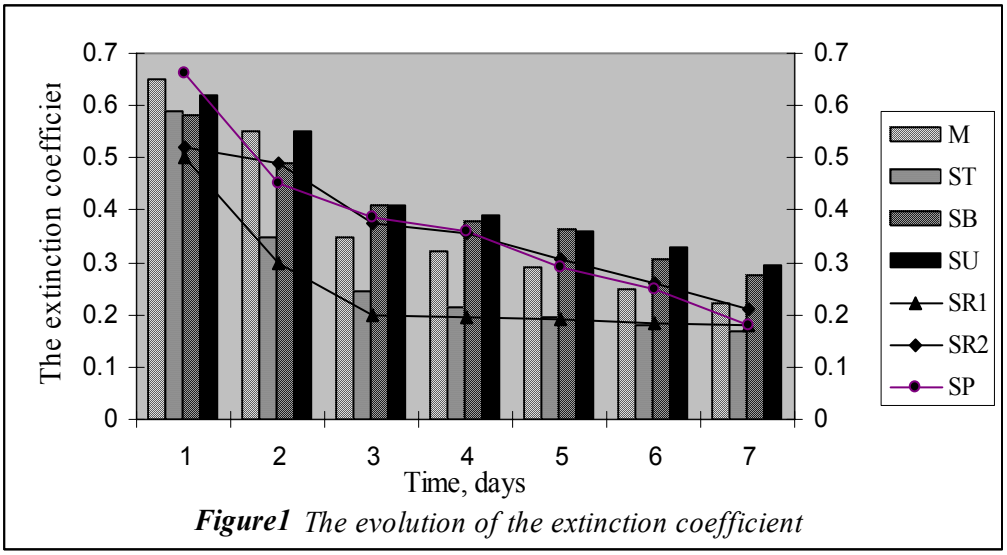

Figure1 *The evolution of the extinction coefficient*

If in the case of the approval sample the extinction varies from 0.650 to 0.220 in the case of the diluted sample this lowers down from 0.590 to 0.170.

As far as the dilution factor is concerned there has been noticed that the sample which was diluted with radish juice two times presents more prominent color degradation. In the case of the sample that were diluted with black radish the most reduced extinction is registered for the 5/2 dilution from 0.500 to 0.180, respectively and from 0.520 to 0.210 for the 5/1dilution.This evolution can be explained by the diminution of the pigments concentration in the analyzed samples, as a consequence of their dilution with vegetable juice.

Another cause of the beta lain degradation in the case of the mixed samples (ST, SR, SP) is the presence of the oxidative enzymes contained by the celery, the parsnip and the radish especially the polyphenoloxidase and peroxidase. The polyphenoloxidase is stable between *pH* 5 and 8 with a maximum at *pH* = 7, and the peroxidase stable between *pH* = 5 and 6, having a maximum of activity at *pH* = 6.

As it can be noticed in the table 1 in the first three days of the lactic fermentation the *pH* of the analyzed samples is bigger than the minimal value at which the oxidative enzymes can action causing the betalain enzyme degradation.

Table 1. *The pH-value in the juice vegetables*

No.	Vegetable	pH
1	Beetroot	5.83
2	Black radish	5.75
3	Celery	5.99
4	Parsnip	6.2

Once with the formation of the lactic acid and the *pH* diminution the oxidative enzymes are deactivated.

Another factor that influences the color intensity in a negative way in the case of the juices diluted with juices from other vegetables is the content of metal cat ions from those vegetables compositions. Thus, the black radish contains 223 mg Mg/100 g and 10 mg K/100 g and the parsnip contains 600 mg K/100 g.

