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Beer industry in Brazil: Economic aspects, characteristics of the raw material and concerns

Pivovarský průmysl v Brazílii: Ekonomické aspekty, charakteristika surovin a rizika

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Barley is one of the most cultivated grains in the world with numbers rising every year due to market demand. In the past decade, Brazil has shown impressive numbers considering beer production. However, barley cultivation does not reach the necessary amount for the beer industry which raises the need to import barley or to use some alternatives, such as, adjuncts. The most common adjunct used is corn, which is considered a good source of carbohydrates, but also a very contaminated grain. Research and monitoring of all of the steps of the chain is being carried out to improve not only the malt quality but also the competitiveness in world market.

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Ječmen je jednou z nejvíce pěstovaných obilovin na světě, po níž se každoročně zvyšuje poptávka na trhu. V uplynulém desetiletí vykazuje Brazílie působivá data, pokud jde o výrobu piva. Pěstování ječmene však nedosahuje potřebného množství pro výrobu piva, což vyvolává potřebu dovozu ječmene nebo využití některých alternativ, např. surogace. Nejběžnějším přídatkem je kukuřice, která je považována za dobrý zdroj sacharidů, ale je zde riziko kontaminace zrn. Výzkum a sledování všech kroků řetězce probíhá s cílem zlepšit nejen kvalitu sladu, ale také konkurenceschopnost na světovém trhu.

Keywords: beer industry, barley, adjuncts, Brazil**Klíčová slova:** pivovarský průmysl, ječmen, surogáty, Brazílie

1 INTRODUCTION

The brewing industry can be considered one of the most important productive activities of the twenty-first century, although beer production goes on for centuries and its consumption has been introduced as part of the dietary habits of several civilizations for at least 7,000 years before the Christian Era (Poelmans and Swinnen, 2012).

Although millenarian, consumption and brewing only became significant among alcoholic beverages in the last 150 years. Currently, it can be said that beer consumption is globalized and Brazil's participation in this internationalized market has attracted the attention of big companies that work in the sector.

Additionally, the raw material used for beer production have been taken into account considering the quality and also the increase in production. All of the standard characteristics, such as amount of starch, protein and germination capacity are the most important attributes considered for development and production of a new variety (CONAB).

Nevertheless, barley production is not sufficient for the industry's demand and for this reason the importation of grains and also the use of other adjuncts is very common to reach the industrial necessities.

This is the first review considering just the beer industry in Brazil and its aspects. All of the importance is always focused on the European market due to their reputation, however Brazil has shown impressive numbers considering the industry in past few years. In addition, it is necessary to mention that information about the use of adjuncts, such as corn, in the beer process are almost unknown, and for this reason the authors are exposing this relevant data.

2 ECONOMIC ASPECTS OF THE BREWING INDUSTRY IN BRAZIL

Barley is one of the most cultivated grains in the world with numbers rising every year due to the demand of the beer industry. The

global production of 2017/2018 was set around 142.97 million metric tons, with the European Union being the largest producer with 59.09 million metric tons (USDA, 2018). Nevertheless, taking into account the Brazilian production, in 2017 the data was set around 282,1 thousand tons and the country cultivate only 30% of the brewing industry use (CONAB).

For this reason, the industry needs to import barley from other countries or use some alternatives (adjuncts), such as, corn, wheat, rice and so on Poreda et al. (2014).

Barley production and the beer industry have been considered very important for the country and have an important multiplier effect in the economy. Their operations move an extensive productive chain that is responsible for 1.6% of GDP and 14% of the national manufacturing industry (Marcusso and Muller, 2018).

Also, the sector has extensive relevance for the Brazilian economy, with more than 2.2 million people employed within the chain. It is considered one of the largest employers in Brazil (CERVBRSIL, 2016).

