

Antibacterial activity of *Sechium edule* (Jacq.) Swartz against gram negative food borne bacteria

Sibi G¹, Kalpana Kaushik¹, K. Dhananjaya¹, K. R. Ravikumar¹ and H. Mallesha²

¹R and D Centre, Robust Materials Technology Pvt. Ltd, Bengaluru, Karnataka, India

²R and D Centre, Robust Herbs Pvt. Ltd, Bengaluru, Karnataka, India

ABSTRACT

Sechium edule (Cucurbitaceae) commonly called as chayote is commonly eaten for its fruits, young leaves, shoots, stems and tuberous roots around the world. In the present study, various solvent extracts of *S. edule* fruits (pulp and seed) were tested against the food borne bacteria. Phytochemical analysis of the fruit extracts were done and revealed the presence of alkaloids, flavonoids, saponins and terpenoids. Among the various extracts tested, chloroform and methanolic extracts exhibited antibacterial activity against most of the Gram negative bacteria tested (*Escherichia coli* ATCC 8739, *Salmonella typhimurium* ATCC 3224 and *Shigella flexneri* ATCC 12022). None of the extracts were able to control the growth of Gram positive bacteria throughout the study. *E. coli* ATCC 8739 was the most sensitive organism to both chloroform extract of pulp and seed (16.7 and 12.6 mm) followed by *S. typhi* (9.0 and 14.4 mm) and *S. flexneri* ATCC 12022 (10.3 and 6.7 mm). A significant activity against *E. coli* ATCC 8739 (19.3 mm) was exhibited by methanolic pulp extract.

Keywords: *Sechium edule*, chayote, food borne pathogens, Gram negative, antibacterial

INTRODUCTION

Food borne illness has been dramatically increased in the recent years and microorganisms play a major role in food spoilage. Controlling the growth of food spoiling and pathogenic microorganisms by physical and chemical procedures helps to produce microbiologically stable foods [1, 2]. But the resistance increase among diverse bacterial pathogens greatly affects the ability to control them. Further, the indiscriminate use of chemical preservatives has been cause of the development of resistant microorganisms [3]. Plants are rich in wide variety of secondary metabolites having different structures and action when compared with conventionally used antimicrobials [4, 5]. Use of plant and plant derived products is one promising way to keep control of food borne pathogens.

Cucurbitaceae family includes 130 genera and 800 species have a large range of fruit characteristics which are eaten when mature or immature [6]. *Sechium edule* (Jacq.) Swartz commonly called as chayote is an herbaceous, perennal, monoecious climber. Its young leaves, shoots, stems and tuberous roots are edible and the fruit is consumed in many countries. *Sechium edule* has been reported to have antibacterial [7, 8, 9], antioxidant [10, 11, 12], antihypertensive [13] and antiepileptic [14] activities.

The study was carried out to investigate the antibacterial activity of fruit and seed extract of *Sechium edule* against food borne pathogens.

MATERIALS AND METHODS

Solvent extraction:

Sechium edule fruits were purchased from local market and pulp and seeds were separated, dried, pulverized and extracted with solvents (1:10 w/v) of increasing polarity (petroleum ether, chloroform, ethyl acetate, acetone, methanol and aqueous) at room temperature for 48 hrs. The extracts were filtered using Whatman No.1 filter paper and concentrated to dryness under reduced pressure in a rotary evaporator for further use.

Phytochemical analysis:

Phytochemical analysis of the various solvent extracts of pulp and seed was carried out following previous standard procedures [15, 16 17].

Microorganisms used:

Staphylococcus aureus ATCC 6538, *Bacillus subtilis* ATCC 6633, *Escherichia coli* ATCC 8739, *Salmonella typhimurium* MTCC 3224, *Bacillus cereus* ATCC 10876 and *Shigella flexneri* ATCC 12022 were obtained from American Type Culture Collection (ATCC) and Microbial Type Culture Collection (MTCC), Chandigarh. The bacteria were then standardized by adjusting the bacterial suspension to absorbance reading within the range of 0.08 to 0.10 at OD 625 nm which was equivalent to $1-2 \times 10^8$ CFU/mL.

