Antibacterial Potential of Cashew Apple (*Anacardium occidentale* L.) Juice Against Clinical Isolates of *Staphylococcus aureus* and *Streptococcus mutans*

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**Abstract**

The aim of the present study was to determine antibacterial potential of cashew apple juice against clinical isolates of *Staphylococcus aureus* and *Streptococcus mutans*. Agar well diffusion assay was employed to screen the antibacterial efficacy of the condensed cashew apple juice. Clinical isolates of *S. aureus* were more susceptible than that of *S. mutans* isolates. It is concluded that cashew apple juice contain antibacterial principles having potential to inhibit human pathogens. Further studies are under progress to isolate bioactive components and determine their antibacterial activity.

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**INTRODUCTION**

Cashew (*Anacardium occidentale* L.) belongs to the family Anacardiaceae and is native to Brazil. It is one of the most important plantation crops in India, Brazil, Nigeria and Vietnam. It is grown for the nuts (true fruit) having an exclusive fine taste and a commercial importance of its own. However, the edible cashew apple (the thick receptacle or 'false fruit' to which the cashew nut or true fruit is attached) has high nutritive values such as high vitamin C content, minerals such as calcium, phosphorus, iron etc. The cashew apple has found several applications in food industries and in breweries. It can be eaten as natural and also as juice, pulp, wine etc (Mohanty *et al.*, 2006; Lowor and Agyente-Badu, 2009; Marc *et al.*, 2011). The cashew apple is reported to possess several biological activities such as antimicrobial (Muroi *et al.*, 1993; Kubo *et al.*, 1999; Gonçalves and Gobbo, 2012), antioxidant (Gordon *et al.*, 2012; Daramola, 2013), antitumor (Kubo *et al.*, 1993), antimutagenic (Cavalcante *et al.*, 2005). In the present study, we investigated inhibitory effect of condensed cashew apple juice against isolates of *Streptococcus mutans* and *Staphylococcus aureus* recovered from dental caries and burn subjects respectively.

**MATERIALS AND METHODS**

**Collection of Cashew Apples**

The ripe cashew apples were collected at a place called Maragalale, Thirthahalli (Taluk), Shivamogga (district), Karnataka (State), India. The cashew apples were brought immediately to laboratory and washed well with clean water to remove extraneous matter.

**Extraction of Juice**

In order to obtain the juice, the cashew apples were cut into small pieces and the juice was extracted in a blender (without using water). The juice was filtered through 4-fold sterile muslin cloth. Further, the juice was condensed to 1/10th of the original volume and used for determining antibacterial activity.

**Antibacterial Activity of Cashew Apple Juice**

Agar well diffusion assay was employed to determine antibacterial activity of condensed cashew apple juice. A total of 8 clinical strains of bacteria which comprised of 4 isolates of *Streptococcus mutans* (recovered from dental caries subjects) and 4 isolates of *Staphylococcus aureus* (recovered previously from pus samples of burn patients) were screened for their susceptibility to...
condensed cashew apple juice. The test bacteria were inoculated into sterile Nutrient broth tubes (in case of S. aureus isolates) and sterile Brain heart infusion broth tubes (in case of S. mutans isolates) and incubated overnight at 37°C. The broth cultures of S. aureus and S. mutans were then swabbed aseptically on sterile Nutrient agar plates and Brain heart infusion agar plates respectively. Well of 6mm diameter were punched in inoculated plates with the help of sterile cork borer and cashew apple juice and tetracycline (reference antibiotic) were added into respectively labeled wells. The plates were incubated at 37°C for 24 hours in upright position and the zone of inhibition was measured (Kekuda et al., 2012).

