Production and characterization of craft beers IPA style with addition from malted green beans and babaçu mesocarp

Produção e caracterização de cervejas artesanais estilo IPA com adição de feijão verde maltado e mesocarpo de babaçu

Producción y caracterización de cervezas artesanales al estilo IPA con adición de judías verdes malteadas y mesocarpo babaçu

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Abstract
Beer is the most consumed alcoholic drink in the world, and Brazil ranks as the third largest consumer. This work aimed to produce high-fermentation craft beers, IPA style, containing adjuncts, malted beans and babassu mesocarp to incorporate colour, flavour and differentiated

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aroma into the final product. The beer obtained was subjected to physical-chemical and microbiological characterization. Bean grains and mesocarp contributed significantly to the increased primitive extract and alcohol content of the beers above. In terms of colour, they were classified as light and dark; in terms of bitterness, they were called bitter and very bitter beers. The microbiological results identified the absence of mould and the presence of yeast and mesophilic bacteria. The municipality of Zé Doca-MA has full conditions for producing craft beers using low-cost raw materials capable of generating a quality and well-accepted final product.

**Keywords:** Craft Production. Beer. Innovation

**Resumo**

A cerveja é a bebida alcoólica mais consumida no mundo e o Brasil ocupa o terceiro lugar entre os maiores consumidores. Este trabalho teve como objetivo produzir cervejas artesanais de alta fermentação, estilo IPA, contendo adjuntos, feijão maltado e mesocarpo de babaçu para incorporar cor, sabor e aroma diferenciado no produto final. A cerveja obtida foi submetida à caracterização físico-química e microbiológica. Grãos de feijão e mesocarpo contribuíram significativamente para o aumento do extrato primitivo e teor alcoólico das cervejas acima. Em termos de cor, eram classificadas como claras e escuras; em termos de amargura, eram chamadas de cervejas amargas e muito amargas. Os resultados microbiológicos identificaram a ausência de bolor e a presença de leveduras e bactérias mesofílicas. O município de Zé Doca-MA dispõe de condições plenas para a produção de cervejas artesanais a partir de matérias-primas de baixo custo capazes de gerar um produto final de qualidade e bem aceite.

**Palavras-chave:** Produção Artesanal. Cerveja. Inovação.

**Resumen**

La cerveza es la bebida alcohólica más consumida en el mundo, y Brasil se ubica como el tercer mayor consumidor. Este trabajo tuvo como objetivo producir cervezas artesanales de alta fermentación, al estilo IPA, que contienen complementos, frijoles malteados y mesocarpo babasú para incorporar color, sabor y aroma diferenciado en el producto final. La cerveza obtenida fue sometida a caracterización físico-química y microbiológica. Los granos de frijol y el mesocarpo contribuyeron significativamente al aumento del contenido de extracto primitivo y alcohol de las cervezas anteriores. En términos de color, se clasificaron como claras y oscuras; en términos de amargura, se llamaron cervezas amargas y muy amargas. Los
resultados microbiológicos identificaron la ausencia de moho y la presencia de levaduras y bacterias mesófilas. El municipio de Zé Doça-MA cuenta con condiciones completas para la producción de cervezas artesanales utilizando materias primas de bajo costo capaces de generar un producto final de calidad y bien aceptado.

**Palabras clave:** Producción Artesanal. Cerveza. Innovación.

### Introduction

Beer is the most consumed alcoholic drink in the world. It is present in human food and has widespread acceptance due to its sensorial characteristics, high nutritional value and the wide variety of types found in the market (PINTO et al. 2015).

Moderate beer consumption is part of a healthy lifestyle. Taking two daily doses does not cause abdominal enlargement. The carbohydrates that make up this drink come from its cereals and contribute to achieving the daily dose of energy without harming your health. Beer promotes gastrointestinal balance, prevents the appearance of kidney stones and increases good cholesterol (HDL) due to the probiotics inserted during its processing (CERVABRASIL, 2017).

