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THE EVALUATION OF LACTIC FERMENTATION YIELD OF CARROT JUICE WITH DIFFERENT ADDITIVES

Iuliana Manea[1*], Lavinia Claudia Buruleanu[1], Gabriela Ploscutanu[2]
[1]Valahia University of Targoviste, Faculty of Environmental Engineering and Biotechnology, Department of Food Engineering, 18-24 Unirii Bd., 130082 Targoviste, Romania
[2]University *Dunarea de Jos* Galati, Faculty of Food Science and Engineering, 111, Domneasca Street, 800201, Galati, Romania
[*]E-mail: iulia.manea10@yahoo.com

Abstract
This paper aims to assess the efficiency of carrot juice lactic fermentation in the presence of the addition of cysteine and leucine. Lactic fermentation causes an increase in the nutritional value of fruit and vegetable juices, because the enzyme lactic bacteria can predigests the macromolecular compounds intensifying the digestibility and nutrient content. The indicators monitored were pH, reducing sugars and the count of Lactobacillus acidophilus. Materials used were carrot juice (control sample M), carrot juice with cysteine (C) and with leucine (L). All samples were fermented in the presence of Lb.Acidophilus LA-5(0.2g/l), in anaerobic conditions at 37deg.C. The count of Lactobacillus acidophilus was determined by plate count method using Man–Rogosa-Sharpe agar. The results were expressed as CFU/ml juice. Was monitored the evolution of parameters that characterize the lactic fermentation in control sample and the samples with the addition of cysteine and leucine. The results highlight the role of the addition of cysteine in the sample of juice, because the yield is superior to the other samples, the degree of metabolism of carbohydrates was the biggest after 96 hours 1.34g/100ml, which correlates with the lowest pH and high cell viability Lb.Acidophilus LA-5. For describing the time evolution of the process of lactic fermentation was used a polynomial function that faithfully reproduce the metabolism of carbohydrates. The addition of leucine did not affect the lactic fermentation the parameters analyzed were similar to those of the control sample.

Keywords: cysteine, leucine, lactic fermentation, carrot juice, reducing sugar

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1. INTRODUCTION

The carrot juice is considered a food safety due to the potential high nutritional and biological, having a high antioxidant potential. (FAO/WHO, 2001; Donglin Z., Hamauzu, Y., 2003; Saito, T., 2004). He has a high content of carotene, vitamins B1, B2, pectic substances and minerals. Lactic fermentation of carrot juice increases the nutritional value by increasing digestibility and nutrient content. (Buruleanu et al., 2012). Svanberg states that the nutritional value of fermented juice is superior because it increases the bioavailability and quality of nutrients. (Svanberg, 1997) Lactic fermentation improves many chemical parameters of juices, such as the protein solubility, availability of micronutrients. (Kohajdová, Z., Karovičová, J., Greifová, M., 2006). The iron is better use of lactic fermented foods (Karovičová, J., Kohajdová, Z., 2002, 2003)

Along with the carbohydrate metabolism occurs decrease no digestible polysaccharides, such as cellulose, hemicellulose, and polygalacturonic and glucuronic acids, that produce gastric disorders. (Kanlanzopoulus, G., 1997; Nout, M.J.R., 1994) Fermentation processes can result in increased levels of vitamins in the final product, which has positive effects on consumers. (Kaur, I. P., Chopra, K., Saini, A., 2002; Steinkraus, 1997, cited by Buruleanu et al., 2012)

By the addition of *Saccharomyces cerevisiae* to obtain an increase the quantities of thiamin, nicotinic acid and biotin. (Aeschlimann, A., Stockar, U., 1990). The addition of onion juice is beneficial lactic

Fermentation, because efficiency is optimal and improves sensory properties and the addition of garlic juice is not favorable for

obtaining a final product competitive in terms of sensory and physicochemical properties. (Manea, I., Buruleanu, L., 2011)
Fermented carrot juice are used to obtaining healthy beverages for vegetarians and consumers allergic to lactose. (Kailasapathy, K., 2000; Yoon, K. Y., Woodams, E., Hang, E., Yong D, 2006) The parameters analyzed at product obtained by lactic fermentation are acidity, pH, residual sugar content, viable cell counts, biomass, and the content of amino acids, vitamins. (Rakin M., Baras, J., Vukašinović, M., Maksimović, M., 2004; Rakin M., Baras, J., Vukašinović, M., 2005)
To optimize lactic fermentation is practiced use of lactic acid bacteria obtained through genetic engineering, and by using different additives.
The purpose of this work was to compare the spontaneously fermented carrot juice fermentation of carrot juices in the presence of added cysteine and leucine that source of nutrition for lactic bacteria.

