ASSESSING THE THERAPEUTIC ROLE OF JOSHANDA: PHYTOCHEMICAL, ANTIOXIDANT, ANTI-INFLAMMATORY AND ANTIMICROBIAL ACTIVITIES

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ABSTRACT

Objective: Joshanda, a polyherbal Unani formulation is extensively used as a common home remedy for the treatment of a cough and cold accompanied by pharyngeal inflammation and fever. This study aimed to analyze phytochemicals, antioxidant, anti-inflammatory, and antibacterial activities by various in vitro standard methods using ascorbic acid, ampicillin, and aspirin respectively as standard drugs.

Methods: The study investigated the presence of phyto-compounds in joshanda and antioxidant, antibacterial, anti-fungal, and anti-inflammatory activities by various in vitro standard methods using ascorbic acid, ampicillin, and aspirin respectively as standard drugs.

Results: Joshanda aqueous extract revealed the presence of tannins, phenols, flavonoids glycocides, terpenoids, and alkaloids and absence of sterols, saponins, xanthoproteins, and carboxylic acid. Joshanda showed the highest inhibition against B. subtilis (% MGI 99.000±0.577) and least inhibition against P. aeruginosa (%MGI of 84.102±0.491). Joshanda extract, ascorbic acid demonstrated highest % DPPH radical scavenging of 98.379±0.313%, 98.043±0.443% and a minimum of 83.192±0.429%. Results showed H₂O₂ scavenging activity of 0.047±0.001 μg/ml per minute degradation of H₂O₂. PRAP value was observed in joshanda and ascorbic acid with a maximum of 0.945±0.024, 0.675±0.047 mmol and minimum of 0.171±0.036, 0.059±0.005 mmol respectively. Joshanda extract showed the highest albumin denaturation inhibition of 14.06±0.350% and the lowest of 1.880±0.194% at extract volume of 1000 µl and 100 µl respectively. The extract demonstrated the highest proteinase inhibition of 24.00±0.291 % and the lowest of 4.959±0.254% comparable to aspirin. Joshanda had no potent anticandidal activity up to 1 mg/ml.

Conclusion: Results clearly suggested that joshanda is a potent phytodrug and can also be used as a strong reactive oxygen species scavenger, might be used as anti-arthritic and strong natural antioxidant agent for effective treatment of various oxidative stressed disorders.

Keywords: Joshanda, Antioxidant, Antibacterial, Anti-inflammatory, Unani, Biological relevance

INTRODUCTION

In the recent years, there has been a great switchover in the universal trend of medicine selection from synthetic to herbal medicine, which indicates "Return to Nature". Medicinal plants have been best known for millenial and are highly important all over the world as a rich source of therapeutic agents for the prevention and cure of diseases and ailments [1]. The global rise in demand for herbal medicines has led to the decline in their quality as there is a lack of adequate regulations pertaining to drugs [2]. World health organization (WHO) has highly emphasized the need to ensure quality control of medicinal plant products by the use of modern techniques and by applying suitable parameters and standards. In order to overcome inevitable shortcomings of the pharmacopeia monograph other different quality control measures must be explored. [3–6]. Out of 255 drugs (which are considered as basic and essential by the WHO, 11% is extracted from plants, and many synthetic drugs are also extracted from natural precursors. Phytochemicals are known to possess antioxidant, antibacterial, antifungal, antidiuretic, anti-inflammatory, and radioprotective activity [7-13], and due to these properties, they are largely used and given preference for medicinal purpose. The development of drug resistance and the undesirable side effects of certain antibiotics have led to the search for new antimicrobial agents, mainly among plant kingdom, to find leads with unique chemical structures which may exert a hitherto unexploited mode of action. Obtaining potential and basic benefits from plants, always been a field of speculation for researchers and has formed the basis for the development of drugs to treat various diseases. Henceforth, screening of plants for the presence of natural products and beneficial properties presents a major avenue. The resistance acquired by microbes to the existing antibiotics demands increased efforts in the development of new antibiotics. Although various plants with antimicrobial potential have been identified, a great number still remains unidentifed. High range of climatic variation from tropical to alpine leads to the richness in biological diversity. Many kinds of plants are pervasive in India and many of them have been used for antimicrobial assay [14]. There is a dire need of extensive hard studies of medicinal plants found with a special reference to their properties to fight against microbial diseases. Therefore, qualitative phytochemical screening of these phytodrugs is a step towards 'cure by nature'. "Joshanda", a Persian word with a meaning "prepare by boiling". Unani medicines are usually taken as aqueous extracts containing some water-soluble organic principles and mostly inorganic ion compounds. The most frequently used formulation of joshanda consists of seven ingredients [35]. Joshanda has been especially used in the treatment of cold, cough, and related allergic disorders. It has been reported to possess antihistamine, antisettive, expectorant, antipyretic, and anti-inflammatory activities [36, 37]. The main composition of joshanda has been given in table 1. In the market, joshanda is available in the form of a dry mixture. This article aims to assess the presence of phytochemicals in the aqueous extract of joshanda. Further, we have assessed the in vitro antioxidant, anti-inflammatory, antibacterial, and antifungal activities of the aqueous extract of joshanda. This is the first report (to the best of our knowledge) till date on this kind of study where the aqueous extract of joshanda was evaluated for various phyto-compounds and biological activities.
MATERIALS AND METHODS