Beer is an alcoholic beverage produced from barley, water, hops and yeast. Barley grains go through the malting process to produce diastatic enzymes responsible for converting starch into sugar. Under these conditions, barley grain becomes called malt (SANTOS and DINHAM, 2017; DUARTE, 2015).

Craft beers come from microbreweries, are characterized by small-scale production, and are manufactured with unique ingredients. The products generated by these microbreweries are called “premium beer” and aim to serve consumers looking for different drinks (SEBRAE, 2014). The difference between craft beers and industrial beers lies in selecting ingredients rather than in the production stages. The manufacture of craft beer consists of choosing the style of the drink, preparing the formulation, selecting the components to be used to then grinding the malt, adding water, clarifying the brewing wort, measuring the density, boiling, activating the yeast, cooling the must, ferment, mature and bottle. These steps influence the product's quality (ROSA and AFONSO, 2015).

Brazilian legislation allows part of the malted barley to be replaced by malted or non-malted adjuncts. Such adjuncts can contribute as an alternative source of low-cost substrate, compared to malted barley, in addition to providing the beer with visual and peculiar
characteristics due to the source from which it comes. Beer manufacturers prioritize the quality of ingredients and invest in local inputs, promoting the identity of the final product and strengthening the region where they are located (VENTURINI FILHO, 2010). This fact partially justifies the choice of this topic for the present study and the development of a product with local raw materials. Therefore, this research aimed to create a craft beer of the Pale Ale type, IPA style, whose formulation contained malted bean grains and babassu coconut mesocarp as adjuncts, aiming to reduce process costs and incorporate colour, differentiated flavour and aroma to the product.

The following problem was raised: Is it possible to produce craft beer with raw materials that are typical of the municipality of Zé Doca (MA)?

Faced with this original question, the following hypothesis was raised: producing craft beer with typically zedoquense raw material is possible by replacing part of the barley with other products rich in starch in Zé Doca's agricultural production. The chosen products were green beans and babassu mesocarp, abundantly found in the municipality of Zé Doca.

The general objective of this work was to develop processing technology for craft beers of the Pale Ale type, IPA style. The research location was the municipality of Zé Doca (MA) due to the presence of the IFMA Campus Food Laboratory. The choice of theme is justified due to the production of craft beer being accessible from the point of view of production and, at the same time, having a high potential for generating foreign exchange for the municipality, as has been happening in other regions of the state and even the country, since beer is a widely consumed product, that is, it is a potential income generator and, for this reason, it is inserted in the economic matrix of Brazil, which is today the third largest beer producer in the world.

Therefore, it can be stated that this research has the possibility of bringing contributions to the academic community and society in general, as it is committed to the production of a type of beer, the raw material of which can be easily found in the Zé Doca region, where the research was carried out. It could also serve as a basis for future research around craft beer production, using other local raw materials, which could contribute to attracting investment, generating jobs and, therefore, growth for the local economy, resulting in improved quality of life of the residents of that municipality.
Materials and Methods

Four craft beers were developed with malted green bean grains and babassu mesocarp coded according to Table 1.

Table 1
Formulations and percentage by malt addition

<table>
<thead>
<tr>
<th>Sugar Source</th>
<th>Codification</th>
<th>Malt</th>
<th>Malted beans</th>
<th>Babassu mesocarp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stele of Hammurabi</td>
<td>100%</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Malted Beans</td>
<td>95%</td>
<td>5%</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Especiosa Beer</td>
<td>95%</td>
<td>-</td>
<td>5%</td>
<td>-</td>
</tr>
<tr>
<td>Pururuka Beer</td>
<td>90%</td>
<td>5%</td>
<td>5%</td>
<td>-</td>
</tr>
</tbody>
</table>

The manually selected bean grains were washed with running water and immersed in a 5% bactericidal agent. They were then washed with running water and kept in a tray at a controlled temperature of 25°C until complete germination. They were subsequently dried in an oven for 3 hours at 50°C. The rootlets were separated, and the cleaned grains were dried in an oven at 60°C. The malted beans were ground, stored and made available for brewing. The babassu coconuts (Orbignya speciosa) were peeled, and the endocarp separated from the mesocarp. This was crushed and sieved down to 0.12 mm, stored in a plastic bag, and made available for brewing.

