



Blond Ale Craft Beer Production with Addition of Pineapple Pulp

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Authors' contributions

This work was carried out in collaboration among all authors. Authors PMCC, ILMLA and PAR conducted the experiment and wrote the first draft of the manuscript. PAR was the mentor of the idea.

Authors AB, MGAB, PAR and REVS discussed the results, correct and improve the writing of the manuscript in Portuguese and English versions. All authors read and approved the final manuscript.

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ABSTRACT

The second most consumed beverage worldwide is beer. In Brazil, the brewing market is in full expansion, which allowed the emergence of several microbreweries, which end up attractive a significant portion of the consumers of the large breweries, due to the fact that they provide differentiated products, using high raw materials quality and production methods specific to each style. In this context, the objective of this work was the development of a Blond Ale beer, with addition of pineapple pulp (*Ananas comosus* L. Merrill). The physical and chemical attributes were:

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original and final gravity, alcohol content, total dry extract, total acidity, maltose reducing sugar, pH, color and degree of fermentation. The OG and FG of the beer produced were, respectively, 1.0455 and 1.0107, and the alcohol content was 5.24%. The results found are within the range allowed for a Blonde Ale style, according to the BJCP 2015 standard. Thus, the quality of the beer produced meets the proposed in the article.

Keywords: Ananas comosus; brewing process; high fermentation.

1. INTRODUCTION

Beer is the second most consumed beverage, only lost to water [1], which makes it the most popular alcoholic beverage in the world [2]. In Brazil, the brewing market is in full expansion, which allowed the emergence of several microbreweries, which end up attractive a significant portion of the consumers of the large breweries, due to the fact that they provide differentiated products, using high raw materials quality and production methods specific to each style [3,4].

The Brazilian brewing sector owes its economic weight to the performance of large companies, whose main characteristic is competitive production, via the brand and increasing profit margins through productivity gains, to the detriment of differentiation and quality. However, in recent years there has been a growing trend, in which there is a predominance of small and medium-sized companies, which take a significant share of the market due to the offer of special products [5].

The brewing process has existed for millennia, yet the most significant scientific developments that have impacted production have occurred for the most part over the past 150 years. These have been integrating knowledge in several areas such as: engineering, biochemistry and microbiology [4].

Blond Ale beers are easy-to-drink beers, have their origins in malt-oriented American artisanal beer culture, often with fruity, hops or malty notes. Its aroma should be mild to moderate sweet mates, with slight notes of bread or caramel, the level of fruity notes is optional, but acceptable from low to moderate. Its color varies from light yellow to golden, clear and bright, white foam from low to medium volume with good retention [6].

The *Saccharomyces cerevisiae* specie is the yeast which is most involved beer fermentation and known for the good fermentation conduct but

her aromatic power is low [7]. Thus, use tropical fruits as pulp pineapple could give a specific aroma to the beer.

Pineapple (*Ananas comosus* L. Merrill) belongs to the most popular group of tropical fruits in the country, thanks to its characteristic flavor and aroma. The mature fruit presents, on average, 16.2% of total soluble solids, 0.35% of citric acid, 5.06% of reducing sugars and pH 4.15, which makes it favorable for fermentative processes, such as the production of beer [8].

From these data the present work was proposed to valorize the tropical fruit particularly pulp pineapple in the production of a beer in the style Blond Ale added of pulp of pineapple, contributing to the development of new products with tropical flavors maintaining the characteristics of the style.

2. MATERIALS AND METHODS

The experiment was carried out at the grain and microbrewery Laboratory of the Faculty of Food Science and Technology of the Federal University of Mato Grosso, Cuiabá *campus*, Mato Grosso state, in December 2017. For the craft beer production, the recipe was the Blond Ale style, with modified Sorbo's methodology [9].

A 20-liter recipe was prepared using the BIAB (brew in a bag) system. The mashing was done with 10 liters of water (pH 5.5) preheated at 65 °C and 3.5 kg of milled Pilsen (Agraria®) malt for 90 minutes (until complete degradation of the starch). On completion of mashing, with more 77 °C for another 15 minutes (for enzymatic inactivation and grain washing), the entire wort is transferred to another vessel, for the lautering. More 10 liters of the same water preheated at 78 °C was using for the washing the mashed-malt (to rescue the fermentable sugars retained in the malt, ending the lautering).The boiling was 60 minutes (evaporation of dimethyl-sulfide (DMS) and isomerization of the alpha acids of hops); at 30 minutes 6.3 g of German Magnum Hallertauer