It is important to mention that the beer market in Brazil, until the 1990's, was dominated by the large-scale industries. However, this

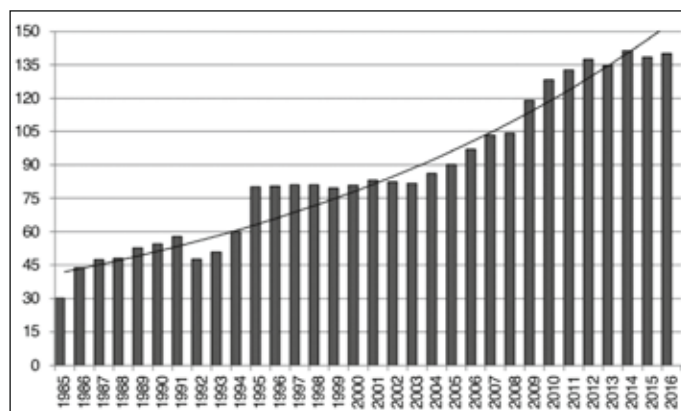


Fig. 1 National beer production in millions of hectoliters per year (Marcusso, 2015; CERVBRSIL, 2016)

concept has changed and the craft beer industry is becoming responsible for the breakthrough in the national market (SEBRAE, 2014).

Taking into account the use of barley in the beer process, all of the raw material produced in the country is destined to go to large-scale industries. This production is combined with other adjuncts as aforementioned and gives Brazil the 3rd position in the world for beer production only behind China and the United States with 13 billion liters a year (Freitas, 2015). Fig. 1 shows the growing trend of beer production in the last 30 years in Brazil.

Nowadays, considering beer consumption per capita, Brazil occupies 17th place in the global ranking with 63 liters. Since 2011, the Czech Republic continues to occupy first place in the world ranking with an annual 143 liter per habitant, followed by Austria and Germany with 108 and 107 liters, respectively (Renato et al., 2018).

3 RAW MATERIALS

3.1 Barley

Barley (*Hordeum vulgare* L sp. *vulgare*) is considered one of the most important cereals in the world context. It is a winter crop that ranks fifth in order of economic importance in the world. In Brazil, barley production is concentrated to the south due to the propitious climate of the region, with the state of Parana as the main producer (165,7 thousand/tons), followed by Rio Grande do Sul (114,3 thousand/tons) and Santa Catarina (2 thousand/tons) (Fig. 2) (CONAB: Companhia de Abastecimento, 2017).



Fig. 2 Barley production in Brazil in 2017

It is necessary that the producers follow the technical indications of barley research commission (Embrapa) and respect the recommended crop management practices to obtain a product of the required quality.

According to the Brazilian Ministry of Agriculture, Livestock and Supply (MAPA no. 691 of November 22, 1996) the brewing barley must have the following quality standards: maximum moisture of 13%, maximum protein content 12%, germination power of at least 95%, maximum impurities of 3% and broken grains maximum 5%. These characteristics can be compared to other countries that have similar requirements for barley quality (Pahl, 2011).

The grain is used in Brazil mainly for the production and industrialization of beverages (beer and distillates), however it could be also used in the manufacturing of flour for baking, in production of medicines and in the formulation of dietetic products and coffee substitutes. In addition, barley can be used in the production of animal feed (Embrapa, 2017).

3.2 Corn

Worldwide, the source of fermentable sugars in beer is starch-rich cereals, mainly malted barley. Nevertheless, adjuncts including corn, rice, un-malted barley, wheat starch, oats and sorghum have been also used by the large-scale brewing industry to provide additional sources of fermentable carbohydrates for the yeast (Poreda et al., 2014).

The brewing industry has many reasons for the application of adjuncts including better availability in the local market, sensory modification of the beer and, most importantly, lower price of this product in Brazil (Diakabana et al., 2013; Glatthar et al., 2005). It has been proven that the use of 30% of corn adjunct can give an 8% reduction in total production costs, although this number may vary depending on the local prices of raw materials and other costs of production (Poreda et al., 2014).

Corn is the most widely available and most commonly chosen grain in Brazil to improve and accelerate the fermentation process in the beer industry, and according to national regulations a given amount of adjunct can replace malted barley up to a maximum of 50% (Brasil, 1997).

