Antioxidant and bioactive compounds are identified in craft beers

Besides describing 57 phenolic and 15 nitrogen compounds present in the drink, researchers have shown that these substances can be used to distinguish between beer styles.

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The types and concentrations of compounds are related to the composition of the primary materials used in production - Photo: Kimm Dombrowsi/CC BY SA 2.0

When speaking of the importance of his research object, Jeverson Frazzon, a professor at ICTA (Institute of Food Science and Technology) at UFRGS, is emphatical: "Beer moves along with the development of society." There is no consensus about when beer, the result of the fermentation of barley, started to be consumed. It is known, however, that the drink was an important part of the social life and of cultural and religious ceremonies for many ancient peoples, including the Sumerian and the Egyptian. Its discovery probably occurred by accident, and its origin may have taken place as early as 10,000 years ago. "There are so many stories about how this type of life we live, grouped as a society, contains aspects that are related to beer production and consumption," he comments. It is not by chance that this is the most consumed alcoholic drink around the world. Despite its long history, however, a lot is yet to be discovered about its properties and benefits.

You may have heard that wine is good for the heart, that it is full of antioxidants and bioactive compounds (substances which are not essential to the body, but bring a series of benefits to one's health), or even that one glass of wine a day can help us live longer and better. "There are indeed many studies about wine. But what do we know about beer?", Frazzon asks us. As he emphasizes, it is likely that beer is good for its consumer's health; and not only because of its social advantages, but also for its nutritional attributes. "In the same way wine had already been studied, we wanted to search for the presence of phenolic and nitrogen compounds in beer. Here the chemical part of the question comes in. What is it in this product, among these phenolic and nitrogen compounds, with bioactive capacities, that can help with cardiovascular conditions and many other diseases that plague us, including diabetes?" Some of these beneficial compounds had already been discovered in previous studies, but with the development of their own methodology, UFRGS researchers were able to identify new substances, and, besides that, for the first time in the scientific literature, to demonstrate that it is possible to distinguish between different types of beer through the absence or presence of these compounds.

The analysis has been based on 81 bottles of craft beer from 3 breweries from Porto Alegre, which donated the majority of the samples. There were 27 bottles from each company, being 3 different lots for each of the three beer styles examined: IPA, Lager and Weiss. Developed as part of Kamila Cheiran master's research, supervised by Frazzon, the work involved a multidisciplinary team which included undergraduate and graduate students and faculty members from a variety of research areas, such as microbiology, chemistry and mathematics. The results were published by the scientific magazine Food Chemistry.

The craft beers, usually produced in a smaller scale and subject to a more attentive selection of ingredients, demand longer periods of brewing and maturation. The focus is the product's quality and distinctiveness, whereas the production of industrialized beers aims at producing in large scale with large machinery. As Frazzon explains, craft beer was chosen on account of its more complex aromas and flavors, which are indicative of the presence of

bioactive compounds in larger amounts. The researchers also seek to verify variations among the lots from a same brewery.

"Our idea was to investigate different types of beer in different lots and from different fabrication dates. The first analysis we made was directed at the more chemical part," tells the researcher. The bitterness, the color and the alcohol content and concentration were evaluated, and a lot of variation was observed, even among lots from the same style and from the same brand. "That is important in many aspects. If you say the beer contains 5% of alcohol, for example, that is a very rigid number, it has to be kept in check. Now, if the brewing process on that week did not work out properly or if the material had more or less sugar, the alcohol concentration can vary. The consumer will not receive the 5%; they may receive 7%, or 4%. That is really serious, it may have various implications," he stresses. Maybe you have already had the feeling that the beer you had last week tasted a little bit different from today's. After all, even small changes in the ingredients may lead to considerable variations in the final product's quality. It is essential, as the professor stresses, that the manufacturer stays attentive to these questions, once the consumer should receive the product that it described in the label.

Health benefits

In a second moment, the researchers sought to identify the presence of substances in the drink that are beneficial for health. Fifteen nitrogen and 57 phenolic compounds were described, 12 of the latter having been found in beer for the first time. Phenolic compounds are linked to sensorial characteristics, granting bitterness and acerbity to the flavor, and are known for their antioxidant properties with positive effects for health, such as the decrease in the risk of cardiovascular diseases. The nitrogen compounds, in turn, besides being possibly linked to sensorial characteristics, present beneficial links to many infirmities, such as diabetes, neurotrauma and cognitive and degenerative disorders.

The types and concentrations of phenolic and nitrogen compounds are directly influenced by the composition of the primary material used in production. Hop, for example, is full of phenolic compounds, while barley is rich in nitrogen compounds. "In order to become a *sommelier* and understand the presence of the compounds, a lot of development must happen. But it is perceptible. People who have this *sommelier* ability can detect the presence of certain compounds in the beer and that is why it receives a classification," he explains.

IPA, for example, has a very marked hop flavor. Professor Frazzon points out that "it is a strong beer, with personality. That is because very often two, three types of hop are added, in different moments throughout the brewing. That results in quite a unique flavor. And it gives us a good feeling when we drink it, it really feels like we are full of antioxidants." He adds: "Being able to bring this information to society is super important so that it can see the benefits of beer. It is not by chance that it has been among us for so many years, there should be some benefit to it. And it is really proven that beer brings us countless benefits through the presence of these antioxidant and bioactive compounds."

Another important contribution of this work was the distinction of beer styles based on the presence or the absence of certain phenolic and nitrogen compounds. By using mathematical formulas, scientists have identified the percentage of compounds found in each of the three researched styles and were able to place them in graphs that clearly show the differences in composition for each style.

That is especially important, Frazzon explains, for the correct classification of the drinks and to avoid falsification processes. He highlights that "if there is a pattern in the style, it has to be followed. This was a step we made, and it does not mean that this method can be applied yet, since it is not very easy to be reproduced. But, obviously, if interest arises, it can be applied in the future."

Scientific paper

CHEIRAN, Kamila P. et al. Simultaneous identification of low-molecular weight phenolic and nitrogen compounds in craft beers by HPLC-ESI-MS/MS. Food Chemistry, 2019.

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Directions