Article
ECORFAN Journal Republic of Guatemala
December 2018 Vol.4 No.7 47-49

Microencapsulation and antioxidant activity of Betabel juice *(Beta vulgaris)*

Microencapsulación y actividad antioxidante del jugo de Betabel *(Beta vulgaris)*

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Received September 10, 2018; Accepted November 08, 2018

Abstract

The objective of this work was to perform the microencapsulation of beet juice (JB) (Beta vulgaris) by spray drying, using as gum arabic (GA) wall materials at a concentration of 30%. The antioxidant activity of JB and the microcapsules of JB during storage was evaluated. Antioxidant properties were determined: percentage of inhibition (DPPH method), redox potential, content of phenols, anthocyanins and flavonoids. In the JB a percentage of inhibition of 73.27 ± 0.77% was obtained suffering an oxidation of 15.57%, this percentage was similar to that obtained in the microcapsules (75.55 ± 1.00%). The redox potential of the JB was 239.25 mV, lower than the 298.2 mV obtained in the microcapsules, as regards the content of total phenols, the JB had 230.53 ± 0.28 mg EAG / L and the microcapsules 534.68 mg EAG / L. The content of flavonoids and anthocyanins obtained a higher content in the microcapsules compared to the JB, however, this had a higher betalaine content.

Microencapsulation, Betalains, Gum arabic, *Beta vulgaris*

Resumen

El objetivo de este trabajo fue realizar la microencapsulación el jugo de betabel (JB) (*Beta vulgaris*) mediante el secado por aspersión, utilizando como materiales de pared goma arábiga (GA) a una concentración del 30%. Se evaluó la actividad antioxidante del JB y de las microcápsulas del JB durante el almacenamiento. Se determinaron propiedades antioxidantes: porcentaje de inhibición (método de DPPH·), potencial redox, contenido de fenoles, antocianinas y flavonoides. En el JB se obtuvo un porcentaje de inhibición de 73.27 ± 0.77% sufriendo una oxidación del 15.57%, este porcentaje fue similar al obtenido en las microcápsulas (75.55 ± 1.00 %). El potencial redox del JB fue de 239.25 mV, menor al de 298.2 mV obtenido en las microcápsulas, en lo que respecta al contenido de fenoles totales, el JB tuvo 230.53 ± 0.28 mg EAG/L y las microcápsulas 534.68 mg EAG/L. El contenido de flavonoides y antocianinas obtuvo un mayor contenido en las microcápsulas en comparación con el JB, no obstante, este presentó mayor contenido de betalaínas.

Microencapsulación, Betalainas, Goma arábiga, betabel, *Beta vulgaris*

Citation: MARTÍNEZ-AYALA, José Leonel, REYES-MUNGUÍA, Abigail, CARRILLO-INUNGARAY, Ma. Luisa and MARTINI-MORALES, Sasi Elibeth. Microencapsulation and antioxidant activity of Betabel juice *(Beta vulgaris)*. ECORFAN Journal-Republic of Guatemala. 2018, 4-7: 47-49.

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December 2018 Vol.4 No.7 47-49

Introduction

Beet (Beta vulgaris) or beet, is a plant little used in human nutrition (Waizel, 2006). This vegetable has healing properties against pain, it is recommended to stimulate the immune system, prevent cancer and reduce oxidative stress in people with obesity and diabetes (Azeredo, 2009). Some studies have focused on red varieties because they produce pigments called betalains, these are phytochemicals considered to be powerful antioxidants (Cai et al., 2003). For the best use and conservation of the active compounds present in the beet, the food industry has implemented innovation technological processes; such as microencapsulation, nanoencapsulation, the development of packaging and preservatives.

