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ECO-INNOVATING OF ORGANIC RHUBARB GRANULES USED TO CORRECT THE ACIDITY MARKER OF THE SUGAR SYRUPS

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• Introduction

The experimental applied research aimed to identify the possibilities of using Rhubarb vegetable waste as an ecological product either in dry granular form or reconstituted as an extract, to correct the acidity marker for sugar syrups in fruit compotes or in the fruit juices. Thus, the raw material Rhubarb was crushed, and after extracting the juices, the resulting mark was dried to the lowest humidity 0.02%, which ensures the shelf life of the dry material over time. Thus, the Rhubarb samples were dried obtaining the granules from the green, pink and red Rhubarb raw material. These were kept under normal conditions of the temperature of 18-20ºC and relative air humidity of 75- 80% for 12 months, without registering their degradation. Wet brand samples consisting of green, pink and red Rhubarb dry wastes were also kept at refrigeration temperature 0-9ºC for 14 days. In firstly 7 days there were no changes, and the complete alteration of the samples occurred in the 10th day. As for the dried, crushed organic products obtained from green, pink or red Rhubarb, they were used for correct the acidity of the sugar syrups that can be used to obtain fruit compotes or fruit juices. It was identifying the acidity of extract resulted after rehydration, when the results obtained were - acidity of green Rhubarb extract 16 g/100g, acidity of pink Rhubarb extract 10 g/100g, acidity of red Rhubarb extract 8 g/100g. After adding of 2-2.95% Rhubarb extracts into the sugar syrups with 23.35-34% soluble substances, the total acidity increased at the 2.8-4.9 degrees acidity, an acidity index which can ensure a redox potential to prevent reversal oxidation and to prevent the fermentation and may stopped the development of mold spores.

Revent (Rhubarb) is a plant native to Central and East Asia, which is also foud in Europe. From this are used the stems, which are used in the preparation of sweet products: jellies, jams, compotes, as well as rhubarb tarts. The benefits of Rhubarb reduce the risk of cancer, regenerates liver cells, lowers blood pressure, fights cholesterol, being recommended for indigestion. It is a good digestive, and the consumption of this plant at a low temperature helps to balance the acids that produce digestion. Nutritional values per 100 g of rhubarb are: 0.39 g, carbs 31.2 g, fibre 2 g, sugars 28.7 g, calcium 145 mg, Fe 0.21 mg, Mg 12 mg, P 8 mg, K 96 mg, Vitamin C 3.3 mg, Vitamin B6 0.02 mg. (https://www.libertatea.ro/lifestyle/rubarba-plantare-beneficii) It is ideal to consume only the stem as the leaves contain a large amount of oxalates, which can become toxic in the context of consuming a large amount. Rhubarb is rich in magnesium, calcium, phosphorus, potassium, sodium, zinc, selenium, iron, protein, fibre and carbohydrates. (https://doc.ro/dieta-si-sport/rubarba-proprietati-si-beneficii).It also has a large amount of vitamins, the most important of which are vitamins A, C, K and E. Vitamin A is considered a powerful antioxidant, helps maintain the health of epithelial tissue, contributes to bone metabolism, ensuring the immunity of the human body. In addition, vitamin C, vitamin K and calcium help in maxillofacial strengthening. (www.sciencedirect.com) Nowadays, the technology of processing canned fruit uses as a manufacturing recipe: sugar, water, dye, citric acid, thickener, identical natural flavours to flavour the assortment after the fruit associated with the finished product. that is, alternatives to the synthesis of citric acid obtained by synthesis with other natural products with similar acid-ifying properties, is a new trend practiced worldwide, especially to improve the quality characteristics of food. (www.sciencedirect.com)