The malts were subjected to the mashing process at 64°C for 45 minutes in pot 1. The temperature was raised to 72°C and remained there for 15 minutes. The temperature was increased to 78°C and remained there for 10 minutes. In the clarification stage, the tap in pot 1 was slowly opened, allowing the must to fall into a jug. The tap was closed, and the wort from the jar was slowly poured onto the grain layer with the help of a slotted spoon to facilitate clarification of the wort. The heating ramp of the mashing stage is shown in Figure 1.
The percolation water was heated to 78 °C. The brewing wort was transferred to the boiling pan (pan 2), and the pomace was washed, adding the percolation water on top of the malt grains contained in pan 1.

The wort was heated to boiling for 70 minutes. The hops responsible for bitterness (10 g of Target) and 15 g of Fuggle, the aromatic hop, were added. After cooling to 30 °C, it was transferred to pan 3 (fermentation). 250 mL of the must was removed and added to a beaker, where the original initial density gravity (OG) was measured.

The must was transferred to the fermentation bucket. 7g of S-04 yeast was added to the must to activate the bacilli. Once the fermentation process was complete, 200 mL of the "green" beer was removed and transferred to a bottle; then, using a hydrometer, the final density (FG) was measured. The "green" beer was matured in the packaging bucket under refrigeration at 3°C and then transferred to bottles, which were kept in a vertical position at room temperature for a period. After carbonation, the beer was made available for physical-chemical and microbiological analysis. Figure 2 illustrates the triple pan system (three pans), STP, for producing craft beers.
Physicochemical analyses were carried out regarding primitive extract, pH, total acidity, alcohol content, density, turbidity, colour, bitterness, aroma, flavour and appearance. The tests were conducted as the Adolf Lutz Institute (2008) recommended. Microbiological analyses included counting mesophilic bacteria at 30°C, counting total and thermotolerant coliforms and enumerating moulds and yeast.

After the formulations were subjected to microbiological analyses and confirming that the craft beers were suitable for human consumption, sensory analysis tests were carried out at the IFMA Food Technology Laboratory – Campus Zé Doca, using the methodology proposed by the Adolfo Lutz Institute (2008). The laboratory was prepared with individual booths; the samples were evaluated in terms of colour, aroma, flavour, overall impression, bitterness, transparency, and intention to purchase each sample. Tasters recorded their scores on forms with a hedonic scale of 9.

The samples were served in transparent glass cups with a capacity of 50 mL. Tasters were instructed to consume savoury snacks and cheese samples. During the tasting, between one sample of the craft beers and another, the tasters took a few sips of mineral water to wash their taste buds and not interfere with the tasting of the other beers. The sensory panel comprised 55 tasters from the IFMA – Campus Zé Doca Food Technology Course, consumers, and non-consumers of alcoholic beverages. These students had already taken the Sensory Analysis discipline. Therefore, they were able to carry out acceptance tests for craft beers. The results were evaluated using the analysis of variance (ANOVA) method, using procedures from the Paleontological Statistics Program (PAST), version 3.21 and Microsoft Excel. The results obtained were shown in the form of tables and graphs.
Results and Discussion

The percentage of the primitive extract revealed for Malted Beans beers was 17.87%, Speciosa Beer equalled 11.21%, Pururuka Beer revealed EP = 12.0% and Estela de Hammurabi EP = 6.70%. Such beers were classified as strong, regular, extra and light, as specified in IN nº 54/2001 – MAPA. The alcohol content of the beers analyzed ranged from 5.10 to 6.60% at 20°C. According to CP nº 69/2010-ANVISA and IN nº 54/2001-MAPA, these are beers with a high alcohol content. Malted green bean grains and babassu mesocarp exerted a strong influence on the increase in primitive extract and, consequently, on the increase in alcoholic content.