Microencapsulation can be defined as a technique by which liquid droplets, solid or gaseous particles, are covered with a porous polymer film containing an active substance (Araneda and Valenzuela, 2009), the applications of this technique have been increased frequently in the encapsulation of aromas, flavor, color and nutritional components, with the purpose of protecting the material from the base of the degradation (reduction or reactivity) with its external environment (heat, humidity, air and light), maintaining its stability and viability for the development of products that provide a health benefit, that present a flavor of freshness and that also have a prolonged shelf life. For the adequate preservation of nutraceutical compounds, biopolymers of natural origin and low cost have been used, such as maltodextrin and gum arabic (Pavón-García et al., 2011).

Methodology

Collection and preparation of the sample

Beets were selected in a state of commercial maturity, which was determined on the basis of color (homogeneous red), then peeled to remove the bark, cut into cubes and passed through a juice extractor, then filtered with Whatman N paper two.

Microencapsulation

The encapsulation with gum arabic was carried out according to what was described by Beristain C. I. et al. (2010). Through a material balance, the necessary amount was obtained to prepare an aqueous solution at 30% (w / w) with gum arabic and beet juice. It was protected from light and allowed to stand overnight at room temperature. The microcapsules were obtained by spray drying. The solution was fed to a spray dryer Mini Spray Dryer, model Büchi B-290. The microcapsules were stored in amber colored bags at room temperature.

Determination of antioxidant properties of juice (JB) and beet microcapsules (MB)

Quantification of total phenols: The content of total phenols was determined by the Folin-Ciocalteu method (Singleton, 1999), in which the phenolic compounds are oxidized by the Folin-Ciocalteu reagent. Absorbance readings were performed at 740 nm in a spectrophotometer (AquaMate Plus uv-vis). The results obtained were expressed in milligrams of Gallic Acid Equivalents (mg EAG / L).

Percentage of free radical inhibition: The antioxidant activity was determined according to the methodology described by Brand-Williams et al. (1995) through the inhibition of the stable radical DPPH • (1,1-diphenyl-2-picrylhydracil). The absorbance was recorded every minute until similar readings were obtained, which is considered the final point of the monitoring.

Redox potential: The measurements were made with an Ag / AgCl platinum electrode connected to a potentiometer (Thermo Scientific Orion Dual Star). The values of the redox potential in mV were recorded until reaching its stability (Manzocco et al., 1998).

Quantification of Betalains: The betalaine content was determined using the spectrophotometric method developed by Nilsson (1970) for red pigments (betacyanines) and yellow pigments (betaxanthines).

Results

The average percentage of inhibition of free radicals in the microcapsules of beet juice with gum arabic was 68.28 ± 4.33% while the average values for total phenols were 509.37 ± 11.92 mg EAG / L. Floirendo et al. (2014) microencapsulated the cranberry anthocyanins with gum arabic and soy protein, obtaining in their research that gum arabic was the one that gave the greatest protection to the antioxidants of cranberry. With regard to the evaluation of the redox potential, the microcapsules of beet juice with gum arabic did not show significant changes during storage.

The microcapsules of beet juice with gum arabic during the first week had a redox potential of 291.2 mV, while in week 14 it had a reducing power of 280.3 mV. With this, a decrease of 3.74% (10.9 mV) during the weeks of storage was slightly observed. However, these redox potential values are similar compared to those obtained from beet juice (299.25 mV). The results obtained in the quantification of betalains (betacianinas and betaxanthines) present in the microcapsules of beet juice with arabica gum were of a content of 204.4 mg / Kg for betacyanins, while for betaxanthines the concentration was 151.2 mg / kg.

Conclusions

The beet juice does not last for a long time due to the oxidation process and the development of microorganisms, which is why it is not common to use the juice for the elaboration of products, however, the active compounds of the beet juice can be preserved by applying technologies such as microencapsulation. The evaluation of the microcapsules with gum arabic as an encapsulating agent, gave a greater protection and stability to the bioactive compounds, this was verified when making the comparison between the activity of the antioxidant compounds of the fresh beet juice with that of the juice microcapsules. beet using as gum arabic wall material, observing a higher percentage of inhibition, redox potential, betalains and total phenols during storage.

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