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Antioxidant and antibacterial evaluation of medicinal plants used in the starter culture (*Wanti*) of fermented rice beverage in West Garo hills, Meghalaya

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Abstract

Starter culture *wanti* used to ferment boiled rice to produce the beverage *bitchi* in the region of West Garo Hills is prepared by incorporating medicinal plants namely *Plumbago zeylanica*, *Thelypteris clarkei* C.F. Reed, *Clerodendrum D. Don*, *Leucas lavandulaefolia* and *Scoparia dulcis* due to which the beverages is claimed to possess therapeutic properties. The objective of the study was to endorse this claim by evaluating the plants with respective to their antioxidant property by 1, 1-diphenyl-2-picrylhydrazyl (DPPH) assay and antibacterial property by agar well diffusion assay. All plant extracts showed excellent antioxidant and antibacterial properties. The extract of *L. lavandulaefolia* recorded the highest radical scavenging activity of 98.51 ± 0.08 % (IC_{50} - $125.17 \mu\text{g/ml}$). The extract of *S. dulcis* exhibited the highest inhibition zone of 41.10 ± 0.96 mm (MIC/MBC - $15.6 / 62.5 \mu\text{g/ml}$) against *S. aureus*. These investigations serve as a prelude to attribute the therapeutic value of the rice beverage due to incorporated medicinal plants.

Keywords: starter culture, medicinal plants, antioxidant activity, antibacterial activity

Introduction

Traditional starter cultures are products of great significance across many Asian countries such as China, Japan, Philippines, Korea, Vietnam and India in particular the central and north-eastern states. The starter culture is used for fermentation of boiled rice to produce alcoholic drink that is commonly referred to as either rice beer or rice wine depending on the percentage of alcohol content present in the beverage [1]. The starter culture is called by various names such as *medombae* or *mae sra* in Cambodia [2] *chu* in China, *banh men* in Vietnam, *nuruk* in Korea, *koji* in Japan, *agi* in Indonesia, *ragi tapai* in Malaysia, and *bubod* in Philippines, *murcha* in the Himalayan regions of India, Nepal, Bhutan, and Tibet [3] and *bakhar* in Central part of West Bengal in India [4]. By and large the starter culture is prepared by incorporating many medicinal plants, herbs and spices that are locally available in a given region. It is believed that the herbs impart an intoxicating property to the fermented rice beverage [5]. They also contribute to various organoleptic and certain medicinal properties to the beverage that could be dependent on the type of medicinal plants used [6]. The plant may also furnish certain nutrients that could be essential for the survival and growth of the indigenous microflora present in the starter cakes, produce fragrance and keep down the growth of undesired microorganisms in the final products. A study on the role of the oriental herbs in the traditional Vietnamese starters by Hieu (1990) showed that 33 of 35 investigated oriental herbs stimulate the growth of yeasts and moulds and there appeared to be a synergistic effect [7].

The medicinal properties of plants have been investigated for their potent pharmacological activities. The preservative effect of many plant spices and herbs indicates the presence of antioxidative and antimicrobial constituents in their tissues. Plants produce substantial amount of antioxidants to prevent the oxidative stress that is caused by photons and oxygen and thus they represent a potential source of new compounds with antioxidant activity [8, 9]. There are pharmacological and clinical documentations available on many of the plant species which are endowed with phytochemicals, antimicrobial components and secondary metabolites such as alkaloids, phenolic compounds, etc. that have marked activity on pathogenic bacteria. The natural antioxidants contained in spices, herbs and medicinal plants may be useful in preventing the deleterious consequences of oxidative stress and in the protection of the body's biochemical functions [10, 11].

A study by Kim *et al.* (2014) reports that distinctive sensorial and health-related characteristics of traditional Korean rice wine (KRW) are derived from added medicinal plants and herbs to

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KRWs which showed antioxidant activity in volatile and non-volatile extracts when six different medicinal plants and herbs were used [12]. Therefore the usage of medicinal plants and herbs in brewing rice beverage could apparently enhances the antioxidative potency of the product and induce positive health effects associated with medicinal or herbal ingredients when added to alcoholic beverages.

In India, fermented rice beverages are very popular amongst the tribal communities of central and north-eastern states who have their own formulation of starter culture with respect to the medicinal plants used. The present study is with respect to the starter culture locally called *wanti* in region of West Garo Hills, Meghalaya that is mainly inhabited by the Garo tribes followed by the Hajong and Bodo. The Garo tribes use the leaves and flowers of the plant *Plumbago zeylanica* or leaves of the fern *Thelypteris sclarkei* C.F. Reed in starter culture preparation while the *Boro* and *Hajong* tribes use the leaves of the *Clerodendrum species* namely *Clerodendrum D. Don*, leaves and vernal stem of *Scoparia dulcis* L. (sweet broom) and *Leucas lavandulaefolia*. In order to understand the rationale that the traditional rice beverages of West Garo Hills have increased health benefits due to added topical medicinal plants, we have assessed the antioxidant and antibacterial potential of medicinal plants used in the brewing process.