Literature Review

The effect produced by the natural invert substances extracted from the Rhubarb stems, on the acidity of the native fruit jellies and the preservation of them. In the classical technology to avoid the inversion of the sugar used in the manufacture of fruit juices, it is used standard, citric acid both to obtain an environment with potential redox that will prevent the formation of invert sugar and for the correction of the taste. The identification of the acidic substances in the rhubarb stems does not allow the experimentation of their use for the replacement of the citric acid obtained by chemical synthesis. Thus, an aqueous extract of rhubarb was obtained which was successfully used to conserve indigenous fruit juices experimentally obtaining stable sugary products, which did not show changes in structure through saccharification. There were studied the fruits juice obtained from natural fruits: plums, nectarines, peaches and grapes to which its were added different concentrations of rhubarb extract, following the sensory, physical and chemical characteristics of the preservation juices. The applied scientific research aimed at both innovating baby fruit juices and consumer segments with different digestive disorders, as well as obtaining a technologically stable product in terms of biochemical and microbiological characteristics.(Radu S., Herdeș D.2019) Acidity has been studied as the most important factor because the use of Rhubarb extract to obtain innovative fruit jellies generates a major impact in the modification of the classical technology of obtaining jellies. However, acidity corrections made when processing fruit juices as well as jellies are a very practical operation in the production process. An important novelty aspect encountered in the manufacture of innovative fruit jellies is related to the use of rhubarb extract which produces their acidification, also having the effect of preventing the invert of sucrose, favoring the stability of the finished products prevents the crystallization of sucrose. (Radu S., Herdeș D.2019)

• Material and method

The samples used to obtain the preparations were immature green Rhubarb marc, pink Rhubarb marc and technologically matured red Rhubarb marc. By drying the samples, the aim was to reduce the humidity to the minimum allowable level for the preservation of organic Rhubarb preparations, preventing the development of different species of mould. Drying was done at 105°C for 60 minutes until a dry preparation with granular characteristics was obtained. The dry waste was crushed into granules that were kept intact for 12 months. For the use of granules, their dosage according to the acidity marker of the sugar syrup studied for the manufacture of fruit compote was used as a first method. Another method was rehydration of dried Rhubarb granules and use of Rhubarb acid extract to correct the acidity of the sugar syrup used to obtain the compote.(Radu S. 2012) In parallel, the control sample was used where the acidification of the sugar syrup was done with citric acid. crystallized obtained by chemical synthesis. The experimental study performed by comparative analysis of sugar syrup using different acidity aimed at replacing synthetic additives, citric acid with natural products that can successfully replace total organic acidity producing the same acidifying effects. Thus, for sugar syrups with 18% soluble substance, for apple, pear, grape, cherry compote, 2.95 g of Rhubarb extract per 1000 g of compote were used, for sugar syrup with 20% soluble substance for compote of apricots, strawberries, quince, plums, peaches, raspberries, 3.66 g of Rhubarb extract were used, and in the sugar syrup with 23% soluble substance for cherry compote 4.29 g of Rhubarb extract were used. Thus, the matrix of acidity markers was used to determine the optimal dose. In the case of adding granules, their dosing was done by weighing the solid material and adding it to the sugar syrup, followed by dissolving the organic acids and separating the wet residue by filtration. After dosing the granules and extracts, the acidity of the sugar syrups was determined, in order to compare the acidity markers obtained and to draw up the matrix of the markers for the sugar syrups with 18%, 20% and 23% soluble substance used for fruit compotes. different. In order to establish the level of preservation of these compotes, the resistance of Rhubarb extracts or granules over time was tested from a microbiological test. The conditions for collecting the analysis samples faithfully represent the quality of the batch from which they come. 5 samples were taken, which consisted of 5 units, the level of the batch for bulk products being low. Apple juice had a heterogeneous structure consisting of a part of the pulp and a liquid part, so the sampling was done from several areas with high risks of contamination, after homogenization of bulk products. The homogenization of the analysis samples was done with the rod and the magnetic stirrer. The temperature of the samples remained constant. Modern principles of microbiological evaluation of fruit juices use techniques of qualitative, quantitative, isolation and characterization of microorganisms in the specific microbiota, to highlight the potential for spoilage, then pathogenic microorganisms and those that produce toxins. These modern techniques are based on microbiological, biochemical, biophysical, immunological, genetic analysis. They are accurate, reduce response time and improve working conditions in the laboratory. In the case of the experiment, the aim was: to improve the test preparation conditions and to simplify the working methodology through the global biomass evaluation. Thus, the method used was the study of microscopic preparations, directly, by cultural examination (classical tests), following the qualitative evaluation of the microbiota by taxonomic, morphological and physiological characterization of microorganisms developed on the culture medium. The cultural examination method has the advantage of quantitative evaluation, and as a disadvantage there was a long response time of 3 to 6 days. The speed of cultural techniques was achieved by direct inoculation and use of specific culture media, suitable for the purpose of determining the total number of NTG microorganisms that grow at 30ºC (bacteria, yeast, mould), on PCA culture medium (Plate Count Agar PH = 7.2), the thermostatic conditions applied being 30ºC / 72 hours +/- 3 h. (D. Bordei, 2007)

