

Proximal and Phytochemical Analysis of Wild Jack Fruit Seeds (*Artocarpus hirsutus* Lam.), Anti-Diabetic and Anti-Microbial Properties and Formulation of Food Products

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ABSTRACT

BACKGROUND: The present study aims at evaluating the proximal principles, phytochemicals, anti-diabetic and anti-microbial activity of *Artocarpus hirsutus* Lam. (Wild jackfruit) seeds thereafter incorporating the seed powder in food. Negligible studies have been conducted to identify the health benefits of *A. hirsutus* seeds. Hence, an attempt has been made to explore the active principles in the *A. hirsutes* seeds. **METHODS:** The seed powder was extracted using three different solvent extracts viz., methanol, di-ethyl ether and water. The extracts were analysed for phytochemicals (qualitative), proximate principles, anti-bacterial (*Salmonella typhi*, *E.coli*, *Staphylococcus aureus*, *Klebseilla pneumonia*) and anti-fungal (*Trichoderma viridae*, *Aspergillus niger*) properties using agar well diffusion method and anti-diabetic properties using α -amylase and α -glucosidase inhibitor activity. Food formulation was done by incorporating the seed powder in traditional foods followed by organoleptic evaluation. **RESULTS:** The study revealed the presence of phytochemicals such as alkaloids, tannins, sterols and quinine in different solvents and contains greater amounts of carbohydrates and proteins. The study shows the highest anti-microbial activity against *Staphylococcus aureus* and *Trichoderma viridae*. The seeds contain potent anti-diabetic activity. **CONCLUSION:** The study concludes that *Artocarpus hirsutus* seeds are nutritionally enriched and prevents food borne pathogens. The seeds reveal excellent anti-diabetic properties. The seeds are not consumed frequently due to the lack of information on its health benefits. Therefore, the seeds can be incorporated in traditional foods to improve the nutritional quality and enhance the importance of traditional medicines and foods.

KEY WORDS: *Artocarpus hirsutus*, Phytochemical, Anti-microbial, Anti-diabetic, Traditional

1. INTRODUCTION

Artocarpus is a genus of approximately 60 trees and shrubs of South-east Asian and Pacific origin, belonging to the Moraceae family. The name *Artocarpus* is derived from the Greek word *artos* meaning "bread" and *karpos* meaning "fruit". All *Artocarpus* species are laticiferous trees or shrubs that are composed of leaves, twigs and stems capable

of producing a milky sap. *Artocarpus hirsutus* is a widely acknowledged as a rich source of bioactive secondary metabolites such as flavonoids, stilbenes, triterpenoids, and xanthones. The ripe fruit of *Artocarpus hirsutus* is eaten after removing the spiny outer skin. The structure of the fruit is similar to that of the much larger jackfruit. The seeds are also

edible, usually fried as a snack. Its bark cures diabetes, tapeworm infection, anaemia, malarial fever, asthma, dermatitis, diarrhoea, pimples and ulcers. It has a long history of medicinal use in Chinese medicine, as a remedy for many kinds of diseases. *Artocarpus hirsutus* have added a great deal in the field of phytochemistry with regard to their availability of complex phytochemical components, anti-bacterial activity, anti-helminthic, anti-inflammatory, and anti-viral^[1]. Phytochemical screening has been done using the extracts of *Artocarpus hirsutus* leaf, bark and fruit. Negligible number of studies has been done to identify the health benefits of *A. hirsutus* seeds. Hence, an attempt has been made to identify and explore the active principles present in the *A. hirsutus* seeds. Analysis of proximate active principles that is used in development of food products should be brought to the limelight of nutritionists who are on the pathway of improving the community health.

2. MATERIALS AND METHODS

The wild jack fruit seeds were identified and collected from farmers in the district of Thiruvananthapuram, Kerala. The seeds were separated from the fruit and shade dried. Dried seeds were pulverised into fine powdered form and an approximate amount was used to prepare extracts with three different analytical grade solvents of varying polarity such as methanol, di-ethyl ether and water.

2.1 Phytochemical Screening

The phytochemical analysis was performed using all three extracts^[1]. Each extract was subjected to the assays to identify the presence of Alkaloids, Terpenoids, Tannins, Sterols and Quinine.

2.2 Nutrient Analysis

The water extract of the seeds was analysed for the nutrients as water is the

medium of cooking using standard procedures suggested by AOAC (2005). The water extract of the seed powder was quantitatively analysed for carbohydrate, protein, fibre, calcium, sodium and potassium.

2.3 Anti-microbial activity

Anti-bacterial activity of *Artocarpus hirsutus* seed extracts were tested against the following bacterial strains: *Salmonella typhi*, *E. coli*, *Staphylococcus aureus* and *Klebsiella pneumoniae*. Fungal strains of *Aspergillus niger* and *Trichoderma viridae* were used for anti-fungal screening of the seed extracts. All the stock cultures were collected from the Centre for Bioscience and Nano science Research Centre, Coimbatore. 24 hr. old pure cultures were prepared for use each time.