Materials and Methods

Sample collection, materials and reagents.

Fresh leaves and vernal stem of medicinal plants (*Plumbago zeylanica*, *Thelypteris clarkei* C.F. Reed, *Clerodendrum D. Don*, *Leucas lavandulaefolia* and *Scoparia dulcis*) were collected from different locations of West Garo Hills. 1, 1-Diphenyl-2-picrylhydrazyl (DPPH), ascorbic acid and nutrient agar media were purchased from HiMedia laboratories, India. Methanol was purchased from Merck Specialities Pvt., Ltd., India. All the materials and chemicals used in this work were of analytically pure grade.

Extraction of plant material

The medicinal plant materials were processed by maceration with methanol [13]. Fresh leaves and vernal stem were cleaned and dried in an oven at 50°C. The dried materials were reduced to a coarse powder in an electrical blender. Each plant powder (25g) was then soaked in 100mL methanol (80% v/v) separately in air tight reagent bottle for 5 days at room temperature (28°C -30°C) on a shaker (MSW-300, Micro Scientific Works). Individual methanol infusions were filtered using cheesecloth and Whatman filter paper (110mm). The filtrates were then further concentrated in rotatory shaker at 40°C (AIT-121, ACMAS Technologies). The dry weights of the various extracts were taken. Each dried plant extracts were then dissolved in distilled water in order to obtain solutions of each plant extract (2mg/ml) which were filter sterilised using Millipore filter (0.45 µm, HiMedia) before being used for assays.

Antioxidant activity - Radical scavenging assay

The antioxidant activity of the medicinal plants was determined by 1, 1-diphenyl-2-picrylhydrazyl (DPPH) according to Abera *et al.* (2015) [14] but with modifications. Using Methanol as a diluent, 5 ml of different concentrations (50, 100, 150, 200 µg/ml) of plant extract were obtained from the stock solution (2mg/ml). 1mL of DPPH (0.1 mM in methanol) was added to 1 ml of the different concentrations of each plant extract to provide 2 ml of each reaction mixture.

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All samples were incubated at room temperature in dark for 30 minutes. Absorbance was measured spectrophotometrically (Electronics India -1372). The base line correction of the instrument was done using methanol. Absorbance was measured at 517 nm against a DPPH negative control containing only 2 ml of methanol in place of the extract. All the analyses were done in triplicates and average values were taken. Ascorbic acid was used as standard in the range of 5µg/ml to 25µg/ml. The activity was expressed as µg/ml ascorbic acid equivalent (AAE) present in the sample. The percentage radical scavenging was also calculated based on the following formula:

$$\text{DPPH scavenging activity (\%)} = [(A_0 - A_1) / A_0] \times 100$$

where 'A₀' is the absorbance of the control and 'A₁' is the absorbance of the sample. The IC₅₀ value, which represents the concentration or dilution of extract required for 50% inhibition of DPPH radicals, was determined.

Antibacterial assay

Test organisms

The bacterial indicator strains used as test organisms included two gram positive bacteria (*Bacillus cereus*, *Staphylococcus aureus*) and two gram negative bacteria (*Salmonella typhi* and *Escherichia coli*). The antibacterial assay test was performed at the Department of Dairy Technology, Anand Agricultural University, Anand, Gujarat, India. The test pathogens are maintained by the department on nutrient agar slants (HiMedia, Mumbai) and stored at 4°C and in glycerol stocks. The strains were subcultured and cross checked for purity before use.

Agar well diffusion method.