• Results and discussions

The research results show that the granular brand of Rhubarb and Rhubarb extracts were used to acidify the sugar syrups used in the preparation of the compotes or fruit juices.

Figure 1- Rhubarb raw material-green S1, pink S2, red S3 and Rhubarb granules (dry wasteS4, 5, 6, 7)

Table 1 Matrix of acidity marker correction

Doses of green Rhubarb extract	Sugar syrup (23,35%)+ 2%	Sugar syrup(23,35%)+2, 3%	Sugar syrup (23,35%)+ 2,5%	Sugar syrup (23,35%)+ 2,7%	Sugar syrup (23,35%)+ 2,95%
Acidity of sugar syrup I/green Rhubarb extract	1,28			4,9	5,6
Doses of pink Rhubarb Extract	Sugar syrup 2(29%)+3%	Sugar syrup 2(29%)+3,3%	Sugar syrup 2(29%)+3,66 %	Sugar syrup 2(29%)+3,8%	Sugar syrup 2(29%)4%
Acidity of sugar syrup 2 /pink Rhubarb extract			6,3	6,65	7
Doses of red Rhubarb extract	Sugar syrup 3(34%)4%	Sugar syrup 3(34%)4,09%	Sugar syrup 3(34%)4,5%	Sugar syrup 3(34%)5%	Sugar syrup 3(34%)5,4%
Acidity of sugar syrup 3 / Red Rhubarb extract	2,1			5,6	7

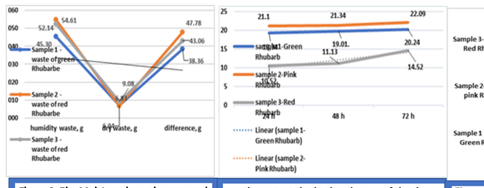

Figure 2- The Moisture dynamic compared to Rhubarb dry waste moisture(granules)

Figure 3 - Rehydration degree of the dry granules of green, pink or red Rhubarb

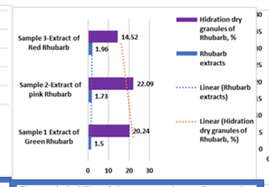

Figure 4- Acidity of the extract depending on the rehydration's degree of Rhubarb granules

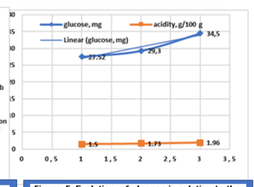

Figure 5- Evolution of glucose in relation to the acidity of sugar syrups corrected with green, pink or red Rhubarb granules

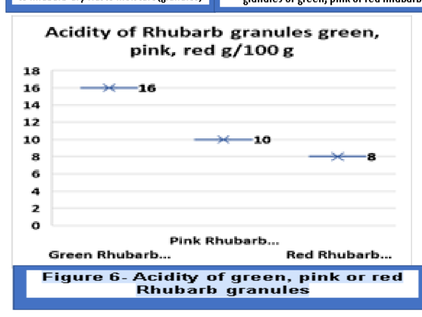

Figure 6- Acidity of green, pink or red Rhubarb granules

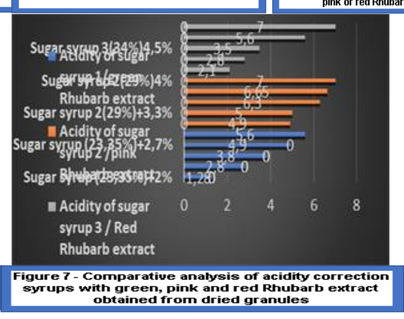

Figure 7 - Comparative analysis of acidity correction syrups with green, pink and red Rhubarb extract obtained from dried granules

