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Physico-chemical and microbial analysis of Wheat Craft Beer added with Ginger (*Zingiberofficinale roscoe*)

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ABSTRACT

Beer is the first most sold alcoholic drink in the world, and wheat beer is one of the featured craft beers, which contributes to the increasing market expansion of craft beers in Brazil. This study aimed to evaluate the use of ginger on craft wheat beer properties. Three formulations were developed named: control (no ginger added), T1 (0,75% (m/v) of ginger) and T2 (1% (m/v) of ginger). The developed formulations were subjected to physico-chemical analysis, antioxidant activity determination and microbiological evaluation. The microbiological analysis agreed with specified standards of legislation, which showed that there were no contamination of the product. The physico-chemical parameters were characteristic of a craft beer, statistical analysis showed that significant differences were found for titratable acid among formulations. It can be conclude that the ginger addition in the development of craft wheat beers held successfully, since the analytical standards were attended and beverages showed antioxidant properties.

Key-words: Wheat beer. High fermentation. Antioxidant activity.

INTRODUCTION

Beer is the third most drunk liquid in the world, and the first most sold alcoholic drink in the world (VENTURINI FILHO, 2005). Wheat beer occupies the third type of beer most sold in the world, specially because of the german participation on the market.

Ginger is a root, widespread around the world, with high evidence as antioxidant adjunct and antimicrobial potencial (BELLIK, 2014) which can perform a good role on beer stability.

The use of ginger beer is very limited, and its use has not been referenced as a good antioxidant compound on beers. This work aimed to investigate the addition of different concentrations of ginger on wheat beer, characterizing its physical-chemical properties and the ginger antioxidant role on the final beer.

MATERIAL AND METHODS

Materials

Malted wheat, barley malt and hops were purchased in a local market, milled (Monster Mill – USA) one day before the brewing process. On the brewing day, the brewing equipment was sanitized with percloric acid (0,5 ppm) and the three beers were produced in sequence. The pans were rinsed between each brewing process.

The three formulations were developed, differing on the ginger content added on the boil step (Table 1), the control treatment (C – no ginger addition), treatment 1 (T1 – ginger addition of 0,75% (m/v)) and treatment 2 (T2 – ginger addition of 1% (m/v)). T1 and T2 received the ginger extract addition 5 minutes to the end of the boil step.

The water was warmed at 1 °C per minute during the whole brewing process. The grain steeping started when the water reached 45 °C, stopping at 53 °C for 30 min (protein step), 63°C for 75 min (beta enzymetic step) and 72 for 20 min. The wort was filtered with a false botton pan until the washing water reached 78 °C. The wort was boiled for 1h, and the Tradition hops were added 1 hour before the end of the boil step. The Tetnnanger hops and the ginger extract was added 15 minutes before the finish of the boil step. The wort was transfered to a PVC fermenter passing through a cooper chiller of 15 meters inside a water bath at 0 °C.

Fermentation, priming and bottling

The wort was inoculated with two packs of ale yeast (WB-06, Fermentis, France). The fermentation tank was airlocked, and the fermentation temperature was carried at 12 °C for 5 days, and 2 days at 13 °C. The wheat beer was transferred to another tank rejecting the bottom ferment for maturation. The maturated beer was added of 5g/L of sugar table and bottled with a manual bottling (Emily, Ferrari, Italy). The bottles were stored in a dark room (20 °C) for 10 days.

Physical-chemical characterization

The physical chemical characteristics of the beer were conducted 10 days after the beer bottling. The beer was degasified in sonicator. The pH was measured with ph meter (Tecnopan, Brazil). The alcohol content was obtained deducting the final density of the original density, multiplied by 131. The determination of total acids was realized by titulation with sodium hydroxide 0,1M, and the acidity expressed in Molar % (v/m). The color was performed in triplicate using a Minolta CR-400 colorimeter, using illuminant D_{65} for determination of color (L * and croma as described by Harder (2005).

Antioxidant activity

The antioxidant activity was peformed by the DPPH (2,2-difenil-1-picril-hidrazil) and by the (2,2´-azinobis(3-etilbenzotiazolina) 6-ácido sulfônico) ABTS methods. The results were expressed in trolox equivalent antioxidant capacity (TEAC).