In vitro antibacterial activity of the medicinal plant extracts was carried out using the agar well diffusion method of Cheruiyot *et al.* (2009) [15], with some modifications. Tetracyclin and ampicillin both of which are broad spectrum antibiotics were used as positive control. The method is based on the principle that the antibacterial constituents present in the plant extracts are allowed to diffuse out into the medium and interact in a plate freshly seeded with the test organisms. The resulting zones of inhibition will be uniformly circular as there will be a copious lawn of bacterial growth. The diameter of zone of inhibition can be measured in millimetre (mm). Bacterial strains preserved in nutrient agar at 4°C were revived in nutrient broth and incubated at 37±1°C overnight, and the suspensions were checked to provide approximately 10⁸ cfu/ml. Active culture (100 µl) of each indicator strains were added to 100ml of nutrient agar (1.6 %) and pour plated. The agar was allowed to solidify. The plates were refrigerated at 4°C for 10-15 minutes before several wells (6 mm diameter, 4 mm deep and 2 cm apart) were punched out of the agar with sterile 6mm cork borer (HiMedia). 100 µL of filter sterilised plant extracts and rice beverages were filled into the wells and the plates were once again refrigerated at 5°C for 1-2 hours to facilitate the diffusion of supernatant after which they were incubated at 37°C for 24-48 hours. The inhibition activities of plant extracts on the test bacterial strains would be indicated by the presence of a clear zone surrounding the agar wells. In addition, minimum inhibitory concentration (MIC), lowest concentration of the plant extracts required to inhibit bacterial growth and Minimum bactericidal concentration (MBC), the lowest concentration of the plant

extracts required to kill the test bacteria were determined using the macro broth dilution method [16]. Bacterial cultures were prepared in the nutrient broth, incubated at 37°C for 24 h and were adjusted with sterilized saline to a concentration of 10⁸cfu/ml. The plant extract-bacterial culture mixtures were then incubated at 37 °C for 24 h to determine the MIC at which the growth of bacterial cells was fully inhibited. To determine MBC, 100µl of broth showing no visible growth was inoculated on Mueller Hinton agar (MHA) and incubated for 24 h at 37 °C. The MBC of beverage samples could be defined as the lowest concentration of the samples at which 99.9 % of inoculated microorganisms were killed.

Statistical analysis

All determinations were made in triplicate. The data was recorded as Mean±Standard deviation using Microsoft Excel Windows10. Comparison of means was performed by one-way ANOVA with post-hoc Scheffe's test and the differences were considered significant at $p \leq 0.05$.

Results

Antioxidant activity determination

In the present study the antioxidant activity of methanolic extract of leaves of *P. zeylanica*, *T. clarkei* C.F Reed, *C. D. Don*, *L. lavandulaefolia* and *S. dulcis* were evaluated using ascorbic acid - a well-known antioxidant, as a standard with

concentrations ranging from 5 to 25µg/ml. The results regarding the DPPH radical scavenging capacity, and the ability to inhibit the DPPH radical scavenging capacity by 50% (IC₅₀ values) of the above methanolic plant extracts are shown in Table 1. The ascorbic acid equivalent (AAE) in µg/ml present in the plant extracts are shown in Table 2. The values express a significant scavenging ability of all plant extracts. The absorbance was found to be inversely related to the concentration of the samples and decreased as the concentration of the sample increased. As soon as the plant extracts were added, the original purple color of DPPH changed into yellow, which indicated that, the plant extracts possess high radical scavenging capacity (RSC). Spectrophotometric quantification at 517nm revealed that the methanolic plant extracts of *L. lavandulaefolia* showed the highest RSC across in all the four concentrations tested and recorded the lowest IC₅₀ value of 125.17µg/ml followed by the methanolic extract *S. dulcis* (IC₅₀132.89 µg/ml). Lowest RSC was observed in case of *T. clarkei* C.F. Reed that recorded the highest IC₅₀ of 198.41µg/ml. The order of the medicinal plant extracts according to DPPH radical scavenging capacity and IC₅₀ values was *L. lavandulaefolia* > *S. dulcis* > *P. zeylanica* > *C. D. Don* > *T. clarkei* C.F. Reed. The F values (Table 2) for each concentration indicate that the results are significantly different at $p \leq 0.05$.

Table 1: Percentage of DPPH radical scavenging capacity (%RSC) and (concentration of plant extract showing 50% inhibition (IC₅₀) of methanolic extracts of medicinal plants

Concentration (µg/ml)	<i>C. D. Don</i>	<i>T. clarkei</i> C.F. Reed	<i>P. zeylanica</i>	<i>S. dulcis</i>	<i>L. lavandulaefolia</i>
50	81.89±0.99 ^a	77.31±0.29 ^b	82.24±1.42 ^a	83.14±1.31 ^a	84.05±1.47 ^a
100	83.86±0.41 ^b	80.57±0.57 ^c	84.09±0.64 ^b	85.15±0.48 ^a	86.94±0.21 ^a
150	89.94±0.53 ^c	87.14±0.64 ^d	90.77±0.31 ^{cb}	93.97±0.64 ^{ab}	95.59±0.95 ^a
200	96.66±0.10 ^c	94.42±0.92 ^d	96.75±0.17 ^{cb}	97.84±0.08 ^{ab}	98.51±0.08 ^a
IC ₅₀	172.35	198.41	154.96	132.89	125.17

