RESEARCH ON THE LACTIC FERMENTATION OF THE VARIOUS VEGETABLE JUICES

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Abstract
In this work was tested several vegetable juices in order to establish the best quality and stability of finished product lactic fermentation. The juices were investigated in terms of the yield of lactic acid, a rapid fermentation rate, and availability of sugars. Depending on the chemical parameters is done choice of raw materials used to obtain lacto fermented vegetable juices. The samples analyzed were white cabbage juice, red pepper juice and juice of cabbage and red peppers. There have been tested two concentrations of lactic culture for the effectuation of the lactic fermentation. All samples were fermented in the presence of Lb. Acidophilus in anaerobic conditions at 37deg.C. Changes in sugar content, lactic acid content, pH-value, and the dry matter during fermentation under controlled conditions were monitored. The results indicate an optimum lactic fermentation in case of using a lactic acid culture of 0.1%. Cabbage and red pepper juice has the best fermentation, reflected by the values of pH 3.5, reducing sugar 0.335g glucose/100mL, acidity 0,152g lactic acid/100mL and sensory properties. The juices fermented with lactic culture concentration of 1% has provided best results for physicochemical parameters, but point of view of the sensory characteristics of fermented juice was lower than fermented juices by 0.1% lactic culture.

Keywords: vegetable juices, lactic acid fermentation, reducing sugars, lactic acid

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1.INTRODUCTION

The vegetables are devoid the daily food of the people, because these contribute to better digestion of all other foods eaten, provides the human body vitamins, minerals and sugars directly assimilated and also stimulates the proper functioning of the digestive system (Gobbetti M., Cagno R.Di., De Angelis M., 2010). The energy value of vegetables is determined mainly by the presence of carbohydrates. Typical for carbohydrates from vegetables is that they are soluble form easily assimilated by the body. In order to conserve the vegetable juices and to increase their nutritional value, the juices are lactic fermented.

The Food and Agriculture Organisation of the United Nations (FAO) assert that the fermentation technologies have an important role in global food security, especially in underdeveloped countries and in vulnerable groups. Therefore perishable foods can be longer preserved, increasing the range of raw materials that can be used to produce edible foods, and the number of finished food products. A food safety issue is the elimination of anti-nutrition factors to make food safe to eat (http://www.fao.org/docrep/x0560e/x0560e06. htm#1.1).

Lactic acid fermentation generally increases the digestibility and the nutrient content of fermented foods. Folate is produced by various green leafy vegetables, cereals, legumes and by some microorganisms and is an essential component in the human diet. Moreover, it has a preventative role against several disorders including the development of neural tube defects, risk of coronary heart disease, some types of cancer and neuropsychiatric disorders (Gangadharan D., Nampoothiri K.M, 2011). A series of attractive biochemical effects have been assigned to them, including action against

cardiovascular diseases, cancer, inflammation and allergy (Halliwell B., 2007).
Lactic acid fermentation has multiple effects on the nutritional value of food by modifying the level and bioavailability of nutrients, by interacting with antinutrient compounds or the gut microbiota and even the human immune system (http://www.teknoscienze.com; Gupta S., Abu-Ghannam N., 2012). Similar effects can be obtained by the eating of probiotic yoghurt with added medicinal plant extracts (Mocanu G. D. et al., 2009). During this fermentation, several antimicrobial metabolites (organic acids, alcohols, and bacteriocins) can be formed, which may increase the food safety by inhibiting or killing of foodborne pathogens. However, dangerous metabolites (biogenic amine and ethyl carbamate) can accumulate and certain pathogens may survive or grow in the fermented foods.
The obtaining of the lactofermentated vegetable juices must take into account the quality of the used raw material of point of view organoleptic, biochemical (acidity, pH), toxicological and shelf life. Also, the technology must be adopted in order to obtain reproducible products, but also for maintaining stability until consumption.
Other methods for increasing preservation is pasteurized vegetable juices on a water bath at 70 deg. C for 3 minutes or ohmic heated to approximately 70 deg. C (Profir A., Vizireanu C., 2013). Initial the lacto fermented juices was obtained on a spontaneous fermentation, due to the microflora naturally present on the raw materials. Later on, the direct addition of selected starter cultures to the food matrix was preferred by the food industry (Panagiota F. P., Efterpi C., Eleftherios B., 2013).
In this study were analyzed vegetable juice and dosage of lactic cultures that lead to the best lacto fermented products.

