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Application of jamun (*Syzygium cumini* Linn) seed extract on cotton fabric for antibacterial activity

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Attempts have been made to use jamun (*Syzygium c*umini Linn) seed extract on cotton fabric to evaluate its antibacterial activity against some Gram positive and Gram negative bacterial strains. Different concentrations of jamun extract (125, 250, 500 and 1000 mg / mL) have been used and zone of inhibition (ZOI) is measured. The findings indicate that jamun seed has an antibacterial effect on bleached cotton fabric at different bacterial strain of *Staphylococcus aureus* (NCIM 2079) and *Streptococcus agalactiae* (NCIM 2401). The antibacterial potential of jamun seed powder is due to the rich bioactive compounds. High inhibition percentage is obtained for 1000 mg/mL seed extract and minimum for 125 mg/mL. *Streptococcus agalactiae* (77% strain) shows the maximum 24 mm ZOI and *Staphylococcus aureus* (55% strain) shows 18 mm ZOI.

Keywords: Antibacterial activity, Cotton fabric, Jamun, *Staphylococcus aureus, Streptococcus agalactiae, Syzygium cumini* Linn

There is a worldwide interest in identifying antibacterial compounds, especially from underutilized fruits, against the increasing resistance of various disease causing organisms. According to the traditional medicinal systems of India, various parts of the plant are claimed to have medicinal properties. There are a huge number of herbal products containing metals and minerals within them. In India due to the diversity in climate, soil, altitudes and other eco-geographical conditions, rich resource of jamun fruits are available. The large number of herbal products has been reported by Parmar *et al.*[1] for the cure of diabetes mellitus in ancient literature. According to Kirtikar and Basu[2], the plant drugs are considered to be less toxic and free from side effects than synthetic drugs. The *Syzygium cumini* (Jamun) of the family Myrtaceae is a large evergreen tree, grown widely in the indegangetic plains and also in the Cauvery delta of Tamil Nadu, India[3]. The seeds of *Syzygium cumini* are known to possess high medicinal value. *Syzygium cumini* (Jamun) seeds have hypoglycaemic [5,11], anti-inflammatory[6,12], antipyretic[7], psychopharmacological[8,13], hypolipidaemic, and antioxidant activities. It grows naturally in tropical as well as in subtropical zones. The juice is carminative, diuretic and gives a soothing effect on human digestive system[9]. The phytochemicals, such as ellagic acid, gallic acid, quercetin and oleanolic acid present in jamun also possess radio protective effects. The juice of ripe fruit is used for preparing sauces as well as beverages. It is also dried with salt and preserved as a digestive powder or *churan.* The bark, flowers and seeds have been used in diabetes for their hypoglycemic activity[10]. Fruits and leaves juices are advocated for dysentry and gingivitis (bleeding gums). Jamun seeds were further reported to have anti-bacterial[14], anti-HIV[15] and anti-diarrhoeal[16] effects. Ahmed and Beg[17] reported that the jamun fruit contains 25% waste; and edible portion containing 80.80% water, 0.70% ash, 0.81% protein, 12.70% sugar (fructose and glucose; no sucrose), 0.63% acidity (sulphuric) and 0.88% (malic) The following composition per 100 g of edible portion was reported[18] for jamun fruits freshly picked at the Lancetilla Experimental Garden, Honduras (1948): moisture 85.8 g; ether extract 0.15 g; crude fibre 0.3 g; nitrogen 0.129 g; ash 0.32 g; calcium 8.3 g; phosphorus 16.2 mg; iron 1.62 mg; carotene 0.004 mg; thiamine 0.008 mg; riboflavin 0.009 mg; niacin 0.290 mg and total ascorbic acid 5.7 mg. The jamun bark contains tannins and carbohydrates, accounting for its long-term use as an astringent to combat ailments like dysentery[19]. However, it is found that underutilized seeds have never demanded attention of the researchers, inspite of being a natural source of treatment for curing various diseases and ailments of the tribal / local inhabitants. Underutilized seeds are superior sources of nutrients and medicine over other commercially used materials[20]. Hence, these underutilized seeds provide unlimited opportunities for screening of new drugs as they are known to possess an array of chemical diversity, which needs to be investigated. To the best of our knowledge, antibacterial activity of alcoholic

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seed extract of jamun has not been reported so far. However, the effect of ethanolic extracts of *Syzygium cumini (jamun)* seed isolated at different temperatures on glucoamylase and antimicrobial activity in vitro was studied. But such type of application of methanolic extract of *Syzygium cumini (jamun)* seed powder on textile application is not found in the literature.