Table 2: Ascorbic acid equivalents (AAE) in µg/ml present in methanolic extracts of medicinal plants

Concentration µg/ml	<i>C. D. Don</i>	<i>T. clarkei</i> C.F. Reed	<i>P. zeylanica</i>	<i>S. dulcis</i>	<i>L. lavandulaefolia</i>	F value
50	14.28±0.18 ^a	13.26± 0.05 ^b	14.34± 0.26 ^a	14.51± 0.24 ^a	14.67± 0.27 ^a	19.84**
100	14.55±0.07 ^b	14.04± 0.10 ^c	14.70± 0.12 ^b	15.00± 0.09 ^a	15.20± 0.04 ^a	77.62**
150	15.74±0.10 ^c	15.05±0.12 ^d	15.89±0.06 ^{cb}	16.11±0.12 ^{ab}	16.77±0.17 ^a	83.62**
200	16.97±0.02 ^c	16.56±0.17 ^d	16.98±0.03 ^{cb}	17.18±0.01 ^{ab}	17.30±0.01 ^a	41.01**

Each of the above tests was performed in triplicate and the results were recorded as mean ± standard deviation. Means that have no common superscript within the same row are significantly different from each other by Scheffe's test at $P < 0.05$.

Antibacterial activity

The antibacterial activity of the medicinal plant extracts are shown in Table 3. Tetracycline and Ampicillin, both broad spectrum antibiotics were used as positive controls. It is observed that *P. zeylanica*, *C. D. Don*, *T. clarkei* C.F and *S. dulcis* possess good antibacterial activity. The extract of *S. dulcis* (2mg/ml) showed a consistent higher inhibitions zones against all the test strains with the highest inhibition zone being shown of 41.10 ± 0.96mm (MIC/MBC - 15.6 / 62.5) for

S. aureus. *T. clarkei* C.F Reed showed the second best activity recording an inhibition zone of 37.27±0.31mm (MIC/MBC- 31.5 / 62.) against *B. cereus*. The extract of *L. lavandulaefolia* at the tested concentration (2mg/ml) did not show any inhibition activity against any of the indicator organisms used. The overall order of the plants according to antibacterial activity is *S. dulcis* > *T. clarkei* C.F > *C. D. Don* > *P. zeylanica*. The F value (Table3) in each case is quite high indicating the results are highly significant at $p \leq 0.05$.

Table 3: Antibacterial activity of methanolic extracts of medicinal plants

Samples	Antibacterial activity	<i>S. aureus</i>	<i>B. cereus</i>	<i>S. typhi</i>	<i>E. coli</i>
<i>P. zeylanica</i>	In. z MIC/MBC	26.40±0.36 ^c 125 / 500	20.60±0.40 ^c 125 / 500	14.10±0.56 ^d 250 / 500	9.90±0.66 ^c 500/nd
<i>T. clarkei</i> C.F. Reed	In. z MIC/MBC	34.13±0.23 ^b 62.5 / 125	37.27±0.31 ^a 31.5 / 62.5	34.07±0.60 ^a 62.5 / 250	13.47±1.29 ^b 500/nd
<i>C. D. Don</i>	In. z MIC/MBC	25.07±0.31 ^c 62.5 / 250	22.70±0.26 ^c 125 / 250	26.39±1.34 ^{cb} 62.5 / 250	11.77±0.75 ^{cb} 500/nd
<i>S. dulcis</i>	In. z MIC/MBC	41.10±0.96 ^a 15.6 / 62.5	33.70±0.79 ^b 62.5 / 125	25.13±0.42 ^c 125 / 500	27.73±0.93 ^a 125/500
<i>L. lavandulaefolia</i>	In. z MIC/MBC	-	-	-	-

Tetracycline (30µg/ml)	In. z	12.43±0.60 ^d	21.77±1.54 ^c	28.83±1.26 ^b	25.50±1.0 ^a 1.001.00
Ampicillin (30µg/ml)	In. z	25.77±0.87 ^c	10.83±0.76 ^d	24.83±1.04 ^c	10.53±0.06 ^c
F value		719.13**	424.91**	146.45**	253.61**

In the above Table, In. z represents the diameter of inhibition zone (mm). MIC and MBC symbolise minimum inhibitory and minimum bactericidal concentration in µg/ml. Each test was performed in triplicate, and the data are presented as the mean ± standard deviation (SD). Mean data with different superscript lower-case letters in the individual column are significantly different at $p \leq 0.05$ according to Scheffe's test.

