YEAST FOAM PRODUCTION AND PHYSICAL CHARACTERIZATION: A STUDY OF THE FOAM-MAT DRYING OPERATIONAL PARAMETERS

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ABSTRACT

The objective is foam drying yeast foam to valorize the co-product of cachaça production. Foam-mat drying makes use of thickening and stabilizing agents to form a stable foam of a liquid or semi-liquid material, which will resist dehydration caused by increased temperature. The yeast (*Saccharomyces cerevisiae*) used was obtained in a cachaça plant during the production process. To characterize the foam, density, stability and over run tests were carried out, according to the variables defined in the experimental planning. The final foam significantly increased in volume and density, especially at higher concentrations of emulsifier. Dilution in foam formation was a crucial factor, with better results in more diluted yeast solutions. Dilution reduces the density of the material, making it easier for the emulsifier to form foam. The results will assist in future studies to investigate the drying parameters of this foam to produce a powder.

Keywords: Drying. *Saccharomyces cerevisiae*. Waste valorization. Biotechnology.

1 INTRODUCTION

Saccharomyces cerevisiae is a fungus that is used for a variety of biotechnological applications, mostly utilized in fermentation, some of those processes are beer and liquor production, this feature is caused by its biological capacity, transforming sugar in ethyl alcohol[1]. At the end of the fermentative processes, part of the biomass produced, which ages over time, is discarded to allow cell renewal, so younger cells can have more space to grow and the process to be continued.

Studies have already shown several ways of reusing this material, including drying methods to get an animal food supplement[2]. Drying is seen as a technique that aims to reduce biological activity and chemical reactions in organic material, facilitating its storage for longer periods[3]. This work is part of a collaborative project between FAPESQ/PB and FAPESP/SP, entitled "Advances in the production of cachaça through innovation in fermentation, distillation and aging".

From this, innovations emerged such as optimizing this process and reducing its costs, such as foam-mat drying, which is a foaming technique using a liquid or semi-liquid material with or without the addition of foaming and/or stabilizing agents, so the foam supports dehydration in shorter times then common and low temperatures. Foam-mat drying offers a low-cost, simple process that returns a product with higher biological quality when compared to other drying processes[4].

Therefore, this study aimed to find better parameters for a foam production and with that, stable physical properties that facilitate the yeast drying process.

2 MATERIAL & METHODS

The foam mixture was prepared using the yeast biomass (*S. cerevisiae*) collected from the production of cachaça at a mill located in Areia, Paraíba, Brazil (altitude of 623 meters above sea level, with longitude and latitude approximately 7° 28' south latitude and 36° 29' west longitude), it was centrifuged during 5 minutes at 5000 rpm, then the pellet was subjected to rigorous agitation in a planetary mixer together with the emulsifier and the supernatant (sugarcane juice) in the established proportions. The agitation time, the concentration of the Porto gel emulsifier from the Du Porto® brand and the proportion of dilution of the centrifuged biomass were the controlled variables and the main response, from the experimental planning factorial 2^3 was the stability of the foam formed (foam density).

The methodology described by[5] was used to analyze the density of the foam formed. Regarding the overrun parameter, the methodology was described by[6].

3 RESULTS & DISCUSSION

The obtained foams showed a significant increase in final volume as well as a substantial reduction in density, especially at higher concentrations of the emulsifying agent. A determining factor for the increase in final volume was the dilution used in foam formation, with more favorable results observed in more diluted yeast solutions. Table 1 shows the parameters and values used in the experiments.

Table 1: Experimental planning and experimental values obtained for density.

Experiment	Dilution	Concentration (%)	Time (min)	Density (g/cm³)
1	**+1** (1:2)	**-1** (10)	**-1** (8)	**0.298**
2	**-1** (2:1)	**-1** (10)	**-1** (8)	**0.276**
3	**+1** (1:2)	**+1** (20)	**-1** (8)	**0.455**
4	**-1** (2:1)	**+1** (20)	**-1** (8)	**0.281**
5	**+1** (1:2)	**-1** (10)	**+1** (16)	**0.385**
6	**-1** (2:1)	**-1** (10)	**+1** (16)	**0.416**
7	**+1** (1:2)	**+1** (20)	**+1** (16)	**0.450**
8	**-1** (2:1)	**+1** (20)	**+1** (16)	**0.232**
9	**0** (1:1)	**0** (15)	**0** (12)	**0.276**
10	**0** (1:1)	**0** (15)	**0** (12)	**0.650**
11	**0** (1:1)	**0** (15)	**0** (12)	**0.401**

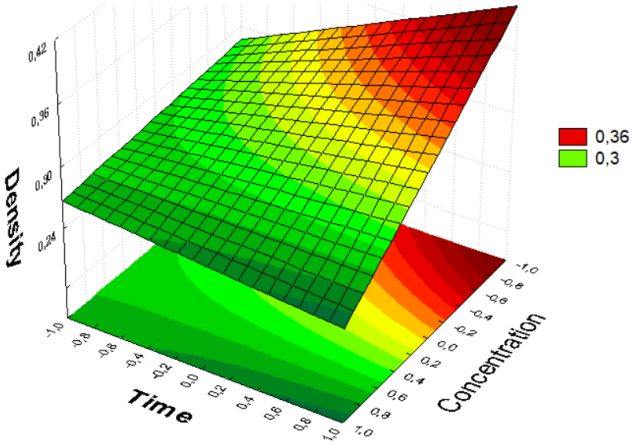

Figure 1: Influence of foaming agent concentration and agitation time on foam density reduction for fixed dilution of 1:2.

The analysis of the optimization surface, illustrated in Figure 1, derived from experimental data, reveals results consistent with the findings of[8], indicating that increasing the concentration of the emulsifier in the process results in a significant reduction in the density of the produced foam. The minimum value found for density, 0.23 g/cm³, exceeds that obtained by[9] of 0.148 g/cm³ when using the Emustab® emulsifier at a concentration of 10% in acerola juice. However, the results obtained in the experiments are promising, considering the high density of the raw material and the presence of dense contaminants such as clay and sand.

Preliminary foam-mat drying tests, obtained based on the identified optimal points for its production, demonstrate a stable and uniform layer throughout the moisture loss process, which highlights its viability for the drying process.

4 CONCLUSION

Based on the experiments conducted and the data obtained, it can be concluded that foam production from residual yeast biomass from cachaça production along with Du Porto® emulsifier resulted in the formation of stable foam. Dilution during foam formation was identified as a crucial factor for optimizing the process, with more diluted yeast solutions exhibiting more favorable performance. Thus, the most favorable operating conditions for parameters found for stable foam are of main importance for enhancing the drying process to obtain yeast powder.

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