Sample preparation
10 gm of joshanda with all seven components in equimolar ratio were boiled in 200 ml of distilled water at 100 °C for 30 min to make a decoction of final volume 100 ml. The extract was then filtered using a muslin cloth. The filtrate was then centrifuged and the supernatant was obtained. This served as an aqueous extract of joshanda for the further phytochemical screening and in vitro biological studies.

Chemicals and reagents
All the chemicals (analytical grade) used for phytochemical screening, antioxidant, anti-inflammatory and antibacterial assay were purchased from Merck, SRL, and Himedia. DPPH (1,1-diphenyl-2-picrylhydrazyl) and TPTZ (2,4,6-tris (2-pyridyl)-S-triazine) were purchased from Sigma-Aldrich.

Phytochemical screening
Various standardized qualitative chemical tests were performed for qualitative determination of different phytoconstituents present in the aqueous extract of joshanda by the method of Harborne with some modifications [38].

Evaluation of antibacterial potential of joshanda

Test microorganisms
The basic four clinical isolates of bacteria used for the study are Staphylococcus aureus (MTCC 902), Escherichia coli (MTCC 443), and Bacillus subtilis (MTCC 736), Pseudomonas aeruginosa (MTCC 2453). Their cultures were procured from NCCS, Pune, India and maintained on nutrient agar plates at 4 °C.

Broth dilution method
Antimicrobical activity of the aqueous extract of joshanda was tested against four bacterial strains, out of which two of them were gram-positive bacteria (B. subtilis and S. aureus) and the other two were gram-negative bacteria (E. coli and P. aeruginosa) by the method of Barbade and Datar with some modifications [15]. Cultures were prepared overnight in Luria broth (LB) media by inoculation with a single colony from agar plates and incubated for 12 h at 37 °C. These cultures were diluted with fresh LB media to approximately 10^4 colony forming units (CFU) and incubated at 37 °C for 12-14 h in the presence of joshanda extract analogized to the growth of the control culture where media and bacterial inoculums were only taken. The experiment was performed in triplicates (n=3). The percentage inhibition was calculated by using the following formula.

\[
\text{Mean Growth Inhibition} \% = \frac{[\text{Abs}_{\text{control}} - \text{Abs}_{\text{sample}}]}{\text{Abs}_{\text{control}}} \times 100
\]

Where dc and dt represent the absorbance of control and treated sample strains at 600 nm respectively.

Agar well diffusion method
To determine the antibacterial activity of joshanda, agar well diffusion method was used. The log phase bacterial cultures (secondary culture) was spread on LB agar medium plates by using a sterile spreader in order to get a uniform bacterial growth on test plates. A sterile cork borer was used to punch the wells over the agar plates. About 10-20 µl of each extract was added using sterile syringe into wells and kept at room temperature for 2h for diffusion.

Amoxicillin (10 mg/ml) was used as the standard antibacterial drug. The plates were then incubated at 37 °C for 18-24 h. The diameter of the inhibition zone (mm) was calculated. The results (zone of inhibition) were compared with the activity of the standard. The experiment was repeated 2 times for the confirmation.