2. MATERIAL AND METHODS

The stability of the juices depend on the chemical composition of the juice and the dose of lactic acid bacteria with which are inoculated these.

2.1. Samples

The juice has been obtained from white cabbage and red pepper according to the imposed methodology. The white cabbage and red pepper have been washed, divided and the separation of the juice has been realized with the help of an electric extractor. The juice was supplied to a thermal treatment at 80^0C, for 5 minutes after which it has been cooled at 37-38 deg. C, the temperature at which the inoculation is done with the rennet of lactic bacteria. The inocul was obtained by a 3 day lactic acid fermentation of a mixture of chopped vegetables (carrots/cabbage) prepared with 2,5% NaCl.
The obtained samples were noted according to the raw material name:

- RP- red pepper juice with a concentration of 0.1% lactic acid bacteria
- C - white cabbage juice with a concentration of 0.1% lactic acid bacteria
- CRP- juice of cabbage and red peppers with a concentration of 0.1% lactic acid bacteria
- RP2- red pepper juice with a concentration of 1% lactic acid bacteria
- C2- white cabbage juice with a concentration of 1% lactic acid bacteria
- CRP2- juice of cabbage and red peppers with a concentration of 1% lactic acid bacteria.

2.2. Methods and reagents

The measured active components were: the reducing sugars, the lactic acid, the pH, dry matter. The determination of biochemical parameters was realized in accordance with the stipulated techniques and the existing methodology. The dosing of the reducing sugar calculated as the glucose has been efectuated using the 3, 5 dinitrosalicilic acid.
The pH has been determined using an electronic pH-meter. The dry matter using Abbe refractrometer. Titrable acidity, expressed as g lactic acid/100mL, was determined by titration with NaOH 0,1N in presence of phenolphthalein.
Analyses were performed for 4 days, the period in which the evidence has been kept at the temperature of 37 deg C.

Table 1. The composition of fresh juices

Sample/Parameters	Red pepper juice	White cabbage juice	Juice of cabbage and red peppers
Reducing sugar, g glucose/100mL	2.45	1.515	2.74
The acidity, g lactic acid/100mL juice	0.0468	0.0468	0.0432
pH-value	4.05	3.75	3.84
Dry matter, g/100mL	8	10	9.5

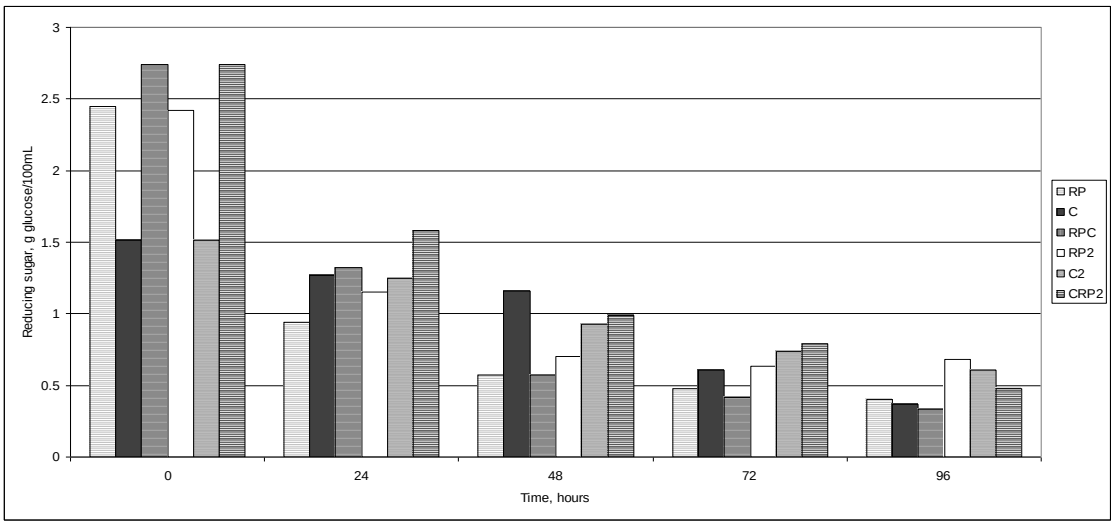

Fig. 1 The reducing sugar value during lactic acid fermentation

Concerning on the appreciation of the obtained lactofermented juices, there has been kept at the temperature of refrigeration another 3 weeks.