Previous studies have demonstrated that underdeveloped countries, such as Brazil, usually export the best sources (grains) produced (Leslie and Logrieco, 2014). The average quality grains are for the population's consumption and the rest, namely the worst part of the production, are destined for the adjuncts and processed food.

4 BEER INDUSTRY CONCERN IN BRAZIL

Some studies have reported mycotoxin contamination in the final products, such as beer made with corn and also beer made exclusively with barley, with high levels of certain compounds (Piacentini et al., 2017). This is a relevant subject that should be taken into account by the beer industry. Nevertheless, nowadays no regulation is established.

Fungi and mycotoxins can be easily found in grains, however in Brazil the tropical climate conditions could cause higher contamination due to the different humidity, rain forecast and temperature when compared to other countries (CPTEC, 2015).

Not only barley, but wheat, corn, oats and other grains are exposed to this kind of contamination. In the past few years some studies have been carried out analyzing these grains and reported a con-

Table 1 Occurrence of mycotoxins in the most important grains cultivated in Brazil

Grain	Mycotoxin	Frequency (%)	Level range (µg/kg)	Reference
Barley	DON	18	200 – 15000	(Piacentini et al., 2015)
		94	1700 – 7500	(Piacentini et al., 2018)
	ZEA	73.6	300 - 630	(Piacentini et al., 2018)
	FB1	12	1 – 13	(Piacentini et al., 2015)
Wheat	DON	99	183 – 2150	(Tralamazza et al., 2016)
		47.2	243.7 – 2281.3	(Savi et al., 2007)
		94	90 – 4732.3	(Calori-Domingues et al., 2007)
	ZEA	66.4	206.3 – 4732.3	(Sifuentes Dos Santos et al., 2013)
Corn	ZEA	96	20.4 – 233	(Tralamazza et al., 2016)
	DON	48	35.6 – 1008	(Oliveira et al., 2017)
		73.6	1.4 – 5088	(Oliveira et al., 2017)
	FBs	95	1.8 – 99	(Queiroz et al., 2012)
		100	62.4 – 66274	(Oliveira et al., 2017)
	Aflatoxins	100	230 – 6450	(Queiroz et al., 2012)
	25.6	0.4 – 49.9	(Oliveira et al., 2017)	

siderable occurrence of fungi and mycotoxins. More data is showed in Table 1.

Fusarium and their toxins (Trichothecenes, Fumonisin, Zearalenone) are the most common ones found in grains. However other toxins are also frequently found (Table 1).

Mycotoxin contamination is a concern for the industry and new technology is being studied and tested in order to reduce contaminations, such as the ozonation of food products, adsorbents, gamma radiation, nanoparticles, etc. Nevertheless, the studies are still being done in laboratories (Piacentini et al., 2017; Savi et al., 2014a,b; 2015a,b).

For some of these new processes that aim to reduce contamination, such as the treatment with ozone gas, more than 93.3% of fungi spores were detoxified without any modification in the barley grains. Furthermore, nanoparticles of zinc showed to be efficient for fungi and also mycotoxins decontamination in wheat grains with 80% of contaminant reduction.

The complete elimination of fungi-contaminated commodities may not be achievable (FAO/WHO, 2003), but a reduction is essential for final product quality as well as for the well-being of the consumer.

5 CONCLUSIONS

The Brazilian beer industry could be a promising market in the next few years due to the increase in all of the areas of the sector, and this can be seen clearly with the impressive numbers that have been demonstrated. However, the best raw material should be chosen for the brewing process, due to the contamination that can be found in the final product if it is not, in fact, utilized. More research should be carried out considering the genetic improvement of the barley varieties to enhance quality and also the resistance of grains against contaminants, such as fungi and mycotoxins. It can be seen that the beer industry in Brazil is being monitored in all aspects and in every part of the chain. This could make a difference not only in product quality, but also in a more competitive market.

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