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Screening of the Phytochemicals of Sugarcane juice and its Potential Health Aspects

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ABSTRACT

Originally from tropical South Asia and Southeast Asia, sugarcane (Saccharum officinarum Linn.) is a significant perennial grass of the Poaceae family. Due to the high yielding plant's valuable medical and economic products, it is grown all over the world. Sugarcane juice is widely recognized as a raw material for the manufacturing of refined sugar. Although the main end result of sugarcane juice is refined sugar, additional important products including brown sugar, molasses and jaggery can also be produced during processing. In India, sugarcane juice is frequently used to cure urinary illnesses such anuria, dysuria, bleeding, and jaundice. In the present work, the many phytoconstituents and health advantages of sugarcane and its useful products are fatty acids, alcohol, phytosterols, higher terpenoids, flavonoids, -O- and -C-glycosides phenolic acids and its derivatives have been found in sugarcane leaves, juice and wax. The wax from sugarcane juice is being studied as a possible replacement for pricey carnauba wax, which has aesthetic and medicinal uses.

KEYWORDS: *Sugarcane juice, Phytochemical Profile, Sugarcane Wax, Health Aspects*

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INTRODUCTION

The Poaceae family of plants includes the well-known crop sugarcane (*Saccharum officinarum Linn.*). After Brazil, India is the second-largest producer of sugarcane. (James, 2004) The name "saccharum" comes from the Greek "sakcharon," which implies sugar, particularly sucrose. A perennial grass native to tropical South and Southeast Asia is *S. officinarum Linn*. Due to its high sucrose content, it produces a thick longitudinal stalk that is typically three to five meters tall and five centimeters in diameter. It is distinguished by its sweet flavor. Noble cane

and chewing are some names for it. Tropical and subtropical climates are ideal for the growth of the sugarcane crop. It will need a hot, humid climate, well-drained soil with a pH of 7.5 to 8.5 and rich organic matter (Koh et al., 2009). Around the world, sugarcane has been utilised to treat a variety of illnesses. Sugarcane is utilised as a solo medicament or in combination with other plant elements in the Ayurvedic medical system (Anis, 1986; Vedavthy, 2010). Because of its diuretic properties, sugarcane juice has been advised by several indigenous and traditional healers across the world. (Cáceres et al., 1987; Karthikeyan, et al., 2010) It is believed that drinking sugarcane juice regularly will keep the urine flow quick and clean, further assisting the kidneys in carrying out their duty. For improved outcomes, it is occasionally used with lime juice and ginger juice. It is also employed as a tonic, cooling agent, laxative, demulcent, and aphrodisiac (Khare, 2007).Sugarcane juice is recommended for patients with jaundice in the Unani school of medicine. It is advised that jaundice sufferers consume a significant amount of sugarcane juice for quick alleviation since it is thought to be healthy for the liver. Modern pharmacological research has shown that sugarcane has a variety of bioactivities, including anti-inflammatory, analgesic, antihyperglycemic, diuretic, and hepatoprotective properties. These findings validate the assumptions of these old Indian medical systems. Although the primary components of sugarcane juice were found to include apigenin, tricin, and lute line glycosides including orientin, vitexin, schaftoside, and swertisin, diverse policosanols and steroids were also identified in various regions of *S. officinarum.* It has been highlighted that in recent years, a lot of attention has been dedicated to the examination of some lead molecules, this cheapest crop, for the treatment of various diseases because of their bioactivities and chemical components. We have attempted to condense the chemical composition and pharmacological properties of sugarcane and its byproducts in the current study.

MATERIALS AND METHODS

Plant collection

The sugarcane stem was procured from the Mullana Ambala campus of MMDU. The harvested plant stem was processed in accordance with protocol. To expose a greater surface area for drying, the bark was thoroughly cleaned, peeled, and chopped into pieces. An electrical blender was used to ground the chopped pieces into a powder after they had been dried in an oven at 55°C.

Plant Extraction

The powdered substance (800g) was extracted using one liter of 70% ethanol in a conical flask. The conical flask was occasionally manually stirred with a sterile rod following a thorough shaking, sealing with a rubber cork, and allowing it remain at room temperature for 24 hours. The substance was filtered using Whatmann No.1 after 24 hours. I used clean filter paper. The resulting residue was concentrated in a water bath. The% yield of the extract was calculated using the technique.

Percentage yield of the extract = [Weight of extract / Weight of sample of sugarcane] x 100.