3. RESULTS AND DISCUTION

For a better understanding of the dynamics of the chemical parameters during the lactic acid fermentation, before the beginning of lactic acid fermentation the fresh juices as raw material for the lactic acid fermentation process had the following analytical parameters (table 1).

In the technological process of extraction of the juice, from the vegetables surface, microorganisms passes in the juice. Vegetable juices have low pH and contain significant amounts of carbohydrates that are selective media favoring the growth of yeast. After the determination of the reducing sugars content during the lactic acid fermentation the results were presented in figure 1.

The decreasing of the sugars content during the accounting processes is accompanied by the energetic value reducing. The quality of the red pepper and cabbage, from the commercial and technological point of view, depends both on the sugar content.

In the samples with concentration 1% lactic cultures sugar metabolism is less intense than in the samples with 0.1% lactic cultures, because the residual sugar content is high (average 0,591g/100mL), comparative with the samples with 0.1% lactic cultures (average 0,37g/100mL).The metabolism of sugar during lactic fermentation lead at increasing acidity expressed as lactic acid in parallel with the decrease of pH value (figure 2).

In the samples fermented with 0,1% lactic bacteria culture, highest content of lactic acid was registered in red pepper juice 0.18g/100mL and lowest in the cabbage juice 0,117g/100mL.