Determination of anti-inflammatory activity

Inhibition of albumin denaturation
The anti-inflammatory activity by inhibition of albumin denaturation was done using the method of Mizushima et al. [16] with minor changes. A wide range of diluted working solutions of the joshanda and its constituents plants were prepared and mixed with 1% aqueous solution of bovine serum albumin (BSA) fraction. The samples were incubated at 37 °C for 20 min and then heated at 57 °C for 20 min. 1% BSA was taken as control and Tris buffer was taken as blank. Aspirin (100 µg/ml) was taken as a standard drug. After few minutes of cooling the samples, the turbidity was studied at 660 nm. The experiment was performed in triplicates (n=3). Percent inhibition of protein denaturation was calculated by the formula.

\[
\% \text{ inhibition} = \frac{(\text{Abs}_{\text{control}} - \text{Abs}_{\text{sample}})}{\text{Abs}_{\text{control}}} \times 100
\]

Proteinase inhibitory action

The experiment was executed according to the revised procedure of Oyedepo et al. [17]. The reaction mixture (2 ml) contained 1 ml 20 mmol Tris HCl buffer (pH 7.4), 1 ml test sample of different concentrations, and 0.06 mg trypsin. The mixture was incubated at 37 °C for 5 min followed by addition of 1 ml of 0.8% (w/v) casein. The mixture was again incubated for further 20 min. At the end, 2 ml of 70% perchloric acid was added to finish the reaction. The absorbance of the supernatant was read at 210 nm against buffer as blank. After removing the cloudy suspensions through the centrifuge, the experiment was performed in triplicates (n=3). Further, the percentage inhibition of proteinase inhibitory activity was determined by the following formula.

\[
\% \text{ proteinase inhibition} = \frac{(\text{Abs}_{\text{control}} - \text{Abs}_{\text{sample}})}{\text{Abs}_{\text{control}}} \times 100
\]

Determination of antioxidant activity

Catalase (CAT) assay
Catalase activity was assayed following the method of Jambunathan et al. with minor modifications [18]. The mixture was incubated at 37 °C for 5 min followed by addition of 1 ml of 0.8% (w/v) casein. The absorbance of the supernatant was read at 210 nm against buffer as blank. After removing the cloudy suspensions through the centrifuge, the experiment was performed in triplicates (n=3). Further, the percentage inhibition of proteinase inhibitory activity was determined by the following formula.

\[
\% \text{ catalase activity} = \left(1 - \frac{\text{Abs}_{\text{sample}}}{\text{Abs}_{\text{control}}}ight) \times 100
\]

1, 1 Diphenyl-1-(2,4, 6-trinitrophenyl) hydrazyl (DPPH) assay
The antioxidant activity of joshanda was checked on the basis of the free radical scavenging effect of the stable DPPH according to the protocol of Gouveas and Abraham with minor modifications [19]. A wide range of diluted working solutions of joshanda was prepared in distilled water and methanol respectively. 0.1 mmol DPPH was prepared in 80% methanol and 500 µl of this solution was mixed with 500 µl of working sample solutions and standard solution separately. Ascorbic acid (1 mg/ml) in distilled water was used as a standard.
the determination of GSH. The supernatant (0.1 ml) was composed of 1.0 ml with 0.2 M sodium phosphate buffer (pH 8.0). Standard GSH corresponding to concentrations ranging between 2 and 10 moles was also prepared. Two ml of freshly prepared DTNB solution was added and the intensity of the yellow color developed was measured in a spectrophotometer at 412 nm after 10 min. The values were expressed as n moles GSH/g sample. The experiment was performed in triplicates (n=3).

**Determination of antifungal activity**

The determination of the minimum inhibitory concentration of joshanda extract against *Candida* cells (ATCC 10261 and ATCC 90028) by broth dilution was carried by the method given by the Clinical and laboratory standards institute (CLSI). Different cultures were grown with or without test compounds in the media. Two-fold dilutions of the test compound were carried out as an initial step. *Candida* cells (10<sup>6</sup>cells/ml) were inoculated in molten yeast extract peptone dextrose (YPD) agar (~ 40 °C) and poured into Petri plates. Also, the antifungal activity of aqueous extract in solid media was determined by the disc diffusion method. Different concentrations of test compounds were spread on the disc placed on solid agar in 10 μl volume. The average diameter of the zone of inhibition was measured in millimetres. The experiment was performed in triplicates (n=3).

**RESULTS**

**Phytochemical screening**

The phytochemical analysis of the aqueous extract of *joshanda* revealed the presence of phytochemicals. An adequate amount of tannins, phenols, flavonoids glycosides, terpenoids, and alkaloids were found in the aqueous extract. However, screening depicted the absence of sterols, saponins, xanthoproteins, and carboxylic acid. The results obtained are depicted in table 2.