Microbiological analysis

Total mould and yeast at 25 °C was performed using medium of potato dextrose agar. For total number of mesofilic bacteria, potato count agar was used as medium. The samples were prepared on the day of inoculation. Counting was carried out at the dilutions 10^{-3} and 10^{-4}, in duplicate.

Statistical analysis

The results obtained were subjected to analysis of variance – ANOVA using the Biostat 5.8 program. The Tukey test at 1% probability ($p \leq 0.01$) was used to compare the results between the three treatments.

RESULTS AND DISCUSSION

Ferreira et al. (2013) obtained a craft beer with ginger with pH of 4.16, confirming the results of this work, which ranged from 4.13 to 4.27 (Table 1). In the same study, the alcohol content obtained was 5.89%, slightly higher than the alcohol content of this work, which were between 5.67 to 5.79%. According to Smith (2007), ale type beer alcoholic graduation must range from 4 to 8%, therefore the results of both studies are within the standards of commercial wheat beers.

Table 1. Physico-chemical properties of beers.

Treatment	pH	SS (°Brix)	TS (%)	Lightness	Croma	Acidity (mL/g)	ABV (%)
Control	4.27[a]	6.25	3.84[a]	12.66[a]	2.04[a]	2.59[b]	5.77
T1	4.13[a]	6.50	3.74[a]	13.30[a]	2.10[a]	3.01[a]	5.67
T2	4.27[a]	7.25	4.08[a]	13.19[a]	1.94[a]	2.94[a.b]	5.79

SS: soluble solids; TS: total solids. ABV: alcohol content. Means followed of the same letters on the same column did not differ significantly from each other by the Tukey test ($p<0.01$).

Ferreira et al. (2013) also examined the total and soluble solids, giving an average result of 3.41% of total solids and 3°Brix. These values are lower than those found in this work, which can be attributed to the fact of different raw materials used to make the beers.

The antioxidant activity results ranged from 1157.08 to 1252.92 uM TEAC/L for the DPPH method, and from 860.33 to 980.33 uM TEAC/L by the ABTS method (Table 2). These differences in values are mainly explained by sensitivity of methodologies to different components present in the formulations, but in general, showed the same behavior.

Table 2. Antioxidant properties of beers using DPPH and ABTS methods.

Treatments	DPPH-TEAC (µMol/L)	ABTS-TEAC (µMol/L)
C	1164.58 ± 23.23[c]	860.33 ± 40.07[c]
T1	1157.08 ± 41.34[c]	932.00 ± 37.71[c]
T2	1252.92 ± 41.56[b]	980.33 ±40.07[c]

Fett et al. (2006) evaluated the antioxidant activity of different beers, finding 3294.91 uM TEAC/L in light wheat beers by the DPPH method and 2829.89 uM TEAC /L by the ABTS method. These higher values might be due to differences in the beer formulations that can change the amount of antioxidant components, and by modifications on the antioxidant determination test, which can result in differences on values. On the other hand, Pellegrini et al (2003) obtained values of 1.040 uM TEAC/L in lager beers, results closer to those obtained in this work.

Molds and yeasts counts were considered regular once the beers have not undergone through the pasteurization process (Table 3). The mesophilic bacteria total count showed no growth of colonies in the tested dilutions, demonstrating safety manufacture practices during processing.

Table 3. Colonies formation unit (CFU) per mL of the different beers analyzed

Treatment	BDA (10^{-3}) UFC/ml	BDA (10^{-4}) UFC/ml	PCA (10^{-3}) UFC/ml	PCA (10^{-4}) UFC/ml
Controle	$5x10^4$	$2,2x10^4$	$<10^3$	$<10^3$
0,75%	$2,3x10^5$	$4,5x10^4$	$<10^3$	$<10^3$
1%	$1,1x10^5$	$3x10^4$	$<10^3$	$<10^3$

CONCLUSION

The addition of ginger on wheat craft beer resulted in acceptable levels of antioxidant activity, without interfering on other physico-chemical properties. Most of the beer antioxidant activity is due to the own beer compounds. The production of craft beers has an important potential for economic exploration.

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