2. MATERIAL AND METHODS

2.1. Materials

To obtain the juice, there have been used carrots of Romanian provenience from the zone of the Dambovita district. Materials used were carrot juice (control sample M), carrot juice with cysteine (C) and with leucine (L).
The carrots have been washed, divided and the separation of the juice has been realized with the help of an electric extractor.
The obtained juice has been pasteurized at 80 deg. C during 10 min after which it has been cooled at 37-38 deg. C, the temperature at which the inoculation is done with the lactic bacteria. Amino acids as a source of nitrogen were dosed at 0.1% (w/v).
This way the substratum was prepared for inoculation with pure culture. A Christian Hansen lyophilized pure culture of *Lactobacillus acidophilus* was used for juice's fermentation.The initial inoculum of 6±0.1 log CFU/ml was used. All samples were fermented in the presence of *Lb.Acidophilus* LA-5(0.2g/l), in anaerobic conditions at 37deg.C. Measurements were made every 2 hours for 8 hours, then after 24 hours.

2.2. Analytical methods

The indicators monitored were pH, reducing sugars and the count of *Lactobacillus acidophilus.* The count of *Lactobacillus acidophilus* was determined by plate count method using Man–Rogosa-Sharpe agar. The results were expressed as CFU/ml juice. The pH values were measured with a HACH pH-meter.The reducing sugars were analyzed applying the spectrophotometric method with 3.5-dinitrosalicilic acid (DNS), which is a colorimetrical method, described by Segal et al. in 2000, Rani et al., 2001, McCleary et al., 2002. The results were expressed as g glucose/100mL.

2.3. Mathematical modelling

The mathematical analysis of the analytical data has been realized using Microsoft Excel X_p – Trend lines. The evolution of the lactic fermentation has been analysed using the mathematical simulation (MEX_p).

3. RESULTS AND DISCUTIONS

In figure 1 can observe that the cysteine sample had the lowest pH (4.08), so lactic fermentation had a higher yield, by accumulation of lactic acid. In the first 2 hours C sample fermented to the highest speed, pH value decreased by 13.09% compared with 6.62% the control sample and 6.1% in L sample. The leucine sample of fermented harder than the control sample, pH was 4.16, showing that leucine was not a good source of nutrition for lactic bacteria.
In figure 2 shows that after 24 hours residual sugar in the L sample is the biggest 1.34g/100ml and the C sample contained 1.1g/100ml. In the analyzed study the best modeling results have been obtained using a polynomial trend model, for de reducing sugar, where R squared has the biggest value (R^2 = 0,8855-0,955).

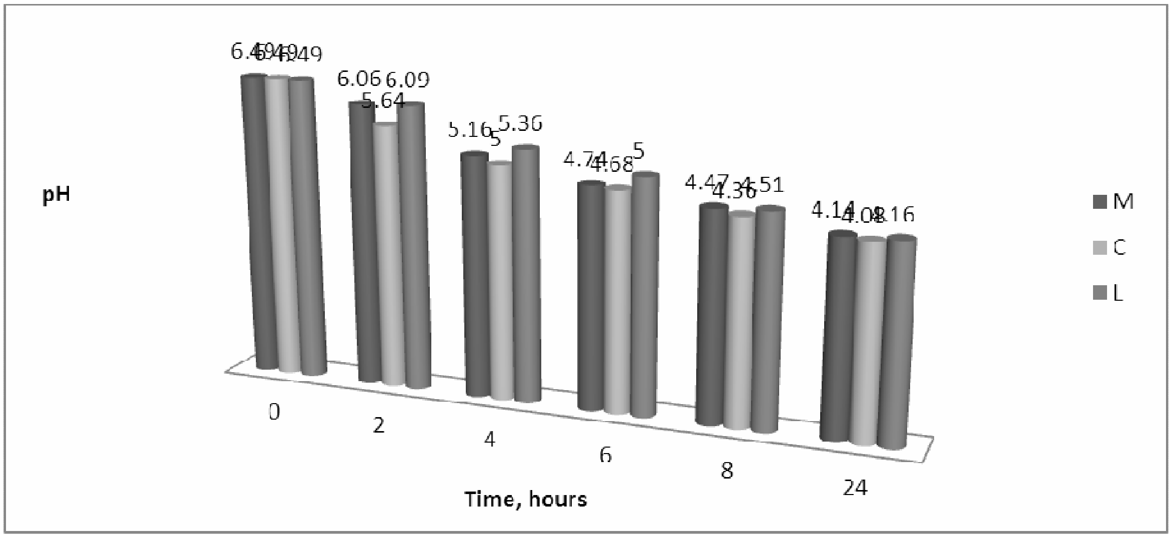

Fig. 1 The pH dynamics during the lactic acid fermentation with different additions of carrots juices with *Lb. acidophilus* LA-5