Antibacterial assay:

The antibacterial activity of different solvents extract of *S. edule* fruit parts against food pathogens were evaluated using well diffusion assay. In brief, 100µl of the appropriate bacterial suspension was inoculated on Mueller Hinton agar using sterile swabs. 20 µl of the extract was added into the 5 mm wells and the plates were allowed for pre-diffusion of the extract before incubation. The diameter of zone of inhibition mean of two replicates \pm SD as indicated by clear area which was devoid of growth of microbes was measured to determine antibacterial activity. The experiment was replicated twice to confirm the reproducible results.

RESULTS AND DISCUSSION

Phytochemical analysis of the extracts revealed that alkaloids, flavonoids, saponins and terpenoids were present in the extracts (Table 1). Among the various extracts tested, only methanol and chloroform extracts exhibited antibacterial activity. None of the extracts were able to control the growth of Gram positive bacteria. Chloroform and methanol extracts were effective against most of the Gram negative bacteria tested (Table 2).

A significant activity against *E. coli* ATCC 8739 (19.3 mm) was exhibited by methanolic pulp extract. Moderate inhibitory activity was observed against *S. typhi* ATCC 3224 (6.1 mm) by methanolic seed extract. Chloroform extract of both pulp and seed demonstrated higher inhibitory activity against all the Gram negative bacteria tested with wide range of zone diameter of inhibition (6.7 to 16.7 mm). *E.coli* was the most sensitive organism to both chloroform extract of pulp and seed (16.7 and 12.6 mm) followed by *S. typhi* (9.0 and 14.4 mm) and *S. flexneri* ATCC 12022 (10.3 and 6.7 mm).

Table 1: Phytochemical analysis of *Sechium edule*

	Extracts	Alk	Fla	Gly	Phe	Sap	Tan	Ste	Ter
Pulp	Pet	-	-	-	-	-	-	-	-
	Chl	-	-	-	-	-	-	-	+
	Eth	-	-	-	-	-	-	-	-
	Ace	+	-	-	-	-	-	-	-
	Met	+	+	-	-	+	-	-	-
	Aqu	+	-	-	-	+	-	-	+
Seed	Pet	-	-	-	-	-	-	-	+
	Chl	-	-	-	-	+	-	-	+
	Eth	-	-	-	-	-	-	-	+
	Ace	-	-	-	-	-	-	-	-
	Met	+	+	-	-	-	-	-	-
	Aqu	-	-	-	-	+	-	-	-

Note: (+) presence (-) absence

In general Gram negative bacteria are more resistant than Gram, positive bacteria due to their phospholipidic membrane and lipopolysaccharide components but in this study Gram negative bacteria were susceptible to the *S.edule* fruit extracts. The presence of terpenoids in the chloroform extract could have attributed antibacterial activity against the food borne bacteria tested. In the present study, flavonoids were found in methanolic *S. edule* fruit extracts. Eight flavonoids have been detected from various parts of *S. edule* [18].

Strains of resistant food borne pathogens to a variety of antimicrobials have become a major health concern [19]. Naturally occurring compounds from plants play a vital role in controlling the growth of food borne microorganisms and *Sechium edule* is one among them. The present study revealed the antimicrobial activity of chloroform and methanolic fruit and seed extracts of *S.edule* against food borne pathogens, Gram negative bacteria in particular. Isolation and identification of the bio-active compounds from *Sechium edule* fruits might be helped to fight against the food borne bacteria.

Table 2: Zone diameter of inhibition in mm

Organisms	Methanol		Chloroform	
	Pulp	Seed	Pulp	Seed
<i>B. cereus</i> ATCC 10876	NA	NA	NA	NA
<i>B. subtilis</i> ATCC 6633	NA	NA	NA	NA
<i>S. aureus</i> ATCC 6538	NA	NA	NA	NA
<i>E. coli</i> ATCC 8739	19.3 ± 0.3	NA	16.7 ± 0.0	12.6 ± 0.7
<i>S. typhi</i> MTCC 3224	NA	6.1 ± 0.4	9.0 ± 0.9	14.4 ± 0.0
<i>S. flexneri</i> ATCC 12022	NA	NA	10.3 ± 0.1	6.7 ± 0.0

Note: NA - no activity

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