Regarding colour, Hammurabi presented EBC = 4.07, and Speciosa Beer revealed EBC = 3.45 and was classified as light beer. On the other hand, malted Bean beers, with EBC = 48.37, and pururuka beer, with EBC = 20.33, were classified as dark. Figure 3 illustrates the colour of craft beers produced.

Figure 3
Beer samples with their colour differences

The beers produced are IPA style, characterized by their intense bitterness. Its creators, the Indians, aiming to obtain a beer with more excellent resistance in the face of their long journeys through the desert, ended up adding hops with a high content of alpha acids. Hence, this style is called IPA (Indian Pale Ale). Its estimated colour was golden to amber, with bitterness intensity ranging from 15 – 25 on the International Bitterness Units Scale (IBU) and alcohol content in the 5 – 7.5% range. The results revealed for this quality standard indicated that Estela de Hammurabi had a bitterness of 22.0 IBU, Speciosa Beer with IBU = 20, Pururuka Beer with IBU = 18 and Malted Beans with IBU = 17, according to Ottenbrau (2023) and Nardini e Foddai (2020), The beers studied were classified as bitter (Malted Beans)
and very bitter (Estela de Hammurabi, Speciosa Beer and Pururuka Beer), with colour varying from golden yellow, through light copper to dark brown, characteristic of Indian Pale Ale style beers (IPA).

According to CP nº 69/2010 – ANVISA, the ideal pH of bottled beer is 4.0 – 4.2.A. Only Malted Beans beer had a pH=5.0 because it was made from green bean grains, whose enzymes in the grains raised the pH. The other beers revealed pH =4, thus meeting ANVISA (2010) specifications.

The microbiological results identified the absence of mould and the presence of yeast. Total coliforms remained within ANVISA specifications. The presence of mesophilic bacteria was also revealed. The maximum limit for the count of mesophilic bacteria in beer is < 3000 CFU/mL (ANVISA, 2010). The values found for the four craft beer formulations manufactured throughout this work exceed the maximum values legislation allows. However, the presence of microorganisms in craft beers is expected since they are generally not subjected to the pasteurization process, thus justifying the presence of mesophilic bacteria in the craft beers produced. Carneiro (2008) states that to obtain craft beers free of yeast residues, mesophilic bacteria, and coliforms, they must be subjected to treatments such as filtration and pasteurization, as craft beer packaging is expected to be contaminated with microorganisms. The filtration and pasteurization processes are critical, as such microorganisms can be of pathogenic origin and harmful to the beer's organoleptic characteristics and the consumer's health. In this sense, the craft beers produced met microbiological parameters and, therefore, are suitable for consumption.

The beers had their attributes, and the purchase intention test was evaluated by 55 trained tasters, aged between 18 and 44 years old, 25 men and 30 women. Therefore, in optimal conditions for carrying out the sensory test. Figure 4 shows the acceptability test revealed for craft beers.
Regarding colour, it shows that 74.04% of tasters liked the colour of Estela de Hammurabi beer. This beer is of the pure malt type since, in its composition, there is only malt, which has a colour ranging from yellow to golden amber. In this sense, the tonality revealed for the beer above was to be expected. On the other hand, 25.96% of evaluators showed some indifference or disliked the colour attributed to the beer. Regarding the aroma, it was observed that 72.02% of tasters were receptive to the attribute, and 27.98% showed some indifference or disliked the characteristic aroma of the beer.

The colour and aroma attributes revealed for Estela de Hammurabi beer may have been influenced by adding mineral salts, such as magnesium sulphate (MgSO$_4$) and calcium chloride (CaCl$_2$). These salts influence the quantity and quality of the beer produced, mainly on the enzymatic reactions that occur throughout the fermentation stage (DUARTE, 2015).