Cotton is a natural fibre and when exposed to environment, it is easily affected by various microorganisms. In order to prevent these attacks by microorganism in cotton fabric, it can be treated with antibacterial agent. Therefore, in the present study, the effect of methanolic extracts of *Syzygium cumini* (jamun) seed isolated at different time intervals (5, 30, 60 and 120 min) has been studied for its antibacterial effects on cotton fabric.

Experimental

The seeds of *Syzygium cumini* were collected from the Siddhalayam, Erode, India at their sequential stages of growth and ripening. The seeds were dried at 30ºC for 12-14 days, grounded to powder form at regular intervals (5, 30, 60 and 120 min after drying) and finally stored in air tight containers until further use. This is because the availability of active substances depends on time interval of jamun seed powder used.

Solvent extraction of *Syzygium cumini* (jamun) seed powder was done by using methanol for purification. The resulting extracts were subsequently subjected to distillation process for the separation of *Syzygium cumini* (jamun) extract and methanol, and finally *Syzygium cumini* (jamun) extract was stored in refrigerator (4°C) until further use. This is done to avoid any chemical degradation of *Syzygium cumini* (jamun) extract.

Bleached cotton fabric was collected from Department of Textile Technology, Bannari Amman Institute of Technology, Sathyamangalam, Tamil Nadu, India. Count of the yarn has been determined in the warp (80s) and weft (70s) direction by following the AATCC TM197-2013 and AATCC TM198-2013 test method respectively. Fabric twist (z twist) was evaluated by using ISO 2061 test method Fabric GSM (110) was determined by using ASTM D751-06 method. EPI (121) and PPI (98) were determined by using ISO 7211-2:1984 test method.

Bleached cotton fabric was treated with jamun seed extract at 40^{o}C for half an hour in a water bath with continuous stirring. After the treatment, cotton fabric was taken out from the bath, washed thoroughly at 30ºC and dried.

Agar Well Diffusion Method

The antibacterials present in the jamun seed extract have been allowed to diffuse out into the medium and interact in a plate freshly seeded with the test organisms. The resulting zones of inhibition occurred uniformly in a circular way and there was confluent lawn of growth. All the bacterial cultures used were grown on nutrient agar medium at *p*H 7.4 and at 37°C. The diameter of the inhibitory zone was measured in mm. All the bioassays were carried out in triplicate to minimize the error.

Before performing Agar well diffusion method, all the glasswares were heat sterilised, and the medium was sterilised by autoclaving and then poured in sterile petri dishes. Petri dishes were labelled as 5 m, 30 m, 60 m and 120 m respectively, indicating the grinding time 5 min, 30 min, 60 min, and 120 min and were swabbed with the bacterial strain [*Staphylococcus aureus* (NCIM 2079)] and [*Streptococcus agalactiae* (NCIM 2401)]. The 55% bacterial strain for NCIM 2079 and 77% bacterial strain for NCIM 2401 were used. Dilutions of extract 125, 250, 500 and 1000 mg / mL were prepared for 5 min, 30 min, 60 min, and 120 min and the zone of inhibition was measured. Then 5 holes were created and the jamun extract was injected through that hole; the concentration of extract was 125, 250, 500 and 1000 mg / mL for 120 min sample. In another petri dish, four bleached cotton pieces with nutrient agar medium were placed and different concentrations were poured on the fabric for 120 min sample. Plates were wrapped tightly and then kept in incubator undisturbed for 24 h. After 24 h those plates were observed for antibacterial activity. The same procedure was followed for 5 min, 30 min and 60 min grinding time, and those results were compared and analyzed.

Results and Discussion

The findings of antibacterial activity of different concentrations of *Syzygium cumini* (jamun) extract against selected bacterial strains for various grinding times are shown in Table 1. Good to moderate activity against both 55% and 77% bacterial strains are observed for the extracts of 120 min, 60 min, 30 min and 5 min grinding time.