Microorganisms

Escherichia coli, Pseudomonas aeruginosa a (Gram negative bacteria), and *staphylococcus aureus* were the only microorganisms tested to test the sugarcane bark extract's antibacterial properties (Gram positive bacterium). All of the organisms were isolated pure indigenous cultures from the Peace Diagnostic Centre in Awka.

Phytochemical Analysis

For the qualitative identification of alkaloids, tannins, saponin, flavonoids, cardiac glycoside, reducing sugars, carbohydrates, and anthracine glycosides, the powered extract conducted the following phytochemical analysis:

Determination of Alkaloids

The extract (0.5 g) was boiled and filtered after being diluted with 10ml of acid alcohol. The alkaloidal base was extracted using 2 cc of diluted ammonia that was added and gently agitated. 10ml of acetic acid were used to extract the layer of chloroform. There were two parts to this. To one part, Meryer's reagent was applied, and to the other, Wagner's reagent. Wagner's reagent or Meryer's reagent's ability to produce a cream or reddish brown precipitate was considered indicative of the presence of alkaloids (Evans, 1989; Oluduro, 2012).

Test for Saponins

As a screening test for saponins, the capacity of saponins to induce foaming in aqueous solution was employed. In a test tube, distilled water was agitated with powdered extract (0.5 g). Warming-induced foaming was interpreted as saponin-presence evidence (Sofowora, 1982).

Determination of Tannins

The extract (5 g) was mixed with 100 ml of distilled water, filtered, and the filtrate was then mixed with ferric chloride reagent. A blue-black green precipitate showed that tannins were present (Evans, 1978).

Determination of Flavonoids

A 2.0 g powdered sample mixed in acetone. To ensure that all traces of acetone were removed, the sample was immersed in a hot water bath. The detanned sample was mixed with boiling distilled water. While still heated, the mixture was filtered. After allowing the filter to cool, 5 ml of 20% sodium hydroxide was added to the filtrate in an equal proportion. Having flavonoids means the solution become yellow (Evans, 1998).

Test for Cardiac Glycosides (Keller-Killani Test)

A drop of ferric chloride solution was added to 2 ml of glacial acetic acid, which was used to treat the extract (1.0 g). This had 1 cc of pure sulfuric acid below it. The interface shows a brown ring that deoxysugar, a glycoside property, is present. Below the brown ring, a violet ring may emerge, and in the thin acetic acid layer, a greenish ring may grow gradually.

Detection of Carbohydrates

After being diluted in 5 ml of distilled water, 1.0 g of the extract was filtered. The filtrate was split into two parts, and the following chemicals were employed to check for the presence of carbohydrates in each fraction.

Molisch's Test

Two drops of an alcoholic-naphthol solution were added to the filtrate in a test tube. At the intersection, the development of a violet ring denotes the presence of carbs.

Fehling's Test

Filtrate was heated with Fehling's A and B solutions after being neutralised with alkali and hydrolyzed with dilute HCl. The presence of reducing sugars is indicated by the precipitation of brick red colour.

Test for Anthracene Glycosides (Born Trager's Test)

A dry test tube containing the extract was filled with 10 ml of chloroform and around 10 mg of the extract. After shaking the mixture for five minutes, Whatmann No. 1 filter paper was used to filter it. An equivalent amount of ammonia solution was added to 3 ml of the filtrate and shaken. There are free anthracene glycosides present when the top aqueous layer has a strong pink-red hue (Evans, 2002).

Antimicrobial Assay

Preparation of Antibiotic Discs

0.5, 1.0, and 1.5 g of the concentrated ethanolic extract of sugarcane bark were dissolved individually in 5.0 ml of distilled water to produce concentrations of 10, 20, and 30%, respectively. We cut out filter sheets with defined diameters and soaked them in various extract concentrations.

Preparation of Nutrient Agar Medium

In a conical flask that had already been sterilized, 7.0 g of nutritional agar was dissolved in 250 ml of distilled water after heating in a water bath for around 45 minutes. After the conical flask was corked and the agar had soaked for 10 minutes, it was sterilized and then heated till boiling on a Bunsen burner. Each sterile disposable petri dish received 25 ml of the agar, which was then allowed to gel for 12 hours after being cooled to roughly 37^0C.