- Thus the matrix of acidity corrections in the case of sugar syrups with 23.35%, 29% and 34% includes minimum and maximum values to determine the optimization of the acidity of the compotes in the case of the use of Rhubarb extracts .(table1)
- Figure 4 shows that the highest acidity was recorded in sugar syrups with 29% and 34% soluble substances, to which were added the pink and the red Rhubarb extracts by 3.8% -5.4%. The lowest values were recorded for the 23.35% sugar syrup to which 2% green Rhubarb extract was added.

Figure 8 – Identification of mould species on green, pink and red Rhubarb samples (original image own contribution

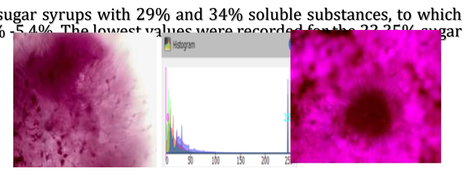

Figure 11– Identification of Rhizopus Nigricans on (original image own contribution)

(original image own contribution)

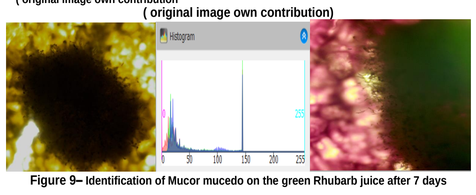

Figure 9– Identification of Mucor mucedo on the green Rhubarb juice after 7 days

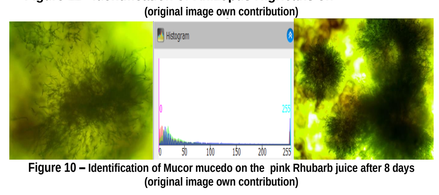

Figure 10 – Identification of Mucor mucedo on the pink Rhubarb juice after 8 days (original image own contribution)

- The humidity of Rhubarb waste decreased by drying it with a percentage between 39.36% and 47.78% to ensure the preservation of Rhubarb granules over time. (figure 1) The significant decrease of the moisture of Rhubarb waste up to 6.83-9.08% ensured a good shelf life of Rhubarb granules for a period of 12 months. The samples were also tested from a microbiological stage to verify the storage conditions. Thus, Rhubarb granules could be stored at a temperature of 18-20°C at a relative humidity of 75-80%, without the development of possible spores of microorganisms in vegetative forms. Rhubarb granules were rehydrated to use the extract to acidify sugar syrups. Rehydration showed the lowest level of water absorption from 10.52% to 14.52% in red Rhubarb granules and the highest degree of rehydration in pink Rhubarb from 21.1% to 22.09%. (Figure 2) An intermediate rehydration was performed. recorded in green Rhubarb granules. The highest degree of rehydration is directly proportional and with the highest level of extraction of the resulting acidity extract (figure 3).

• Conclusions

The matrix of acidity corrections in the case of sugar syrups with 23.35%, 29% and 34% has optimal values for Rhubarb extracts in the following situations: 2.8-3.8% into the sugar syrup with (23.35%) + 2.3%, 2.5% green Rhubarb extracts, the sugar syrup with 2.5% green Rhubarb extract, 4.9% into the sugar syrup 2 with (29%) + 3% pink Rhubarb extracts and 2.8-3.5% into the sugar syrup 3 with (34%) + 4.09-4.5% red Rhubarb extracts. The highest acidity was recorded in sugar syrups with 29% and 34% soluble substances, to which were added extracts of pink and red Rhubarb in a proportion of 3.8% -5.4% when the acidity increased to 7%. The mould species Mucor mucedo and Rhizopus nigricans developed between 8 and 10 days, indicating the alteration of sugar syrups with rhubarb extracts at an acidity between 2.8-7%. The most evolved in terms of quantity were the samples that had between 2.8-4.5% Rhubarb extract. It turns out that these extracts can be used successfully in the acidity matrix for up to 5 days, without mould spores developing.