### Table 2: Phytochemical composition of aqueous extract of *joshanda*

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Phytochemical constituent</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Terpenoids</td>
<td>Positive</td>
</tr>
<tr>
<td>2.</td>
<td>Phenols</td>
<td>Positive</td>
</tr>
<tr>
<td>3.</td>
<td>Carboxylic acid</td>
<td>Negative</td>
</tr>
<tr>
<td>4.</td>
<td>Flavonoids</td>
<td>Positive</td>
</tr>
<tr>
<td>5.</td>
<td>Glycosides</td>
<td>Positive</td>
</tr>
<tr>
<td>6.</td>
<td>Xanthoproteins</td>
<td>Negative</td>
</tr>
<tr>
<td>7.</td>
<td>Tannins</td>
<td>Positive</td>
</tr>
<tr>
<td>8.</td>
<td>Sterol</td>
<td>Negative</td>
</tr>
<tr>
<td>9.</td>
<td>Saponins</td>
<td>Negative</td>
</tr>
<tr>
<td>10.</td>
<td>Alkaloids</td>
<td>Positive</td>
</tr>
</tbody>
</table>

**Determination of antibacterial activity of *joshanda***

**Broth dilution assay**

Antibacterial assay of *joshanda* was examined against various bacterial strains by accessing the percentage inhibition in presence of the extract. A range of various concentrations of extract was tested against four different strains of bacteria. It was found that *joshanda* had strongest inhibitory activity against *B. subtilis* with %MGI of 99.00±0.577 whereas; it showed the least inhibition against *P. aeruginosa* with %MGI of 84.10±0.491. The results were quite comparable to ampicillin which showed almost complete inhibition against all the bacterial strain. The extent of inhibition increased with length of incubation and increase in concentration. Hence, the results showed that *joshanda* exhibit bactericidal property in vitro i.e. the growth of microorganisms was inhibited in its presence in time and concentration-dependent manner (fig. 1).

**Well diffusion assay**

The aqueous extract of *joshanda* was also tested for antibacterial activity in agar medium using well diffusion assay by determining the zones of inhibition. The results showed fair growth in control conditions where no drug/extract was taken. Based on the zone of inhibition produced, *joshanda* proved to exhibit the good antibacterial activity which was quite comparable to the standard drug (ampicillin) reflected through inhibition zone of almost similar diameter (table 3).
Table 3: Zone of inhibition (mm) produced by control, ampicillin and joshanda aqueous extract when tested against *E. coli* and *S. aureus* expressed as mean±SEM respectively

<table>
<thead>
<tr>
<th>Components</th>
<th>Zone of inhibition (mm)</th>
<th><em>E. coli</em></th>
<th><em>S. aureus</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>No zone of inhibition</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ampicillin</td>
<td>25±0.851</td>
<td>24±0.921</td>
<td></td>
</tr>
<tr>
<td><em>Joshanda</em> aqueous extract</td>
<td>17±0.798</td>
<td>15±0.826</td>
<td></td>
</tr>
</tbody>
</table>

Determination of antioxidant activity

**DPPH assay**

DPPH radical scavenging assay is the most extensively used method for screening antioxidant activity since it can furnish many samples in a short period and detect active ingredients at low concentration. The decrease in the absorbance of the DPPH radical caused by antioxidant was due to the scavenging of the radical by hydrogen donation. It is visually notable as the color changes from purple to yellow. *Joshanda* aqueous extract showed DPPH radical scavenging activity in a concentration-dependent manner as shown in fig. 2. The highest and lowest scavenging was observed at amount 500 µl and 50 µl of the extracts. *Joshanda* extract demonstrated highest % DPPH radical scavenging of 98.379±0.313% and the minimum of 36.210±1.174%.

The results were quite comparable to that of standard i.e. ascorbic acid with maximum % DPPH scavenging of 98.843±0.443% and the minimum of 83.192±0.422%. The scavenging activity of *Joshanda* with IC₅₀ (inhibitory concentration) value of 114.49 µg/ml was quite comparable to the scavenging activity of ascorbic acid with IC₅₀ value 60.55 µg/ml taken as standard.

**Fig. 2:** DPPH free radical scavenging activity of *Joshanda* were calculated and compared to ascorbic acid i.e. standard. The activity increased in time and concentration-dependent manner, results represent the mean±SEM from at least three separate experiments

**CAT assay**

Hydrogen peroxide (H₂O₂) is a non-radical reactive oxygen species with weak oxidizing activity. It diffuses through cell membranes rapidly and interacts with Fe²⁺ and possibly Cu²⁺ ions to form hydroxyl radicals and other free radicals. It is therefore biologically advantageous for cells to control the amount of H₂O₂ that is allowed to accumulate. The H₂O₂ scavenging ability of the aqueous extract of *Joshanda* is shown in fig. 3.