RESULTS
Table 1 depicts antibacterial activity of condensed cashew apple juice against clinical isolates of Streptococcus mutans. All the bacterial isolates were found to be susceptible to condensed juice (zone of inhibition 1.4 to 1.7cm). Inhibition of S. mutans isolates was higher in case of reference antibiotic than the condensed juice.

| Test Bacteria | Zone of inhibition in cm |
|---------------|--------------------------|
|               | Cashew Apple Juice       | Tetracycline |
| Sm-01         | 1.6±0.03                 | 2.9±0.07     |
| Sm-02         | 1.7±0.10                 | 2.7±0.04     |
| Sm-03         | 1.4±0.05                 | 2.6±0.11     |
| Sm-04         | 1.5±0.04                 | 3.1±0.09     |

The result of inhibitory efficacy of cashew apple juice against clinical isolates of Staphylococcus aureus is shown in Table 2. All isolates have shown susceptibility to condensed juice (zone of inhibition ranging 2.6 to 3.6cm). Three out of four isolates of S. aureus were inhibited to high extent by condensed juice when compared to reference antibiotic.

| Test Bacteria | Zone of inhibition in cm |
|---------------|--------------------------|
|               | Cashew Apple Juice       | Tetracycline |
| Sa-01         | 3.6±0.20                 | 3.1±0.12     |
| Sa-02         | 3.5±0.09                 | 2.7±0.17     |
| Sa-03         | 2.8±0.12                 | 2.4±0.08     |
| Sa-04         | 2.6±0.15                 | 3.3±0.22     |

DISCUSSION
Dental caries is an infectious, transmissible disease of oral cavity affecting people of all age group. Mutans group of Streptococci in particular S. mutans are considered as principal agents causing the disease (Chaiya et al., 2013). Various parts such as nut shell, stem bark of A. occidentale have shown to possess inhibitory activity against S. mutans. The phenolic compounds isolated from the nut shell oil of A. occidentale showed inhibition of S. mutans (Himejima and Kubo, 1991). Muroi and Kubo (1993) showed the bactericidal activity of anacardic acids from A. occidentale against S. mutans. Pereira et al. (2006) showed in vitro inhibition of clinical isolates viz., Streptococcus mitis, Streptococcus mutans and Streptococcus sanguis by stem extract of A. occidentale. Melo et al. (2006) showed the efficacy of stem bark extract of A. occidentale extract against S. mutans. Akinjogunla et al. (2012) showed the efficacy of Ethanolic stem extracts of A. occidentale against S. mutans associated with dental caries. In the present study, the condensed juice of cashew apple demonstrated inhibitory activity against clinical isolates of S. mutans recovered previously from dental caries subjects.

S. aureus is a Gram positive opportunistic human pathogen. It is one of the most important bacteria isolated from Burn patients and is a common cause of community and hospital acquired infections involving skin infections and septicemia (Revazishvili et al., 2006; Hoerlle and Brandelli, 2009; Chakraborty et al., 2011). Multidrug resistant strains of S. aureus are being reported frequently from burn patients (Beheshti and Zia, 2011; Rajput et al., 2008; Chakraborty et al., 2011). It has been found that A. occidentale possess inhibitory efficacy against S. aureus. Aqueous extract of leaf of A. occidentale showed inhibitory activity against S. aureus (Satish et al., 2008). Jayalakshmi et al. (2011) found higher inhibitory activity of methanol extract of A. occidentale leaf than ethyl acetate. Petroleum ether and chloroform extracts were not effective. Nut shell liquid of A. occidentale was shown to possess inhibitory activity against Methicillin resistant S. aureus (Parasa et al., 2011). In another study, Ethanolic extract of leaf and bark of A. occidentale were more inhibitory against S. aureus than that of aqueous extract of leaf and bark (Arekemase et al., 2011). In our study, the condensed juice of cashew apple was found to possess marked inhibitory activity against S. aureus isolates recovered from pus samples of burn subjects.

CONCLUSION
In the present work, the condensed Cashew apple juice showed antibacterial activity against the clinical isolates of S. aureus and S. mutans. The inhibition of S. aureus isolates was marked when compared with inhibition of S. mutans isolates. The cashew apple can be utilized in the development of new antibacterial agents.
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