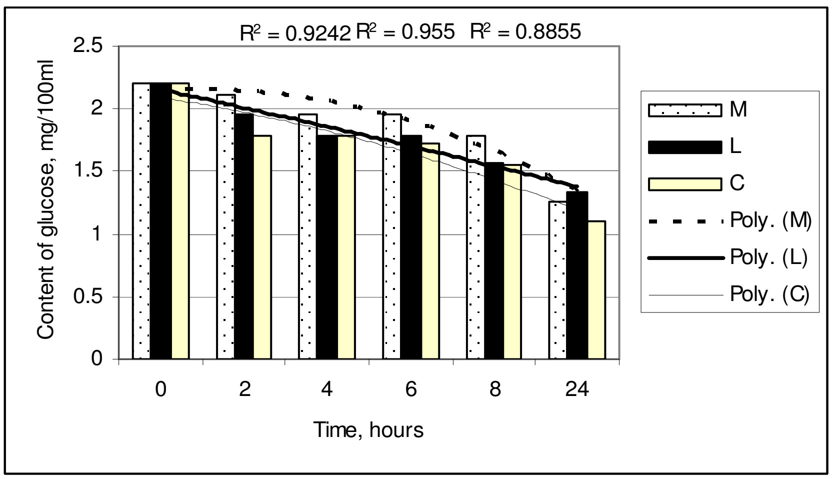

Fig. 2 The evolution of the reducing sugar during the lactic acid fermentation with the additions and *Lb. acidophilus* LA-5 of carrots juices

The polynomial model calculates the least squares by an equation form:

$y = b + c_1 x\tau + c_2 x\tau^2 + \ldots + c_n x\tau^n$,

b and $c_{1,\ldots}$ c_n are constant.

The relations obtained by mathematical modeling are shown in table 1, where "y" is the lactic fermentation, expressed in grams of glucose, and "τ" is the time expressed in hours. Correlated with the decreasing of the pH and the metabolism of sugar, the values of the viable cells count were lower until 2 in all the samples and increased in the next 4 hours. (Fig.3).

Table 1 The equations of mathematical models that describe the optimal fermentation lactic

y M = -0.0393x2 + 0.1133x + 2.076
y C = $-0.0157x^2$ - 0.0697x + 2.174
Y L = -0.0025x2 - 0.1379x + 2.294

After 6 hours of keeping at 37°C the number of lactic acid bacteria is maximum at all the samples and then begins to decline.

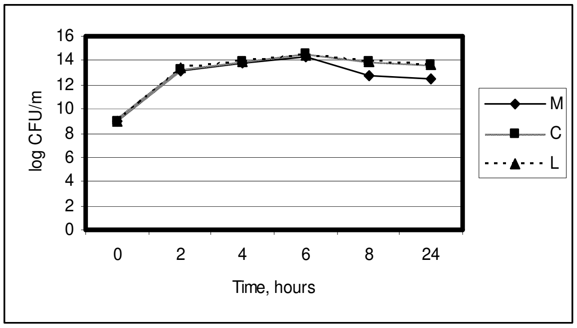

Fig. 3 The evolution of viable cells during the lactic acid fermentation with additions of carrots juices and *Lb. acidophilus* LA-5

The C sample showed a maximum number of 14.6 log UFC/ml bacteria and the lowest in sample M 14.26 log UFC/ml. After 24 hours cell viability is equal in C and L samples (13,6 log UFC/ml), but higher sample M (12,5 log UFC/ml).

4. CONCLUSIONS

The maximum volumetric productivity was determined after 6 hours in all the samples. After 24 h, the viability was lowest in the M sample.

The maximum yield of lactic fermentation of carrot juice was the sample with added cystine and the addition of leucine did not bring an improvement of fermentation parameters from control sample.

The evolution of the reducing sugar decrease was best fit by the polynomial trendline.

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