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RADIATION EFFECT ON SUCROSE CONTENT OF INVERTED SUGAR

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ABSTRACT

Inverted sugar is a mixture of sucrose, glucose and fructose used as an ingredient in the food and beverage industry. During production there are points of contamination by microorganisms that can modify the sugar properties and reduce shelf life. This work aims to consider one efficient technique in the sanitization of this ingredient with minimum alterations in the sugar ratios. Irradiation with Cobalt 60 is a technique with proven efficacy in the reduction of microorganisms. Samples of inverted sugar had been radiated with Cobalt 60, Gammacell type, at the CTR-IPEN, with doses of 5, 10, 20, 30 and 50 kGy, and dose rate of 3.88 kGy/h. The content of sucrose was determined by the Fehling method. The sample irradiated at highest dose presented the most intense reduction in the concentration of sucrose: 13% in comparison to the control. Irradiated samples up to 30 kGy did not presented statistical difference in relation to the control ($p<0.05$), indicating that radiation can be applied to the inverted sugar without significant alterations in the concentration of sucrose.

1. INTRODUCTION

The process of food irradiation is effective in assuring the sanitary quality of foods, efficiently, reducing the population of microorganisms. Food irradiation benefits are: disinfection of grains and fruits and inhibition of sprout of roots and tubercles. Gamma radiation, by the high power of penetration, can be applied to the product in final package, preventing recontamination [1, 2, 3].

Liquid sugar is an ingredient used in beverages and food industry, inverted liquid sugar is a solution of sucrose, glucose e fructose and presents advantages in relation to the bulk granulated form such easiness of the handling and dosage [4].

In sugars, irradiation can provoke alterations in the structure of the molecule, depending on the applied dose, that can lead changes in flavor, texture and color. In solutions of sugars the main role is played by hydroxyl radicals, formed in radiolysis of water and responsible for break the linkage between carbon and hydrogen, another possible reaction is the hydrolysis at the glycosidic bond [4]. The objective of this work was verified the content of sucrose in the liquid sugar, control and irradiated in the doses between 5 and 50 kGy.

2. MATERIALS AND METHODS

2.1. Materials

Sugar samples of inverted liquid sugar were donated by Usina Da Barra S/A.

2.2. Irradiation

Samples were conditioned in glass bottles of 400 mL and irradiated at doses of 5, 10, 20, 30 and 50 kGy. Irradiation was accomplished at room temperature with Cobalt 60 source (Gammacell 220 -AECL, Canada), dose rate of 3.88 kGy/h, at Radiation Technology Center-IPEN. After irradiation all the samples, including control, was kept at -5^0C. Dosimetry was carried out using routine dosimeter type Amber and Red Pespex.

2.3. Determination of sucrose content

Reducing sugars value (glucose and fructose) of irradiated and control samples were determined through the method of Fehling, in triplicate. The determination of the total sugars occurred after hydrolysis of sucrose with hydrochloridric acid in water bath at 98^0C, per 45 minutes. The solution was cooled and added sodium carbonate until the pH 7.0 [5]. The standardization of Fehling´s solutions was carried with 1% of glucose solution. The content of sucrose of the sample was calculated by the difference of the value of total sugars and reducing sugars multiplied by the factor of 0.95 [5].

2.4. Data treatment

Analysis of variance (ANOVA) and LSD test was used to compare the averages of sucrose content of the samples of liquid sugar, with level of significance of α=0.05. The analyses had been carried through using the Statistica program (Statistica 5.1, StatSoft, 1998).

3. RESULTS AND DISCUSSION

The averages of the sucrose values and its respective standard deviations are presented in table 1.

Table 1. Average values of sucrose for liquid sugar: control and irradiated samples

Doses (kGy)	Sucrose (%)*
Control	27.45 ± 0.24^{a}
5	26.89 ± 1.18^{a}
10	26.71 ± 0.34^{a}
20	27.39 ± 0.43^{a}
30	26.81 ± 0.78^{a}
50	23.71 ± 0.08^{b}

Values followed for different letters are significantly different-test LSD- ($p<0.05$)
*Analyses carried in triplicate

Multiple comparisons among means (LSD test) obtained for control and irradiated samples, in Cobalt 60 source, showed statistical difference only for sample irradiated at 50kGy. The increase of radiation dose implied in decrease of sucrose content where the control sample presented value of 27.5 compared to sample 50kGy irradiated whose value is 23.7. Sucrose is a disaccharide formed by union of two monosaccharides: glucose and fructose, by a glycoside bond.

The preponderant reaction in irradiated sucrose is the hydrolysis of glycoside bond. This reaction is fast and can occur in two different points (a or b) of the molecule as can be observed in Figure 1 [6, 7]. Data non published yet indicated that sucrose underwent break in glycoside bond in dose at 50 kGy, producing glucose and fructose.

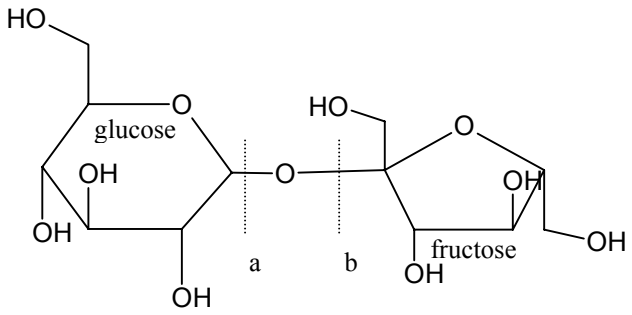

Figure 1. Sucrose molecule

4. CONCLUSION

The irradiation process on inverted liquid sugar samples with Cobalt 60 indicated the sample that received the dose of 50 kGy presented significant reduction ($p<0.05$) in the content of sucrose.

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