hops and, at 55 minutes, 3.1 g of Cascade hops were added. The wort was then recirculated through a whirlpool effect and allowed to sit for 20 minutes to form the *trub* (the residual hop product and proteins and enzymes coagulated). The transfer was carried out by removing the *trub* and the must was cooled rapidly with ice-bath immersion to the temperature of $23 \pm 2^\circ\text{C}$, when the initial density (OG) was measured. Active dry yeast US-05 (*Saccharomyces cerevisiae*) from Fermentis® were inoculated. It was prehydrated according to the manufacturer's recommendation for 30 minutes with 250 ml of water in the rate 11 g of yeast for 15 liters of wort. The fermentation was carried out in a fermenter with sealed lid and airlock coupled for 7 days in a BOD oven, at $23 \pm 2^\circ\text{C}$. The gravity of the wort was determined on the sixth and seventh days, when the final gravity stability (FG) was verified. After 7 days of maturation was added 400 g of concentrated pineapple pulp (4 packs of 100 g). The pulp was pasteurized at 70°C to remove possible contaminations and cooled to 20°C for addition. Nutritional composition of the pulp (each 100 g): 3.96 g of carbohydrates, 0.2 g of dietary fiber, 0.13 g of protein, 35.0 mg of vitamin C, 5.61 mg of calcium, 0.07 mg of sodium and 0.07 mg of iron. After addition, the maturation was continued for more days at 5°C .

The beer was bottled manually using the Priming technique for carbonation where sugar was added at a concentration of 7 g.L^{-1} of beer, pre-dissolved in 3.0 mL of water, with 3 drops of lemon, for inversion of sugar. This technique is based on the production of CO_2 by the remaining yeasts of the fermentation process; a carbonation of 2.4 volumes of CO_2 was achieved. Sterilized bottles of 600 mL were sanitized with 70% alcohol and sterilized at 85°C for 30 minutes. They were capped, sealed with a manual bottle capper and stored at 18°C for 15 days.

The physical-chemical attributes evaluated were: yield, by the difference between initial and final volume; initial and final densities, by means of immersion densimeter; pH, by means of bench pH meter; according to the formula of Lee [10]; total dry extract, total acidity, maltose reducing sugar and degree of fermentation, according to the expression of Alves [11]; and color, according to Maia & Belo [12]. Three replicates were used for each characteristic analyzed. The determinations were carried out on samples at 20°C decarbonated.

The analyzes were compared with the parameters BJCP 2015 [6]. Descriptive analysis was used to discuss the results.

3. RESULTS AND DISCUSSION

In the processing of beer, the initial volume used of 20 liters, generated a volume of 13 liters of Blonde Ale beer, which gives us a difference of 7 liters throughout the production, due to losses throughout the process. That means the yield was only 65%. Despite the significant losses, the yield is within the expected, which is common for the production of small-scale craft beers [13].

Table 1 presents the results of the physical and chemical analyzes of the obtained on beer samples. The results were found to be normal through the symmetry and kurtosis tests. The physical-chemical attributes of beer meet the standards of the Blond Ale style (Table 1).

Table 1. Physical and chemical attributes of beer samples with pineapple pulp

Attributes	Results obtained
Original Gravity (g/g)	1.0455±0,007
Final Gravity (g/g)	1.0107±0,002
pH	3.90±0,01
Alcohol Content (%)	5.24±0,01
Maltose (g/100g)	0.80±0,1
Acidity (%lactic acid)	0.2624±0,01
Total dry extract (%)	5.80±0,05
Primitive extract (%)	16.56±0,1
Degree of Fermentation (%)	67.11±0,6
Color (EBC)	10.07 ± 0,01

The OG and FG are close to those found in the literature. This is confirmed by Araújo et al. [13] which, measuring the OG at the temperature of 21.7°C of a Blond Ale style beer, found the value of 1.049. For FG, the author found the value of 1.008. Alves [11] also found the value of 1.0084 FG. Still, according to current Brazilian legislation, mean values of 1.014 for FG are stipulated [14].

The analyzed sample had a pH lower than 4.5, a factor that helps to avoid further contamination, as Alves [11] reports. The author had values of pH 4.05, very close to the one found in this study, but below those found by Pinto et al. [8], which obtained values between 4.10 and 4.24, and this is most probably due to the different concentrations of added citric attachment.

The alcohol content in the present study was above the standards of common commercial beers [14]. This fact is characteristic of craft beers of high fermentation, as Araújo et al. [13]. In his work with Blond Ale, the author obtained the alcoholic content of 5.37%. The low values of reducing sugars (maltose), 0.80%, confirm the good conversion of sugars into alcohol. In addition, it is characteristic of the yeast US-05 a greater attenuation, consuming maltose and maltotrioses what justifies the greater alcoholic content. This is again confirmed by the work of Alves [11], which obtained values between 1.57% maltose and 3.75% alcohol content. For the legislation, the maltose found in the work is low, close to the minimum limit, but within the required standards and it is possible to be commercialized [14].

The acids formed during fermentation, expressed as lactic acid, and the total dry extract also conformed to commercial standards [14].

According to the primitive extract obtained in the work, this is classified as strong beer, and, by the degree of fermentation, as beer ale (high fermentation), as already expected due to the type of yeast used in the process [14]. According to the color scale established in Brazilian legislation (Decree No. 6.871/09), it is classified as dark because it presents values lower than 20.0 EBC [14]. In the EBC scale, which is more accurate, the value was 10.07, golden color (10 to 12 EBC) [12].

4. CONCLUSION

It can be concluded that, since all the attributes analyzed are within the standards established by the consulted literature, it was possible to produce a Pineapple Fruit Ale, Blonde Ale style. Since the values found are within the range allowed for this style of beer.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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