Coincidentally, like the aroma, the flavour had an acceptability of 72.02%. Tasters showed 27.98% indifference or dislike of the evaluated attribute. Transparency showed 69.19% acceptability due to few particulates (residues from yeast, barley, hops, etc.) in its composition. 30.81% of tasters showed indifference to the attribute. The bitterness presented 69.39% of acceptability, as it is an IPA-style beer whose characteristic is the intensity of bitterness. 30.61% of tasters did not appreciate the intense bitterness of the beer style studied. The Global Impression attribute had an acceptability index of 73.84%, showing that the product generally had great acceptance.
The Acceptability Index (AI) revealed that the beer was 72%, considered a high-quality product. According to Teixeira (1987), for a given product to be successful in an acceptability test, it must reach an \( IA \geq 70\% \).

The craft beer, Malted Beans, among those evaluated, was the one that had the least acceptance. The results revealed that for the colour attribute, 51.77% of tasters liked the colour of the beer. 49.33% showed rejection. According to IN no. 54/2001 – MAPA, a beer is considered dark or black when EBC > 20. The Malted Beans beer presented EBC = 48.37, classified as a dark beer, causing indifference from half of the tasters. Likewise, evaluators had difficulty evaluating the transparency attribute due to the high turbidity. Malted Bean beer presented 50.44% acceptability for the attribute above. It is worth noting that Malted Beans were not subjected to the filtration process; malted green beans were also added, which increased the sugar content during the braising stage and revealed a darker colour, possibly due to the oxidation process.

The aroma attribute had 55% acceptability and 45% rejection. Tasters reported that the flavour was intense and had 49.44% acceptability. This attribute originated due to the addition of starch in the malted beans, making the beer fuller than the other beers analyzed. Depending on the bitterness, 49.44% of tasters were satisfied with the characteristic attribute of the IPA style.

The Global Impression attribute had an acceptability rate of 49.77%, not reaching the acceptance targets specified by Teixeira (1987).

Green beans were the innovative ingredient in Malted Beans beer. Through the malted grain, it was possible to obtain a significant release of starch, which was later converted to fermentable sugars in large quantities, leaving the beer fuller in colour, transparency, and flavour. The overall acceptability rate was 50.94%.

Speciosa Beer had its attributes satisfactorily evaluated by tasters. The results showed that the overall impression attribute had an acceptance rate of 68.55%, and 31.45% of evaluators disliked the evaluated product.

Speciosa Beer received its name due to the addition of babassu mesocarp to its composition. The babassu mesocarp had a significant influence on the final product. A smaller amount of starch was observed, giving a less full-bodied appearance in colour, alcohol content and transparency. The acceptability index (AI), generally equal to 70%, proves to be a well-accepted product. The colour attribute had 75% acceptance by tasters, being the best-evaluated attribute; it reached 74% acceptance for the transparency attribute. Speciosa Beer presented EBC = 3.45, considered straw-coloured and light beer. The aroma had 70% acceptance and
30% rejection by tasters. Said beer had 65% acceptance and 35% rejection for the flavour attribute. The bitterness received 66% acceptance.

Pururuka Beer was designed to be the main product of this work since malted beans and babassu mesocarp were added to their composition to replace part of the malted grains. Tasters evaluated its attributes. The colour attribute had an acceptability rate of 69%. Pururuka Beer, in terms of colour, presented EBC = 20.33, constituting a beer with a light copper colour, according to the SRM classification, and is also considered a dark beer according to the specification of CP nº 69/2010 – ANVISA and IN nº 54/2001 – MAPA.

Its aroma is characteristically fruity and has an acceptability of 65% with 35% rejection. On the other hand, the flavour was accepted by 59%. Its transparency had 64% acceptance, considering the turbidity result equal to 30.0 EBC. Its bitterness had 51% acceptance and 49% rejection. The overall impression of the beer had 60% acceptability and 40% rejection. The general acceptance index (AI) for this beer revealed a percentage of 61%. However, this product did not reach the expected degree of acceptability since the balance between the adjuncts malted green beans and babassu mesocarp was expected. Therefore, this beer needed to gain the acceptability of tasters as expected.

