ALCOHOLIC FERMENTATION OPTIMIZING OF MESQUITE AND PINEAPPLE COMPOST JUICE

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ABSTRACT

The present study aimed to optimize the fermentative process of a pineapple and mesquite composite juice, applying a 2^2 factorial design and response surface analysis to assess the effects of input variables (yeast concentration and pineapple-mesquite ratio) on output variables (productivity, percentage of theoretical yield (Yp/s), percentage of biomass yield (Yx/s), and conversion percentage), evaluating the best conditions necessary for the most efficient production of mixed mesquite and pineapple brandy. The experiments were conducted on a bench scale, and the fermentative kinetics were monitored. A maximized process efficiency value was observed in experiments at the central point level with a yeast concentration of 0.3 g/L and equal proportions of pineapple and mesquite, indicating that the fermented must exhibits characteristics suitable for distillation (production of mixed brandy).

Keywords: *Prosopis juliflora. Ananas comosus* L. Alcoholic fermentation. *Sacharomyces bayanus*.

1 INTRODUCTION

Brazil stands out as the third largest fruit producer in the world, trailing only behind China and India. Thus, this work aims to maximize the utilization of this abundance of fruits available in Brazil. It emphasizes the importance of developing products that add economic value and consequently generate income for Brazilian producers[1], contributing to the improvement of the population's quality of life and ultimately leading to an increase in the Gross Domestic Product[2].

Pineapple is one of the fruits of great importance in the economy of countries. In Brazil, Paraíba stands out as the third largest in terms of pineapple plantation area[3]. It is observed that there is a large quantity of pineapples produced annually, yet the total harvest is not fully utilized because food industries cannot accommodate all this production, and the best way to utilize it is by bringing new ideas for the consumption of all this cultivation[4]. To avoid some of this waste, the idea of this project is to develop a brandy that utilizes pineapple juice in alcoholic fermentation along with mesquite juice.

Prosopis juliflora thrives in semi-arid soils, with widespread distribution in the Northeast region, it blooms during dry times, and serves various purposes, with the entire plant being utilized. Its leaves and seeds can be used for nutrition due to their high nutritional value; the strong and resistant wood can be utilized in the construction sector, while substances extracted from its leaves and trunk hold potential for beverage production and use in the food industry[5].

Through the fermentation process of these fruits, followed by distillation, fruit brandies can be obtained[6].

2 MATERIAL & METHODS

The pineapples, of the Pearl variety, were acquired at a street market in the city of João Pessoa-PB, while the mesquite pods were obtained in the city of Serra Branca-PB (altitude of 623 meters above sea level, with longitude and latitude approximately 7° 28' south latitude and 36° 29' west longitude). The fruits were cleaned and sanitized, and the juices were extracted using a hydraulic press with a capacity of 30 tons, from the Skay brand. For the extraction of mesquite juice, it was necessary to carry out a boiling and hydration process of the pods before the extraction process[7].

Applying a 2^2 factorial design, with the aim of optimizing the fermentative process of the mixture of pineapple juice and mesquite juice, and to analyze all possible combinations of the independent variables to obtain the best response regarding the efficiency of the fermentative process (kinetic parameters: productivity (g/Lh), percentage of theoretical yield (Yp/s), percentage of biomass yield (Yx/s), and conversion percentage), was conducted a minimal number of experiments using *Sacharomyces bayanus* yeast as the fermentative agent. The influence of the quantitative independent variables (factors) was evaluated, including yeast concentration (YC) and pineapple/mesquite ratio [2:1, 1:1, and 1:2 (v/v)], Table 1.

Table 1 Values of real and coded levels for the preparation of alcoholic fermented mesquite and pineapple

Independents variables	Levels		
	-1	0	+1
Yeast concentration (g/L)	0.1	0.3	0.5
Mesquite / Pineapple Ratio	2:1	1:1	1:2

The fermentations took place in 500 mL Erlenmeyer flasks containing 400 mL of the must. A kinetic monitoring was conducted, analyzing the levels of Total Soluble Solids (direct reading with a Brix saccharometer, correcting the reading results to 20°C), cell concentration, pH (direct reading), total acidity[8], alcohol content by ebulliometer, Reducing Sugars, and Total Reducing Sugars[9]. The end of fermentation was established when the levels of Total Soluble Solids stabilized.

3 RESULTS & DISCUSSION

Using the factorial planning methodology, it was possible to maximize the operational conditions of the fermentative process of pineapple and mesquite juice. The Table 2 shows the region of the best condition for the conversion parameter, reaching a maximum value of 94%, which is found at the central point conditions, that is, 0.3 g/L of yeast inoculated at the beginning of the process and equal proportions of pineapple and mesquite, with an initial total soluble solid content (SST) of 17.1 °Brix. Under these conditions, productivity of 0.936 g/Lh, $Y_{P/S}$ of 0.487 and $Y_{X/S}$ of 0.024 are achieved.

Table 2 Result of full factorial experimental design matrix 2^2 plus central points, applied to fermentative process of mesquite and pineaple compost juice. Average of replicate values.

Factors	Productivity (g/Lh)	% conversion	$Y_{X/S}$ (g/g)	$Y_{P/S}$ (g/g)
0.3 g/L e 1:1	0.936	94.00	0.024	0.487

Based on the literature[10], similar results were found for alcoholic fermentation using only pineapple juice and *Saccharomyces cerevisiae* yeast. The best response was obtained at the central point, with a yeast concentration of 10 g/L and Total Soluble Solids (SST) of 14 °Brix. The conversion percentage was 81.24%, productivity was 1.55 g/L h, biomass yield with respect to the substrate (Yx/s) was 0.072, and product yield with respect to the substrate (Yp/s) for the pineapple fermentate was 0.413.

Another result found in the literature utilized mesquite pods, employing different fermentation durations, and achieved the best outcome with thirty hours of alcoholic fermentation, yielding a product yield with respect to the substrate (Yp/s) of 0.44, productivity of 4.69 g/L h, and a conversion percentage of 86.81[5].

In another study[11], to produce ciriguela (*Spondias purpurea* L.) spirits using different *Saccharomyces cerevisiae* strains, a yeast concentration of 3 g/L and a total soluble solid of 16 °Brix were employed, obtaining the best result with the *Saccharomyces cerevisiae* strain LNFCA11, which resulted in a productivity of 4.18 g/Lh.

4 CONCLUSION

Based on the obtained data, it is concluded that the best results for the parameters of productivity (g/Lh), percentage of theoretical yield (Yp/s), percentage of biomass yield (Yx/s), and conversion percentage were found under the conditions of the central point experiments, which used 0.3 g/L of yeast and equal amounts of pineapple juice and mesquite juice. This result will be utilized for the scaled-up alcoholic fermentation of pineapple juice and mesquite juice, aiming at the production of mixed brandy (distillation in a copper alembic).

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