Inoculating/Culturing of Microorganisms

The organism (inoculum) was initially created as a primary inoculum on the medium, and then it was streaked throughout the entire Petri plate. The three different organisms (*Escherichia coli, Pseudomonas aeruginosa,* and *Staphylococcus aureus*) were transferred into their respective growth conditions using this method. Using sterile forceps, the antibiotic (antimicrobial discs) were applied to the inoculated organisms (in the center of the medium). The varied bacteria and antibiotic disc concentrations were noted on the Petri plates' labels. For 24 hours, the organisms were incubated at 37°C. Their percentage zones of inhibition were estimated after determining their zones of inhibition in cm. The disc utilized had a 2.40 cm diameter.

Phytochemical profiles of sugarcane juice and its potential health aspects

Chemistry of sugarcane juice: - Sugarcane juice is the first material used for the production of sugar and other various valuable products like raw sugar/brown sugar, jaggery and molasses. Although these products are prepared from the same source, their method of processing is different, as shown in Figure 1. Furthermore, to understand the phytochemistry of jaggery (noncentrifugal sugar), brown sugar, and molasses, it is necessary to explain the phytochemical profile of sugarcane juice. Sugarcane juice is obtained by grinding the sugarcane culms. Basically it comprises of 70 - 75% water, 13 - 15% sucrose, and 10 - 15% fiber. Before 1971, it was assumed that the color of juice might be due to the presence of plant pigments. In 1971, several color components from sugarcane juice have been identified, with chlorogenic acid, cinnamic acid, and flavones being some of them (Faber et al., 1971). Following that, all the colored components from sugarcane juice were classified into four major classes: Plant pigments, polyphenolic compounds, caramels, and degradation products of sugars condensed with amino derivatives. Sugarcane juice was then extensively studied for their flavonoid content. Thereafter, a large number of old and new flavonoids were isolated and identified (Smith & Paton, 1985; McGhie, 1993; de Armas et.al., 1999). High-Performance Liquid Chromatography with Diode-Array Detection (HPLC-DAD) analysis of phenolic compounds from sugarcane juice showed the presence of phenolic acids such as hydroxycinnamic acid, sialic acid, and caffeic acid, along with flavones such as apigenin, lutein and tricin (Figure 2). Among the flavones, tricin derivatives accounted for the highest concentration (Maurício et al., 2006). Extensive chromatographic and spectroscopic studies indicated the presence of various -O- and -C-glycosides of the above-mentioned flavones, and 3947 were identified (Vila et al., 2008) (Figure 2). Four new minor flavones swertisin, tricin-7-O-neohesperoside-4"-O-rhamnoside, tricin-7-Omethylglucuronate-4"-O-rhamnoside, and tricin-7-O-methylglucuronide were isolated and identified from sugarcane juice (Colombo et al., 2009). In addition, some novel acylated flavone glycosides, such as, tricin-7-O-β-(6"-methoxycinnamic)-glucoside, luteolin-8-Crhamnosyl glucoside, and tricin-4"-O-(erthroguaicylglyceryl)-ether were isolated, along with orientin, from sugarcane juice (Duarte-Almeida et al., 2007).

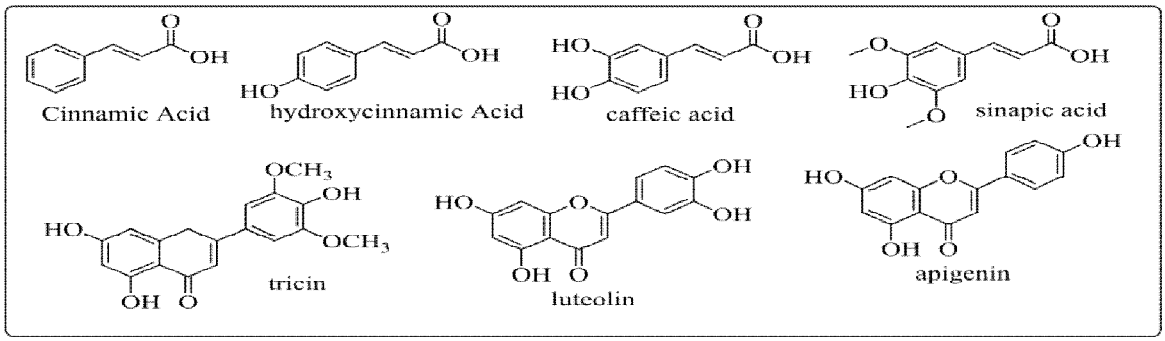

Figure 1: Phenolic compounds identified from sugarcane juice Phenolic acids; Flavones