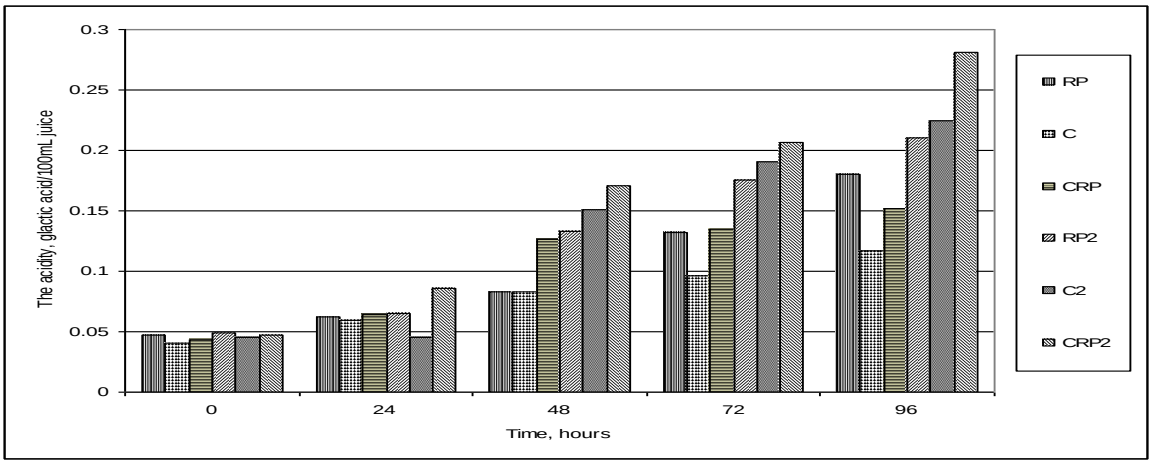

Fig. 2 The evolution of the acidity expressed as lactic acid

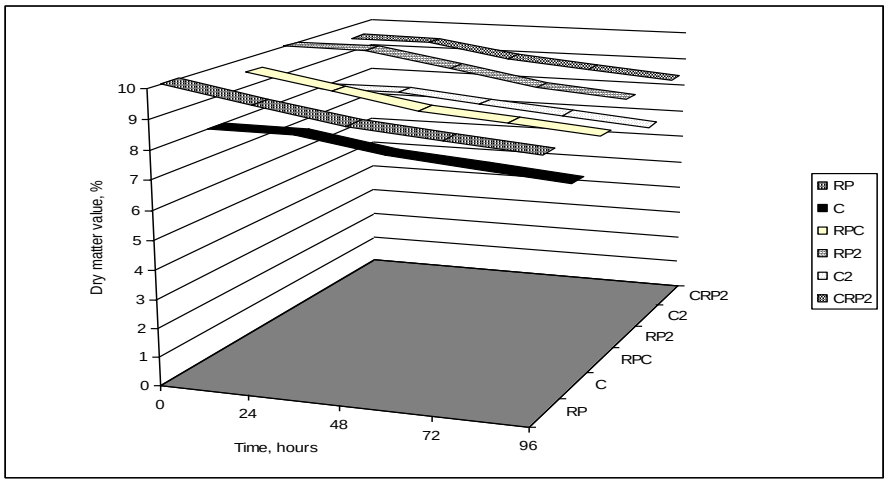

Fig.3 The evolution of the dry matter value during the lactic fermentation

In the samples fermented with 1% lactic bacteria culture, average acidity (0.1245g/100mL) was lower than case of the samples fermented with 0.1% lactic cultures (0,149g/100mL). The variation of dry matter content in juices samples during the lactic fermentation is presented in figure 3.

In all samples the dry matter values decreased. The fermented samples with 1% lactic cultures have a content of dry substance higher because fermentation yield is lower than in the first case.

The evolution of de pH-value is presented in figure 4. Decreased the pH in fermented juice inhibit the contamination micro-organisms activity. If the the pH is lower, the antimicrobial effect will be greater. It was demonstrated that organic acids have a greater antimicrobial effect than inorganic acids.

Lacto fermentated juices stability is explained and the availability of other substances that are formed during fermentation lactic acid: hydrogen peroxide, diacetyl, bacteriocins, and secondary reaction products such as hypothiocyanate (Zeuthen P. et al., COMMISSION OF THE EUROPEAN COMMUNITIES).

The pH evolution is correlated with increasing acidity and sugar metabolism, the juice fermented with 0.1% lactic cultures average value is 3.49, and the juice fermented lactic cultures with 1% average value is 3.62. The lowest pH ensures the best conservation for lactic fermented juices and was registered in red pepper juice, RP: 3,42.

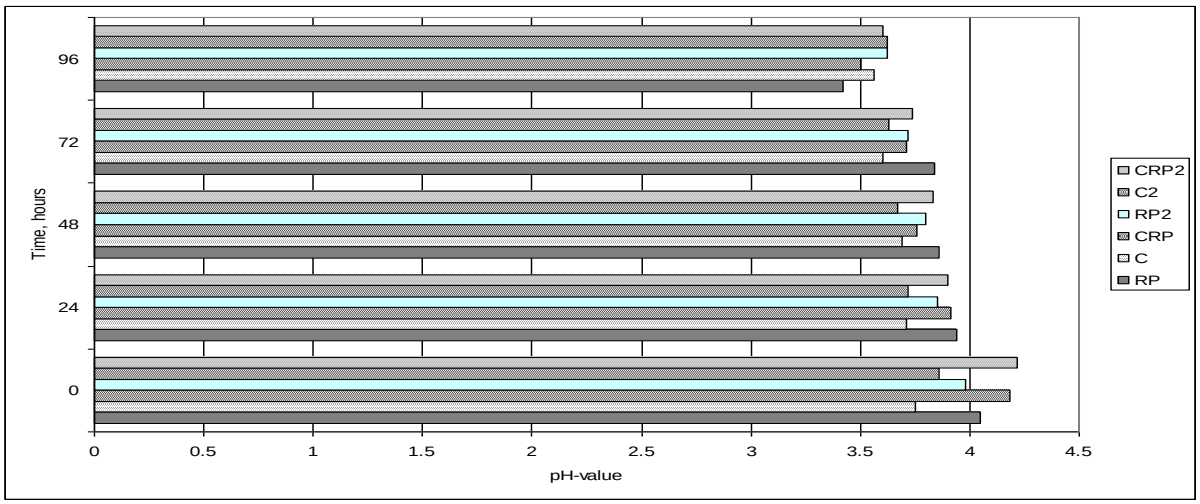

Fig. 4 The evolution of pH value during lactic acid fermentation

4. CONCLUSIONS

Lactic fermentation takes place with greater intensity when using culture of 0,1% concentration, obtaining juices with low pH and residual sugar content lower than the fermentation of 1% concentration.

Cabbage and red pepper juice has fermented best, sugar metabolism is achieved after 96 hours at a rate of 87,77% for the CRP sample. Also the acidity and pH ensure the conservation optimal of CRP juice. The cabbage juice fermented hard, sugar metabolism being in proportion of 75.57% for the C sample compared with 59.73% for the C2 sample.

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