2.4 Bioassay for bacterial strains

The well-diffusion assay was employed in this study. 50 µL of bacterial and fungal cultures aged 18-24 hrs were used. After sterilising the hands with ethanol, the sterilised nutrient agar is poured into 6 petri-plates (4 for bacterial screening and 2 for fungal screening). The plates are allowed to solidify. The solidified agar medium plates are first marked (organism name) under the plate. The organism is then spread in each plate uniformly using a cotton swab. After this, holes were made using 5 mm cork borer and each hole was filled with 25 µL of extracts. The inoculated agar plates were incubated at 37°C for 24 hrs. the zones of inhibition were then recorded in diameter. Two discs were used as standard, Cefotaxime 30 SDO40 – 1CT (bacterial screening) and Ampicillin (fungal screening).

2.5 Anti-diabetic screening

Anti-diabetic activity of the extract was tested for α-amylase inhibitory and α-glucosidase inhibitory activity^[6].

2.6 Food formulation

In order to formulate food products, the *Artocarpus hirsutus* seeds were roasted to remove the outer coat which gives a bitter taste. After cooling the seeds after roasting, it was finely powdered. In food formulation, food products were made by combining the seed powder in specific proportions in a formulation. Incorporation of the seeds powder into South Indian traditional food products like Idly, Chapatti and Steamed cakes was performed. Three categories of seed powder and flour mixtures were formulated. The three categories included three different proportions of seed powder and flour in the ratio of 10:90 (category A), 20:80 (category B) and 30:70 respectively (category C).

The food products developed were subjected to organoleptic evaluation using 9-point hedonic scale covering the aspects of appearance, texture, flavour, aroma, taste and overall acceptability.

2.7 Analysis of data

The data collected were processed and analysed statistically. Sensory evaluation variables were analysed through paired T test using SPSS.

3. RESULTS AND DISCUSSION

3.1 Phytochemical analysis

The *Artocarpus hirsutus* seeds are rich in phenolic compounds. The present study revealed the presence of 'alkaloids and tannins' in aqueous extract, 'alkaloids, tannins, sterols and quinine' in methanol extract, and 'alkaloids and sterols' in di-ethyl ether extract. The results obtained from the qualitative phytochemical analysis are summarized in Table 1.

3.2 Anti-microbial Screening

In the present study, agar well-diffusion method was performed for both anti-bacterial and anti-fungal screening. With this method, the zone of inhibition for *E.coli* was seen to be highest in aqueous extract with a value of 9 mm (Standard anti-biotic disc – 11 mm), *Staphylococcus aureus* in methanol extract with a value of 15 mm (Standard anti-biotic disc – 7 mm), *Klebsiella pneumoniae* in aqueous extract with a value of 10 mm (Standard anti-biotic disc – 14 mm) and *Salmonella typhi* in aqueous extract with a value of 14 mm (Standard anti-biotic disc – 7 mm). For anti-fungal screening, the zone of inhibition for *Trichoderma viridae* in methanol extract was seen to be highest with a measurement of 8 mm. The anti-bacterial screening results are summarized in Table 4. Figure 1 shows the different plates and their zone of inhibition.

3.3 Anti-diabetic Screening

The results of the anti-diabetic screening using both the assays showed very good anti-diabetic property of the seeds. (Annexure 2) are summarized in Table 5.

3.4 Food formulation

Sensory evaluation was performed among 35 subjects with different categories of the food products. Statistical analysis was performed using paired sample 't' test among the different responses. The results revealed that the category C among all the foods (chapati, idly and steam cakes) was statistically found to be more acceptable by the panel. Therefore, it can be concluded that higher concentration of the seed powder incorporated into the food products had better sensory perception than the other concentrations.

Table 1. Qualitative (phytochemical) analysis of *Artocarpus hirsutus* seeds

Compounds	Extracts		
	Aqueous	Methanol	Di-ethyl ether
Alkaloids	+	+	+
Terpenoids	-	-	-
Tannins	+	+	-
Sterols	-	+	+
Quinine	-	+	-

(+ present, - absent)

Table 2. Quantitative (nutrient) analysis of *Artocarpus hirsutus* seeds

Nutrient	Optical Density value	mg/g
Carbohydrate	1.69	303
Protein	1.52	178
Sodium	0.039	28
Potassium	0.022	21
Calcium	0.032	26