High inhibition percentage is observed for 1000 mg/mL *Syzygium cumini* (jamun) extract and

Table 1 — Zone of inhibition for *Syzygium cumini* (jamun) extract samples using methanol solvent

Grinding time min	Extract conc. mg/mL	Diameter of ZOI, mm	
		S. aureus	*S. agalactiae*
5	125	5	9
	250	6	10
	500	8	11
	1000	9	12
30	125	4	9
	250	8	10
	500	9	11
	1000	10	13
60	125	4	10
	250	5	11
	500	8	15
	1000	12	16
120	125	11	18
	250	15	19
	500	12	20
	1000	18	24

minimum is found for 125 mg/mL *Syzygium cumini* (jamun) extract. Superior activity is measured for methanol extracts of *Syzygium cumini* (jamun) seed. Maximum of 18 mm zone diameter for 55% bacterial strain and 24 mm zone diameter for 77% bacterial strain are noticed.

Results obtained with four different concentrations of *Syzygium cumini* (jamun) extract by Agar well diffusion method using 55% and 77% bacterial strain as test microorganisms are shown in Fig. 1.

The availability of active substances is dependent on the time interval of *Syzygium cumini* (jamun) seed powder used. Hence, 2 h samples extracts show high percentage of inhibition against the organisms tested followed by other methanol fractions. Besides, the essential oil of Jamun leaves are also credited to have good antibacterial properties. Bagchi *et al*.[21] also reported considerable activity of *S. Cuminii* against Gram positive and Gram negative bacteria and fungi. Bhuiyan *et al*.[22] showed good antibacterial activity against five Gram positive and nine Gram negative bacterial strains. According to Ahmad and Beg [17], the Gram positive bacteria are considered to be more sensitive as compared to Gram negative because of the differences in their cell wall structures.

This antibacterial activity observed for *S. cumini* thought may be due to the presence of monoterpene aldehydes. Besides, the fruits have been reported to possess other bioactive compounds like citric, mallic and gallic acid as well as phytochemicals, such as anthocyanins, alkaloids, carotenoids, flavonoids,

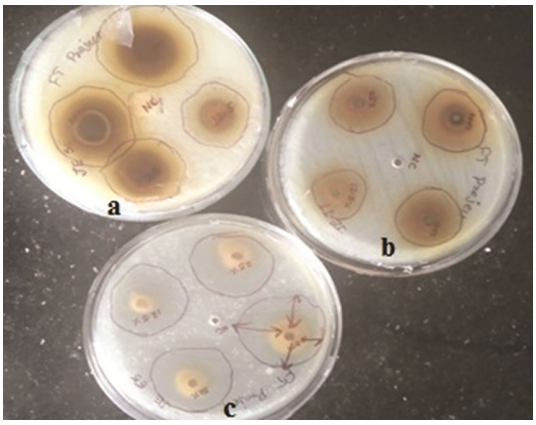

Fig. 1 — Zone of inhibition for four different concentrations of *Syzygium cumini* (jamun) extract by Agar well diffusion method using 55% (a) & 77% (b) bacterial strain; and blank bath (c)

polyphenols and tannins, which are also known to be effective and play an active role as antibacterial substances against a wide array of infectious agents. Thus, the study reveals that *Syzygium cumini* (jamun) seeds have a great potential for antibacterial action. Besides, the particle size of the jamun seed powder also plays an important role in accumulation of those bioactive compounds. Although a large number of natural products have been approved as new antibacterial drugs, still there is an urgent need to identify more novel substances that are active towards pathogens of high resistance.

Jamun seed has an antimicrobial effect on bleached cotton fabric at different bacterial strain of *Staphylococcus aureus* (NCIM 2079) and *Streptococcus agalactiae* (NCIM 2401). High inhibition percentage is observed for 1000 mg/mL *Syzygium cumini* (jamun) seed extract and minimum for 125 mg/ml *Syzygium cumini* (jamun) seed extract. Superior activity is observed at maximum of 24 mm zone diameter for 77% bacterial strain [(*Streptococcus agalactiae* (NCIM 2401)] and at 18 mm zone diameter for 55% bacterial strain [*Staphylococcus aureus* (NCIM 2079)].

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