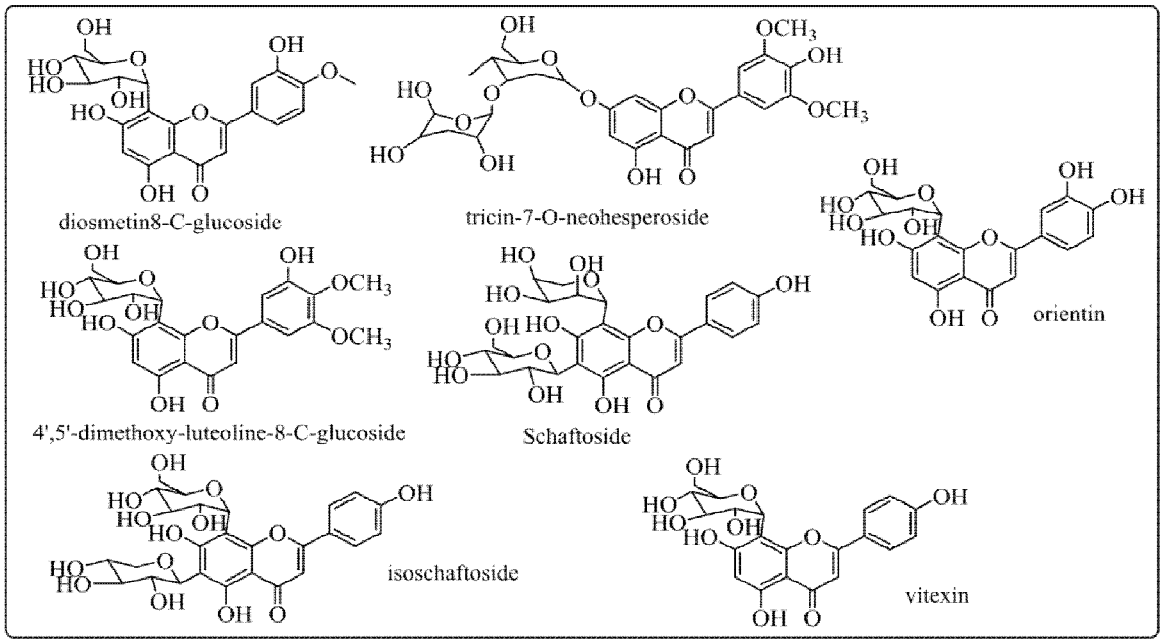

Figure 2: Flavone glycosides identified from sugarcane juice and from sugarcane leaves

Toxicity profile of sugarcane juice

Sugarcane juice contains some polycyclic aromatic hydrocarbons (PAHs). Food processing and cooking are the major sources of PAHs, which are created through incomplete combustion of organic materials. The majority of the sugarcane plantation is burned during harvest, and this burning is a significant source of PAHs. Four PAHs, including benzo (a) anthracene, benzo (b), fluoranthene, and benzo (k), fluoranthene, were found in sugarcane juice collected throughout the harvest season, according to an HPLC study of juice collected at various times (Silvia et al., 2009)

RESULTS AND DISCUSSION

Phytochemical analysis of the bark of *Saccharum officinarum* is shown in the Table 1. Represent Presence and absence of the phytochemical Saponin, tannins, flavonoids, alkaloids, cardiac glycosides, reducing sugars, and anthracene glycosides (SHAH et al, 2021).

Table 1: Phytochemical analysis of the aqueous ethanolic extract of the bark of *Saccharum officinarum*

Phytochemical	Observation
Saponin	+
Tannons	+
Flavonoides	+
Alkaloids	-
Cardiac glycosides	-
Reducing sugars	+
Carbohydrates	+
Anthracene glycosides	+
Note. + = Indicate; - = Not indicate	

Antimicrobial Activity of *Sacchaarum officinarum* against Bacteria

Sacchaarum officinarum having antimicrobial activity against microbes. Below in table 2 ethanolic extract of the bark of *Sacchaarum officinarum* having antimicrobial activity against *Escherichia coli, Pseudomonas aeruginosa and Staphylococcus aureus.* The result shows that the extract had inhabitory effects on the gram negative bacteria (*Escherichia coli* and *Pseudomonas aeruginosa*) and mild effect on *Staphycococcus aureus* (Gram positive bacterium). The inhibitory effect was highest for *Pseudomonas aeruginosa* and had a dose dependent action. The higher doses gave a greater zone of inhibition. This was in the reverse for *Escherichia coli* where higher doses gave a reduced zone of inhibition. Increased doses of the extract showed no inhibitory activity on *Staphylococcus aureus*.