The results show that *Joshanda* exhibited significant H₂O₂ scavenging activity i.e. 0.047±0.001 µg/ml per minute degradation of H₂O₂ (fig. 3).

**Fig. 3:** H₂O₂ scavenging (%) was assessed with increasing amount of *Joshanda* extract. The H₂O₂ degradation increased in concentration-dependent manner, results represent the mean±SEM from at least three separate experiments
FRAP assay

The ferric reducing antioxidant power of *joshanda* is shown in fig. 4. The results showed that FRAP value of *joshanda* increase in the concentration-dependent manner. The highest absorbance of FRAP was observed in *joshanda* at 500 μl and the lowest was at 50μl with maximum FRAP value 0.945±0.024 mmol and the minimum value of 0.171±0.036 mmol respectively as compared to the standard which showed maximum FRAP value of 0.687±0.047 mmol and minimum at 0.059±0.005 mmol respectively. These concentrations were effective to react with ferric tripyridyltriazine (Fe III-TPTZ) complex and produce a blue colored ferrous tripyridyltriazine (Fe II-TPTZ). From the observations, it is clear that *joshanda* showed fair antioxidant activity comparable to ascorbic acid.

![Fig. 4: FRAP value of *joshanda* extract was estimated and compared to the ascorbic acid as standard.](image)

Evaluation of anti-inflammatory activity of *joshanda*

**Inhibition of albumin denaturation**

*Joshanda* has mild anti-inflammatory property. If there occurs any infection or damage to the body or tissue then body show response against the infection through inflammation. Protein denaturation has to be one of the major causes of inflammation. Due to this, we have tried to find out the ability of *joshanda* to inhibit protein denaturation. The results showed that *joshanda* was effective in inhibiting thermally induced albumin denaturation at different concentrations (fig. 5). The *joshanda* extract showed the highest percentage inhibition of albumin denaturation of 14.069±0.350% and the lowest of 1.880±0.194% at extract volume or amount of 1000 μl and 100 μl respectively. The IC\(_{50}\) value of *joshanda* was found out to be 2.005 mg/ml. Aspirin which was used as standard drug showed the inhibition of 71±0.396% at 100 μg/ml.

![Fig. 5: Inhibition of albumin denaturation activity of *joshanda* was checked at various concentrations taking aspirin (100 μg/ml) as standard, results represent the means±SEM from at least three separate experiments](image)

**Proteinase inhibitory assay**

The proteinase inhibitory assay showed that honey exhibits anti-inflammatory property in a concentration-dependent manner. Results exhibited significant anti-protease activity at different concentrations of *joshanda* extract. The extract demonstrated the highest percentage proteinase inhibition of 24.003±0.291% and the lowest of 4.959±0.254% at extract volume or amount of 1000 μl and 100 μl respectively (fig. 6). Aspirin which was used as standard showed the maximum inhibition of 87±0.311% at 1000 μg/ml.

![Fig. 6: % inhibition of trypsin activity in presence of *joshanda* extract was evaluated, results represent the means±SEM from at least three separate experiments](image)

Determination of antifungal activity

Antifungal assay of the *joshanda* and its constituents extract was performed against *Candida* cells (ATCC 10261 and ATCC 90028). The extract showed no zone of inhibition up to 2 mg/ml as well as there was no inhibition in growth of Candida cells. Our results showed that *joshanda* had no potent anticanidal activity up to 1 mg/ml; increased concentration of extracts might lead the anticanidal effect.

**DISCUSSION**

The practice of traditional medicine (hikmath and homeopathy) is regulated by the Federal Government through Unani, Ayurvedic, and Homeopathic (UAH) Practitioners Act, 1965. In this regard, the National Council of Tibb (NCT) and National Council for Homeopathy (NCH) were established as corporate bodies under
some other biological activities, such as wound-healing, anti-
malarial, antiviral, anti-cancer activity.

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Millia Islamia, New Delhi, India for providing the infrastructure to
carry out the proposed research work.

CONFLICTS OF INTERESTS

The authors declare that they have no conflict of interest. It has not
been published elsewhere. That it has not been simultaneously
submitted for publication elsewhere. All authors agree to the
submission to the journal.

