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RESEARCH ARTICLE

Nutritional value of cane broth and nutraceutical potential of Caná – cane broth´s fermented drink

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ABSTRACT

Brazil is the world's largest producer of sugarcane and its juice is used mainly for the production of sugar, fuel alcohol and industrial cachaça. To a lesser extent, thousands of producers cultivate sugarcane on a rural scale, for the production of alembic cachaça, brown sugar, rapadura and molasses. In recent years, however, these producers have been looking for options that, in addition to expanding the range of products, allow them to add more value to their properties and sugarcane fields. In this context, the feasibility of producing fermented sugarcane juice as a final drink, similar to grape wine, has been considered. The market potential of this beverage has been markedly expanded as a result of recent research, which proved the presence of phytoactive substances in sugarcane juice, such as apigenin, luteolin and asterin, among others. Continuing these works - which have already made it possible to scientifically support millenary practices related to the use of sugarcane juice in Ayuvedic medicine - is very important, both to reinforce the appreciation of sugarcane juice in the human diet and to enable the classification of the fermented sugarcane juice as a beverage with functional activity, following the example of the recognition already won by wines that come from the fermentation of grape juice. To contribute in this direction, an update is presented in the scope of the chemical composition of the sugarcane juice, highlighting the main phytoactives already characterized.

Keywords: Sugarcane; Phytochemicals; Caná; Fermented sugarcane juice.

1. Introduction

The broth extracted by grinding the stalks of sugarcane (*Saccharum spp*) is tasty and has a high content of glycides. In Brazil, the world's largest producer of sugarcane,broth is mainly intended to obtain sugar and ethanol fuel, in addition to cachaça – a distilled beverage typical of Brazil[1].Sugar and ethanol fuel are manufactured predominantly in large mills and distilleries. The cachaça, in addition to being distilled by some large factories (column cachaça), is also produced in an agricultural scale by thousands of units spread throughout the country (alembic cachaça).

With the technological advancement of recent decades, many producers of alembic cachaça have realized that fermented sugarcane juice can have excellent palatability, with potential for insertion and great acceptance in the market.In fact, the feasibility of taking advantage of the infrastructure of the still cachaça factories for the safe production of fermented sugarcane as a stable and healthy beverage has already been demonstrated[2,3]. By analogy with wine, whose name refers to the vineyard, the drink has been called "cana", which refers to the sugarcane field (caná-vial). The production of sugarcane has the potential to enhance geographical areas (such as the terroir of wines), expand economic viability and strengthen the productive sector of alembic cachaça, using resources already available: raw material, equipment, practices and knowledge. Nevertheless, it is necessary to perceive sugarcane juice in a similar way to grape juice, whose resveratrol and quercetin contents are already popularized as factors of nutritional appreciation of wines[4,5,6].

For this, it is necessary to advance in the minority composition of sugarcane juice, evidencing compounds that add nutraceutical values. The objective of this article is to point out the state of the art and stimulate the development of further research in the field of phytoactive components of sugarcane juice.

2. Methodology

A survey (Google Scholar, Scielo and Science.gov) of publications referring to the nutritional and phytochemical value of sugarcane juice was carried out from 1990 to the present. The work included technical articles published in national and international journals, as well as master's monographs and doctoral theses in Brazilian universities.The review was written in a concise manner, with emphasis on the phytochemical compounds already identified and that demand further scientific deepening in the scope of Brazilian sugarcane varieties.

3. Centesimal Composition

The sugarcane juice is composed mostly of carbohydrates, among which sucrose represents around 90%. In much smaller proportions, which vary in the extent of the stem, fructose, glucose and other glycides,such as raffinose also occur[7].

Among the varieties grown in Brazil, the average carbohydrate content is 18.2 g/100 g broth[8], above the average of 13.2 g/100 g reported by the IFCD for Indian varieties[9]. And it is known that, at the point of maturation, Brazilian sugarcanes reach values of up to 24 brix, which correspond approximately to the total carbohydrate content (in g/100 g).Quantitatively, the contents are similar to those of grapes; the difference is structural, as fructose and glucose are the predominant sugars in grapes[10,11].

The contents of the other classes that make up the centesimal composition vary from traces to 0.5 g/100 g (Table 1)

Table 1 – Centesimal composition of sugarcane juice (g/100 g)

COMPONENT	BRAZIL [8]	INDIA [9]
Moisture	81,7	86,0
Carbohydrates	18,2	13,2
Proteins	Tr.	0,2
Ashes	0,1	0,2
Total fats	Tr.	0,4
Total fibers	0,1	0,5

Regarding the levels of vitamins and minerals, data from the literature allow us to infer that the daily intake of 200 mL of broth corresponds to about 10% of the RDI (reference daily intake) of pyridoxine, folic acid and iron, as well as 30% of the RDI of vitamin C, pantothenic acid, riboflavin and thiamine.These contents are relevant, but do not characterize exceptions compared to other vegetables in our usual diet[8,12].