During the sensory analysis, the evaluators assigned scores from 1 to 9 in the hedonic scale test for the attributes colour, aroma, flavour, transparency, bitterness, and overall impression. The results were analyzed using analysis of variance (One-way ANOVA) with the help of the statistical program PAST (Paleontological Statistics). The results demonstrate that variance occurred (One-way ANOVA) for all attributes.

The analysis of variance using the one-way technique indicated a significant difference in the distribution of attributes. However, it did not indicate between which beers analyzed the significant difference occurred. To this end, the multiple comparison test, called the Tukey Test, was used. The average results revealed for each attribute analyzed are shown in Table 2.

**Table 2**

*Averages obtained for beer attributes in sensory analysis*

<table>
<thead>
<tr>
<th>Beer</th>
<th>Print Global</th>
<th>Colour</th>
<th>Aroma</th>
<th>Flavor</th>
<th>Transparency</th>
<th>Bitterness</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>EH</strong></td>
<td>2.45 (a)</td>
<td>2.43 (a)</td>
<td>2.61 (a)</td>
<td>2.61 (a)</td>
<td>2.87 (a)</td>
<td>2.85 (a)</td>
</tr>
<tr>
<td><strong>MB</strong></td>
<td>4.61 (b)</td>
<td>4.36 (b)</td>
<td>4.14 (b)</td>
<td>4.67 (b)</td>
<td>4.56 (b)</td>
<td>4.65 (b)</td>
</tr>
<tr>
<td><strong>SP</strong></td>
<td>2.92 (a)</td>
<td>2.32 (a)</td>
<td>2.76 (a)</td>
<td>3.21 (a)</td>
<td>2.45 (a)</td>
<td>3.16 (a)</td>
</tr>
<tr>
<td><strong>P.K.</strong></td>
<td>3.72 (b, c)</td>
<td>2.87 (a)</td>
<td>3.25 (a)</td>
<td>4.07 (b)</td>
<td>3.38 (a, c)</td>
<td>4.52 (b)</td>
</tr>
</tbody>
</table>

Averages followed by the same letter in the column do not differ significantly at the 5% probability level. EH = Stele of Hammurabi; MB = Malted Beans; SP = Speciosa Beer; PK = Pururuka Beer.
Production and characterization of craft beers IPA style with addition from malted green beans and babaçu mesocarp

EH and SP beers received a higher percentage of acceptance than MB and PK beers. EH beer differs significantly from MB and PK beer, at a 5% variance. MB differentiated from SP and PK.

As for colour, tasters accepted the EH, SP, and PK beers. The beers EH, SP and PK showed no significant difference between them. There was a significant variance when compared with the same attribute of MB beer.

Tasters evaluated EH beers, SP and PK better than MB beers. While the EH, SP and PK formulations did not differ significantly, the MB beer differed significantly at a variance level of 5% from the other craft beers.

Regarding the flavour attribute, it can be seen in Table 11 that EH beer, pure malt, received greater acceptance compared to other beers. It differed significantly from MB and PK beers, chemically made of innovative raw materials such as malted beans and babassu mesocarp. It was also observed that the MB beer differed significantly from the SP formulation.

Regarding the transparency attribute, it is observed that the EH and SP beers did not present a significant difference between them and were the best evaluated when compared to the MB and PK beers. MB beer showed a significant difference between EH, SP and PK beers. On the other hand, SP beer showed a significant difference from PK beer.

Craft beers, EH and SP, received greater acceptance due to their bitter attributes. EH beer did not differ significantly from SP beer. However, it showed a difference between MB and PK beers. On the other hand, MB beer showed a significant difference in SP. Finally, SP significantly differentiated from PK.

When comparing the results obtained for the acceptability and hedonic scale tests revealed for the craft beers EH, MB, SP and PK, it was observed that among the six attributes analyzed by the tasters (transparency, aroma, colour, bitterness, flavour and overall impression) there was a consistent relationship. For example, the reference beer, EH (pure malt), had 72% acceptance in tasters' preference; of the six attributes analyzed, it had greater acceptance in 4, and for the others, it came in second place.