Table 3. Percentage of Fibre, Moisture and Ash

Nutrient	Percentage (%)
Fibre	13
Moisture	0.14
Ash	0.02

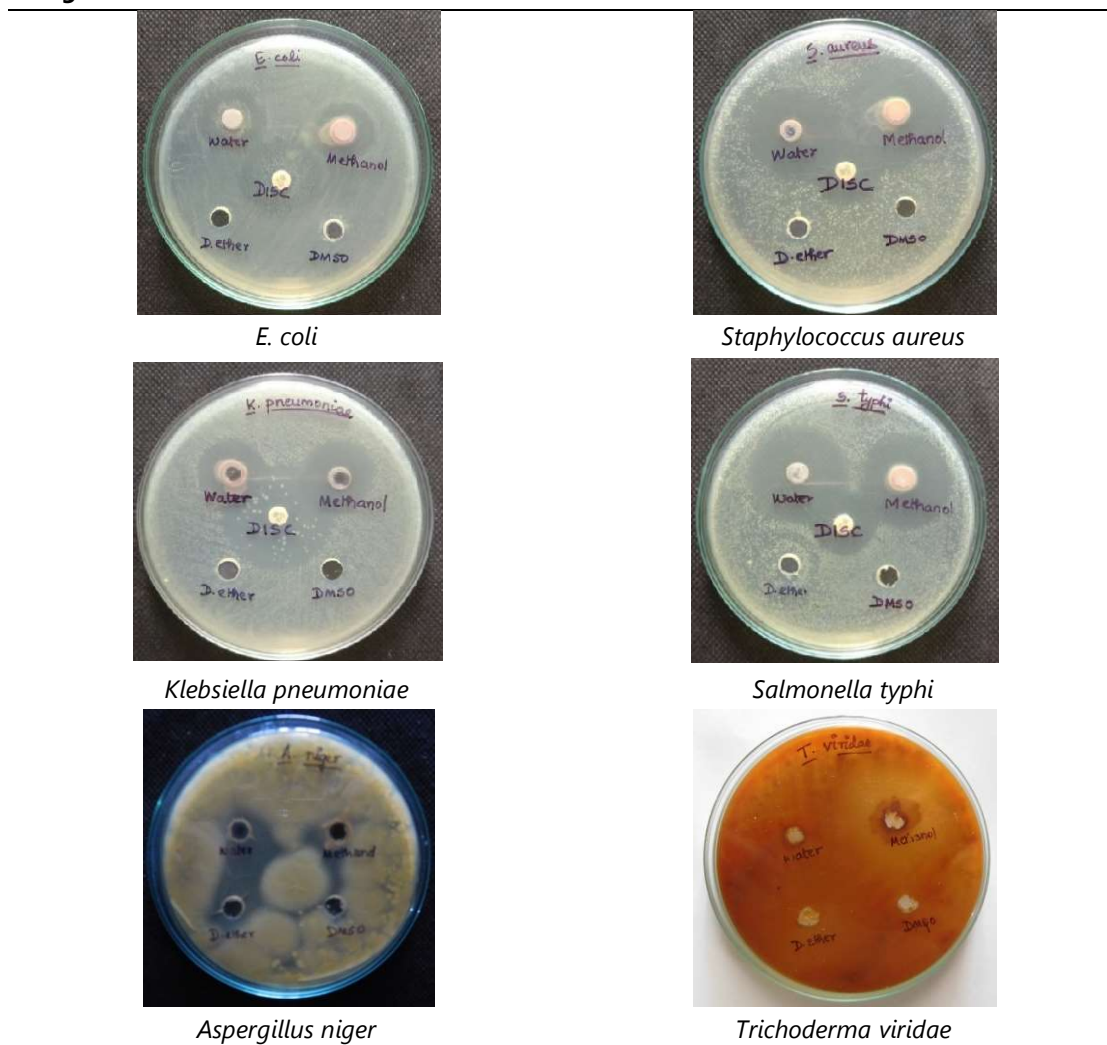
Table 4. Anti-bacterial and Anti-fungal activity – Zone of inhibition

Organism	Extracts			Disc	DMSO
	Aqueous	Methanol	Di-ethyl ether		
<i>E.coli</i>	9 mm	6 mm	3 mm	11 mm	-
<i>Staphylococcus aureus</i>	11 mm	15 mm	3 mm	7 mm	-
<i>Klebsiella pneumoniae</i>	10 mm	8 mm	-	14 mm	-
<i>Salmonella typhi</i>	14 mm	15 mm	-	7 mm	-
<i>Aspergillus niger</i>	5 mm	3 mm	5 mm	-	-
<i>Trichoderma viridae</i>	2 mm	8 mm	-	-	-

Table 5. Optical Density values for Anti-diabetic testing

Assay	Optical Density Value	Control Optical Density Value	% of inhibition
α-Amylase inhibition	0.029	0.631	95.4
α-Glucosidase inhibition	0.067	0.743	90.9

Figure1. Zone of Inhibition of *Artocarpus hirsutus* seeds powder against bacterial and fungal strains



4. CONCLUSION

In the current study, phytochemical analysis reveals the present of phenolic compounds which are known to exhibit medicinal as well as physiological activities.

Nutrient analysis shows that the seed powder is an excellent source of carbohydrate and protein and it also has good anti-bacterial action against food borne pathogens. The study also reveals excellent anti-diabetic

properties of the seeds. The study can be further extended by conducting shelf-life and cytotoxicity studies. Due to the anti-diabetic properties, it can also be subjected to further supplementation studies.

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