In view of the above, it is understood that, throughout the twentieth century, Western medicine has recognized the nutritional value of sugarcane juice only by the association between the high energy content and attenuated glycemic potential due to the predominance of sucrose disaccharide[13]. Although recurring, claims of herbal effects were attributed to unsubstantiated "popular beliefs."

4. Therapeutic Properties

Over many centuries and up to the present date, Eastern medicine (Ayuvedic) has always employed sugarcane juice as an agent of health and therapeutic action in the fight against various pathologies. More recently, these practices have been extended to various veterinary applications, with scientific support of researchers from Asia (especially India, Turkey and China) and other countries.In chickens, for example, the efficacy of administering medicinal doses (on the order of 500 mg/kg weight/day) has been demonstrated for the purposes of:

a. Immunostimulating effect and fight bacterial infections[14,15,16].
b. Protective action against deleterious effects of UV radiation applied to captive chickens[17] .
c. Protective effect against intestinal parasites[18].

Using similar doses, tests in pig farming allowed to demonstrate:

a. Immunostimulating effect and preventive action against the pseudorabies virus, a severe contagious infectious disease[19,20].
b. Measurable antioxidant effect on pork quality[21].

With tests in rats, the antibiotic gentamicin has been proven to be protective against acute kidney toxicity, with evidence considered promising for the treatment of bone infections, endocarditis, pelvic inflammatory disease, meningitis, pneumonia, urinary tract infections and sepsis [22].

5. Phenolics

Phenolics – compounds that are characterized by containing one or more aromatic rings with one or more hydroxyl groups – are the most abundant secondary metabolites of vegetable plants. The structures of more than 8,000 phenolics have begun to be unraveled from relatively recent advances in equipment and analytical methodologies. Subsequently, numerous physiological functions were explained, as well as the molecular mechanisms involved[23,24,25,26,27,28]. In particular, phenolic acids and flavonoids (Figure 1) have received great attention[29,30].

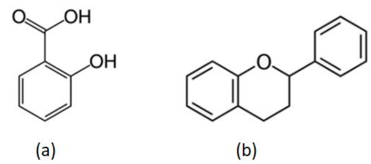

Figure 1 - Molecular skeletons characterizing: (a) phenolic acids (C6-C1); (b) flavonoids (C6-C3-C6).

In sugarcane juice, the presence of important phenolic acids and flavonoidshas already been proven[31,32,33,34,35] with emphasis on caffeic, synapic and chlorogenic acids (Figure 2) and the flavonoids apigenin, luteolin, diosmetin, vitexin and tricin (Figure 3).

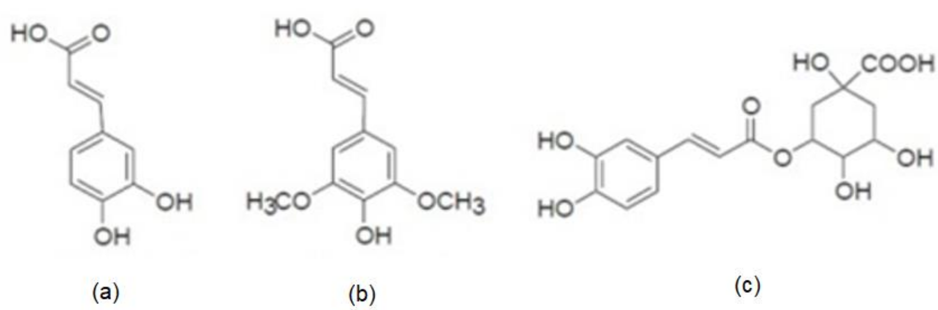

Figure 2 – Phenolic acids identified in sugarcane juice: (a) caffeic acid; (b) synapic acid; (c) chlorogenic acid.