SP beer containing babassu mesocarp in its chemical composition was the second most well-accepted among tasters, with 70%. On the other hand, for the attribute’s transparency and colour, it revealed the best scores; for the other attributes, it received the second-best score.

PK beer containing malted green beans and babassu mesocarp reached 61% of tasters' preferences. For the attributes analyzed, it came in 3rd place regarding preference.
MB beer containing malted green beans in its chemical composition showed 51% preference and remained in 4th place about the attributes analyzed.

The results revealed led us to infer that the order of preference of beers containing raw materials found in the municipality of Zé Doca – MA, the purpose of this work, consisted of the following increasing scale of preference:

\[ SP > PK > MB \]

The judges also assessed the intention to purchase craft beers. According to the results revealed, it was observed that the reference craft beer, \( EH \) (pure malt), received greater purchase certainty with 51% of intentions. The second beer with the highest purchase intention was \( SP \), with 38% preference. Next, tasters preferred \( PK \) with 12% and MB with 11% of intentions.

When asked if they would probably buy the beers under analysis, Tasters responded that 33% would probably buy the \( SP \) beer, 27% would probably buy the \( EH \) beer, 24% would probably buy the \( PK \) beer, and 20% would probably buy the \( MB \) beer.

The tasters needed clarification regarding their intention to purchase the beers. The results revealed that 29% had doubts about buying \( MB \) beer, 24% for \( PK \) beer, 18% for \( SP \) beer and 14.5% for \( EH \) beer. The results obtained for the intention of probably not buying constitute \( MB \) with 27%, followed by \( PK \) with 24%, \( EH \) with 5% and \( SP \) with 4% of intentions.

Tasters throughout the sensory test of craft beers stated that 17% would certainly not buy \( PK \) beer, followed by 12% for \( MB \) beer, 7% for \( SP \) and 2% for \( EH \) beer.

When comparing the acceptability and hedonic scale tests with the purchase intention test with absolute certainty, the same decreasing preference scale is obtained \( (SP > PK > MB) \), indicating a logical sequence of preference for the products analyzed by the tasters during the sensory analysis.

Conclusions

The variations identified about some quality parameters were justified based on the beer style and the production process route. However, it is necessary to carry out a more in-depth study to understand the factors that interfere with the quality of beers and, in this way, implement improvements to increase the level of acceptance of this input.

The additives malted green bean grain and babassu mesocarp contributed significantly to the increase in the primitive extract and alcohol content of craft beers. The alcohol content
varied between 5.10-6.6% according to CP nº 69/2010-ANVISA and IN nº 54/2001- MAPA; they were classified as beers with a high alcohol content. As for the primitive extract, the beers Estela de Hammurabi, Malted Beans, Speciosa Beer and Pururuka Beer were classified as light, robust, standard, and extra strong, respectively.

Regarding colour, the beers Estela de Hammurabi and Speciosa Beer presented EBC < 20 were called pale beers. Malted Beans and Pururuka Beer revealed EBC > 20 and were classified as dark. Regarding the bitterness parameter, Malted Beans received the name bitter beer. Stele of Hammurabi, Speciosa Beer and Pururuka Beer were considered too bitter. The results are consistent with the said style, considering they are IPA-style beers.

The microbiological results identified the absence of mould and the presence of yeast and mesophilic bacteria. Total coliforms remained within ANVISA specifications. Yeasts were already expected, but craft beers are not subjected to filtration and pasteurization processes. There is no evidence in the literature that mesophilic bacteria present imminent risks to human health, so the consumption of craft beers is relatively high. Small amounts of yeast found in beer containers do not pose any risk to the consumer.

About the results obtained during the sensorial and statistical analyses, among the craft beers containing additives found in the municipality of Zé Doca – MA, the one that revealed the highest quality standard in the tasters’ view was Speciosa Beer, with 70% acceptance. The descending scale of preference consisted of the following: Speciosa Beer > Pururuka Beer > Malted Beans.

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Declaration of Interest Statement

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