AUTHOR CONTRIBUTION

Tooba Naz Shamsi: Concept, Data collection, and analysis, drafting
article, writing manuscript.

Romana Parveen: Data collection and analysis, revision of the
article, editing of the manuscript

Afaque Ahmad: Data collection, editing of the manuscript

Archoo Sajida: Sample and data collection, experimental work

Dr. Sadaf Fatima: Design of the work, data analysis, revision of the
manuscript, final approval of the manuscript to be submitted for
publication.

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scavenging potential, phytochemical investigation and in vivo

section 3 of the Act. Their formation was aimed to encourage and
popularize the traditional system of medicine in masses [22, 23].

Therefore, in this study, in vitro pharmacotherapeutic properties
and phytoconstituents of joshanda were assessed.

Secondary metabolite such as alkaloids, tannins, flavonoids are
known to have activity against pathogens and therefore aid the
antimicrobial activities of medicinal plants [24] which contribute
significantly towards the biological activities of medicinal plants
such as hypoglycemic, anti-diabetic, antioxidant, antimicrobial, anti-
inflammatory, anti-carcinogenic, anti-malarial, anti-cholinesterase,
anti-leprosy activities etc [25-32]. From the present study, it is
found that the decoction of joshanda contains flavonoids, alkaloid,
tannin, phenol, glycosides, and terpenoids which are of great
importance in the field of drug research. Therefore, further study
must aim to isolate and purify them to confirm their pharmacological and medicinal use [33].

Protein denaturation and membrane leakage are the main cause of
inflammatory processes implicated in the pathogenesis of diseases and
infections. Joshanda was tested for their potential property of
antioxidants using two assays, Albumin denaturation, where the
inhibition coagulation of protein by joshanda was tested and also
protease inhibition where the inhibition of trypsin was tested. In
both the cases, joshanda showed the minimal efficacy in both the
reactions thus confirming lack the anti-inflammatory properties at
low concentrations [34].

Antioxidants are very important since they possess the ability to
protect the body from damage caused by free radical induced
oxidative stress [35]. The antioxidant potential of joshanda was
investigated in the search for affirmation of efficacy of this unani-
drug as decoction obtained from natural resources. It became clear
that joshanda presents high antioxidant activity compared with
reference antioxidant Vitamin C for DPPH scavenging activity and
FRAP. Also, it showed fair activity when assessed by other methods.
Hence, joshanda is a promising candidate for use as natural
antioxidant for the health of human being.

Alkaloids and flavonoids are known to possess antibacterial activity.
The antibacterial mechanism of action of selected flavonoids are
attributed to inhibition of DNA gyrase, cytoplasmic membrane
function, and lipoxygenase A and C energy metabolism [36]. These
phytochemical acts as natural antibiotics by preventing lipid
peroxidation or by iron deprivation, hydrogen bonding, or specific
interactions with vital proteins such as enzymes in microbial cells.
Joshanda, being rich in alkaloids and flavonoids demonstrated
antibacterial activity against four bacterial strains, two gram-
positive and two gram-negative namely P. aeruginosa and S. aureus
(gram-negative bacteria). The most significant finding in this study was that the
heating treatment up to 100 °C could not impair the antibacterial
action of the components. Till date, no antibiotic can withstand that
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bacterial). The most significant finding in this study was that the
heating treatment up to 100 °C could not impair the antibacterial
action of the components. Till date, no antibiotic can withstand that
heat treatment, to retain its antibacterial property. It would be of
great significance if these heat stable and biologically active
components are purified and characterized. The studies on purified
antibacterial components and their cumulative action might indicate
and elucidate their efficacy as future antibacterial remediation.

CONCLUSION

Joshanda was quantified for the main phytochemicals present in
the extract. The presence of various phenolics and non-phenolics
phytoconstituents concluded that the plant might be of significant
importance. The varying antioxidant (free radical scavenging)
activities of extracts when compared to standard antioxidant i.e.
Vitamin C, suggested the possibility that the antioxidant activity of
this medicinal plant may contribute to play their role against various
reactive oxygen species (ROS) mediated disorders such as cellular
aging and cancer, becoming an alternative in the fight against skin
aging and cancer cells. Altogether, these results establish the
therapeutic applications of joshanda and its use as the herbal
medicine for the prevention of inflammation and treatment of ROS
and bacterial diseases. It can also be accomplished as an important
mark in the field of human health and sciences. Finally, considering
the results obtained, as future perspectives, we intend to evaluate

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