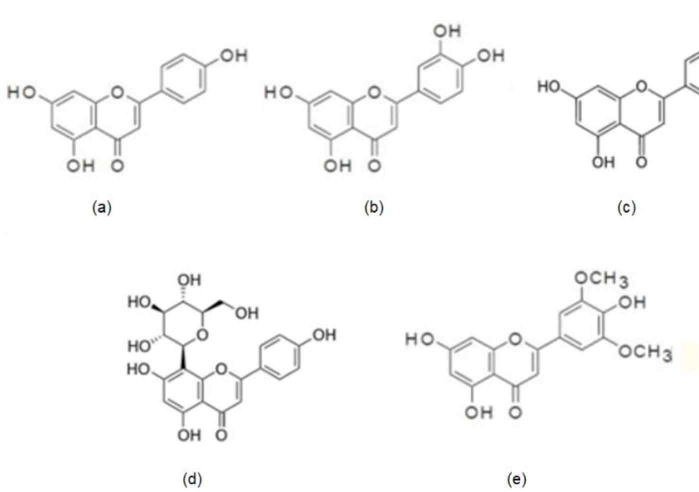

Figure 3 – Flavonoids already identified in sugarcane juice: (a) apigenin; (b) luteolin; (c) diosmetin; (d) vitexin; (e) tricin.

Caffeic, synapic and chlorogenic acids are widely recognized for their antioxidant and anticarcinogenic activities, among numerous other biological functions in the human and animal body[36,37,38,39,40].

Apigenin and luteolin are among the most potent antioxidants in the flavonoid class[23]. Its antitumor activity has also been proven[41]. Among other benefits, Almeida et al.[32] pointed out the potential of sugarcane phenolics in combating methylmercury poisoning (the most toxic form of mercury).

6. Anthocyanins and Carotenoids

Flavonoids have a yellow color (*flavus*, from Latin, yellow), with the exception of anthocyanins, whose blue hue (from Greek, *anthos*, flower, and *kianos*, blue) may contribute to the green color of fresh broth[42]. In a recent study, Xu et al.[42] pointed to cyanidin-3-O-glycoside (also called asterin) as the main representative of anthocyanins in sugarcane juice. According to Aguirre et al.[43] asterin has solid evidence of antioxidant efficacy in DNA protection, gastroprotective, anti-inflammatory and antithrombotic action; it is also an epigenetic factor, exerting protection against *Helicobacter pylori* infection, age-related diseases, type 2 diabetes, cardiovascular disease, metabolic syndrome and oral cancer.

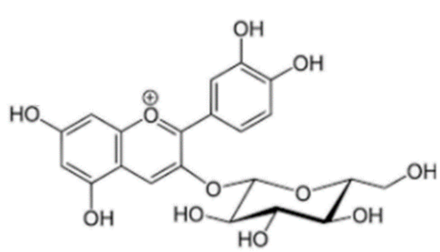

Figure 4 – Asterin, anthocyanin from sugarcane juice

Sugarcane juice also contains carotenoids, which occur in chloroplasts, in association with chlorophyll[44]. Carotenoids act with numerous functions in the human body, and many of them are precursors of vitamin A[45]. There is still a lack of studies that clarify the peculiar structures in which they occur in sugarcane juice. To date, it is relevant to note that sugarcane juice has been widely researched as a medium for fermentation by genetically modified strains *of Saccharomyces cerevisiae* for the purpose of obtaining high yield in ß-carotene and other carotenoids[46]. Thus, it can be admitted that Caná, as fermented sugarcane juice, has potential for aggregation of technology associated with relevant levels of carotenoids.

7. Chlorophyll

The green color of sugarcane juice is mainly attributed to its chlorophyll content, the nutraceutical effects of which are widely known[47,48]. The stem of sugarcane is rich in chlorophyll; however, its original structure is affected as a result of the grinding carried out to extract the broth, due to the disintegration of chloroplasts[44]. In addition, being insoluble in water, chlorophyll tends to separate from the broth, by natural decantation or as a result of clarification procedures. These factors reduce the potential relevance of the original chlorophyll of sugarcane juice in relation to other plant sources.

8. Conclusion

The nutraceutical potential of sugarcane juice has already been pointed out, based on the presence of caffeic, synapic and chlorogenic acids and the flavonoids apigenin, luteolin, diosmetin, vitexin, tricin and asterin.

Integrating the class of phytophenolics, these compounds have aroused great scientific interest around the world – both for nutritional and medicinal purposes. In Brazil, research has been sporadic and random, without evidencing a consistent effort to value the dozens of varieties cultivated throughout the length and breadth of the Brazilian territory. However, these studies are essential to support and validate the production of fermented sugarcane juice (Caná), giving it a status of appreciation similar to that of fermented grape juice (wine). Finally, it should be noted that, although it already exists in some countries (Congo, Philippines, Jamaica), the extensive production of fermented sugarcane juice in hundreds of stills throughout the country will be covered with multiple peculiarities that will characterize it, in fact, as the first fermented drink of genuinely Brazilian conception.

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