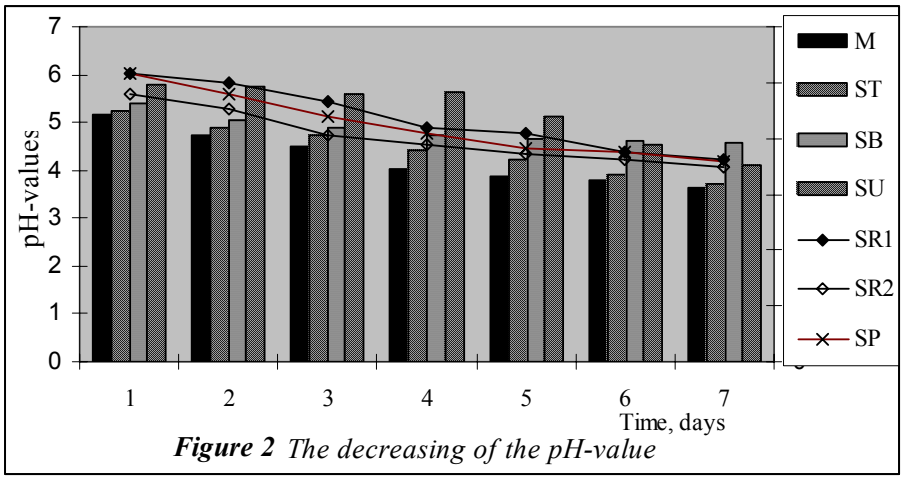

Figure 2 *The decreasing of the pH-value*

Mono, di and trivalent cations react with the pigment and they form less colored compounds. The forming of the pigment cation compounds can be hindered by the *pH* diminution, fact that can happen during the lactic fermentation or by EDTA admixture.

The *pH* evolution is illustrated in figure 2 in which there can be noticed that the samples with garlic and sodium benzoate admixture initially present the highest values 5.88 respectively 5.95. SU and SB acquire superior values to the other samples as far as the *pH* is concerned to the end of the lactic fermentation as well 4.1 respectively 4.59.
In the case of the sample with a *pH* lower than 4 the degradation of the lactic ferments was more prominent. Consequently, the betalain stability is optimum when the *pH* interval is 4-6. The *pH* field in which the color stability is optimum depends on the presence of oxygen which has values between 5.5 and 5.8. If there are anaerobic conditions the *pH* values vary between 4-5.
The samples' acidity is illustrated in figure 3 and its evolution points out the fact that the lactic fermentation occurred in the case of all the samples having a higher intensity in the case of the SP and SR2 samples.

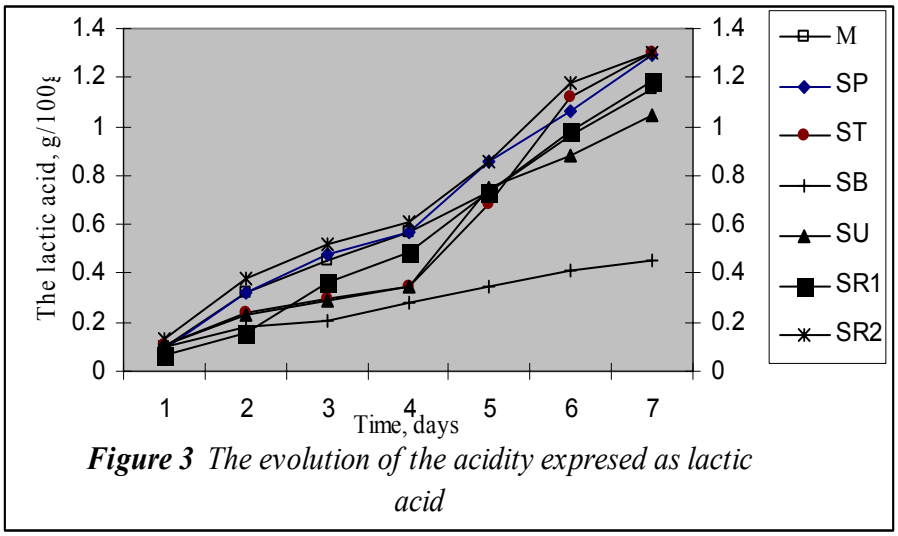

Figure 3 *The evolution of the acidity expresed as lactic acid*

The sample with garlic admixture has presented a higher intensity after the 3rd day of fermentation and beginning with the 4th day the juice presented a spun aspect. This fact is due to the presence of the glucose with big molecular mass in the garlic composition.
During the study there has been noticed an optimum lacto-fermentation for all the samples that were analyzed but in the case of the approval sample, starting with the 5th day, there has been noticed the forming of a sediment pellicle on the surface, a phenomenon that is caused by the lack of the compounds with antimicrobial action that are present in the vegetable juices with which the dilutions were realized.
Even if the lacto-fermented juice with garlic admixture does not provide a high stability in time it is recommended that we should produce and consume it due to the beneficial effects of the beetroot, the garlic and the lactic acid.

CONCLUSIONS

- During the lactic fermentation there takes place the diminution of the juices color intensity the last being more prominent if the *pH* is lower;

- The betalain stability depends on the concentration of the pigments in the juice samples, this being an important factor which influences the intensity of the color;
- The pigments degradation from the lacto-fermented beetroot juice is favored by the action of the oxidative enzymes from the juices that were used to prepare the dilutions and from the cat ion content from the respective juices;
- The lacto-fermented beetroot without natural admixtures is the most susceptible to be altered;
- From the safety food point of view it is recommended that we should use natural preservatives instead of the synthetic ones.

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