Table 2: Antimicrobial activity of the ethanolic extract of the bark of *Sacchaarum officinarum* on the different organisms

Organism	% conc. of extract	Zone of inhibition	% Zone of inhibition
Escherichia coli	10	1.10	45.83
	20	0.90	37.50
	30	0.60	25.00
Pseudomonas aeruginosa	10	1.10	45.83
	20	1.20	50.00
	30	1.30	54.16
Staphylococcus aureus	10	0.1.	4.17
	20	0.00	0.00
	30	0.00	0.00

DISCUSSION

Microbial infections are common among the human population. A lot of efforts have been made in containing these infections. The first line of action is usually the use of synthetic antibiotics. Recently, there has been a growing trend of antibiotic resistance thereby rendering some of these antibiotics ineffective. In addition to this, some of these synthetic antibiotics have dangerous side effects. For example, parabens are widely used as preservatives by cosmetic and pharmaceutical industries basically because of their bactericidal and fungicidal properties. However, their use is becoming increasingly

controversial because they have been found in breast cancer tumors (an average of 20 nanograms / g of tissue) (Harvey & Everett, 2004; Darbre et al., 2004). They have also displayed the ability to slightly mimic estrogens (a hormone known to play a role in the development of breast cancer) (Harvey & Everett, 2004). Although there has not been a report of a direct link between parabens and cancer, a lot of caution is still needed in their use. All these drawbacks in the use of synthetic antibiotics call for an alternative approach and plant based therapies provide this platform. The bark of sugarcane demonstrated a strong antibacterial activity on the gram negative bacteria indicating its high antibacterial potential and effectiveness in the treatment of wound infections. *P. aeruginosa* showed the highest zone of inhibition at the highest concentrations of the extract tested (30%). This suggests that higher concentrations of the extract may be needed to inhibit the growth of *P. aeruginosa* but once the threshold is attained, it becomes very sensitive. The antibacterial effect of the extract was minimal for *S. aureus* suggesting some degree of resistance by the organism.

The result of the phytochemical screening revealed the presence of saponins, tannins, flavonoids, reducing sugars and carbohydrates. Saponins, tannins and carbohydrates were strongly indicated while alkaloids and cardiac glycosides were absent. These phytochemicals have been suggested to be responsible for the antimicrobial effect of some plant extracts (Ankri & Mirelman, 1999; Cushnie & Lamb, 2005; Ratrout et al., 2009; Mahesh & Satish, 2008). Flavonoids have been reported to possess many useful properties including enzyme inhibition, anti-inflammatory activity, oestrogenic activity, antimicrobial activity (Havsteen, 1983; Harbone & Baxter, 1999), antiallergic activity and antioxidant activity (Abbas et al., 2013). The antibacterial activity of flavonoids is being increasingly documented. Extracts from plants with a history of use in folk medicine have been screened in vitro for antibacterial activity by many research groups (Cushnie & Lamb, 2005). Some of the proposed mechanisms for the antibacterial activity of flavonoids include; inhibition of nucleic acid synthesis (Mori et al., 1987), inhibition of cytoplasmic membrane function and inhibition of energy metabolism (Tsichuya & Linama, 2000)).

Saponins have also been reported to have antibiotic activities. (Soetan et al., 2014) evaluated the antimicrobial activity of saponin extract of *Sorghum bicolor* L. They were able to show that the n – butanol purified saponin extract of *S. bicolor* had inhibitory effect on gram negative organisms.

CONCLUSION

The modern phytochemical and pharmacological reports on the sugarcane crop and its different products, used as food in India, were reviewed. Sugarcane juice is commonly known as a nutritional drink in India and is considered a unique source of variable contents of different hydrophilic components, with significant biological activities. Sugarcane juice and its unrefined products such as brown sugar, molasses, and jaggery are the richest source of phenolic compounds, such as phenolic acids, flavonoids, and different glycosides. These components justified their presence in the juice by showing significant pharmacological results. As future investigations continue, *S. officinarum* and its products may prove to be a rich source of new compounds and there is a wide scope for investigating more activities from the compounds isolated from this cheapest source.

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