Discussion

Antioxidant activity

The DPPH radical scavenging assay developed by Blois (1958) [17] is a popular and commonly employed method in antioxidant studies of specific compounds or extracts since it is simple and sensitive. It is based on the theory that a hydrogen donor is an antioxidant and measures compounds that are radical scavengers. 1, 1-diphenyl-2-picrylhydrazyl (DPPH) is one of the few stable and commercially available organic nitrogen radicals that accepts hydrogen from an antioxidant and the effect is proportional to the disappearance of DPPH radical in test samples which can be monitored with a UV spectrometer as DPPH radical shows a strong absorption maxima at 517 nm (purple). The color turns from purple to yellow followed by the formation of DPPH radical upon absorption of hydrogen from an antioxidant. This reaction is stoichiometric with respect to the number of hydrogen atoms absorbed. Therefore, the antioxidant effect can be easily evaluated by following the decrease of UV absorption at 517 nm [18, 19]. A previous study on *L. lavandulaefolia* by Ramani *et al.* (2012) showed that 70% ethanol plant extracts of *L. lavandulaefolia* exhibited more antioxidants and free radical scavenging in all the experimental models (61.88±1.32) per 100µg of sample and he directly correlated his results to the high phenolic and flavonoid content which play a major role in controlling the oxidation. In this experiment, we used 80% methanol to prepare extracts of the plant and found that these extracts showed higher DPPH scavenging capacity, thus showing that methanolic extracts of *L. lavandulaefolia* have a higher DPPH scavenging capacity than those of Ramani *et al.* [20]. Zulfiker *et al.* (2010) studied the potential antioxidant properties of 95% ethanolic extracts of *S. dulcis* by DPPH assay across six serial dilutions (5- 500 µg/ml) and obtained an IC₅₀ value to be 243.82 µg/ml [21]. In this study, 80% methanolic extract of *S. dulcis* recorded an IC₅₀ value of 132.89 µg/ml. A lower value of IC₅₀ obtained in our study again shows higher antioxidant activity witnessing that 80% methanolic extracts *S. dulcis* in our study performed better the 95% ethanolic extract used in previous studies. The results incurred with ethanol extracts may be because of low solvation of antioxidant molecules rendered by ethanol, probably due to the presence of the ethyl radical that is longer than the methyl radical present in methanol. According to the report by Boeing *et al.* (2014), amongst pure solvents, methanol was found to be the most efficient solvent for extraction of antioxidant compounds, followed by water, ethanol and acetone [22]. Abera *et al.* (2015) investigated the antioxidant activities of 99.8% methanol extract of *P. zeylanica* (soaked for 72 hours) and observed a DPPH scavenging percentage of 87.14% at extract concentrations of 1.0mg/ml and supported the view that *P. zeylanica* plant is a promising source of potential antioxidants [14]. In the present study a higher DPPH

scavenging percentage of 96.75±0.17 was recorded for 80% methanolic extract of *P. zeylanica* (soaked for 5days) at a much lower concentration of 200µg/ml. The results plausibly explain that 80% methanol performs better than absolute methanol in extraction or release of active antioxidant scavenging compounds from plants. Previous work verifies that solvent mixture was more efficient solvent in the extracting of antioxidant compounds. Solvent /water combinations can destroy the cell membranes by simultaneously dissolving the antioxidant molecules and stabilizing them [22]. Study by Wu *et al.* (2004) affirms that a mixture of methanol and water were found to be more efficient in extraction due to better solvation of antioxidant compounds in methanol-water mix as result of interaction of hydrogen bonds between polar sites of the antioxidant molecule and the solvents since methanol and water are both proton donors [23]. The time period for which the plant materials are soaked could also govern the experimental results. In our study the plant materials were soaked for five days in air tight sealed reagent bottles that probably resulted in the extracts showing higher DPPH percentage. The process intended to soften and break the plant's cell wall to release the soluble phytochemicals. There are also many reports on the ethno-medical importance of various species of the genus *Clerodendrum*. It is used in various indigenous systems of medicines and as folk medicines specifically in India, China, Thai, Korea, and Japan. Species like *C. inerme* have been used as antioxidant drugs in various indigenous systems of medicines. Compounds such as Isoacteoside and trichotomoside isolated from *C. trichotomum*, when tested show significant scavenging activity of intracellular reactive oxygen species produced by hydrogen peroxide suggesting their antioxidant properties [24, 25].

Nevertheless, within the confinement of our study we can attest that all the medicinal plants tested showed excellent antioxidant potential with special reference to *L. lavandulaefolia* and *S. dulcis*, both of which showed the highest radical scavenging activity. We can thus suggest that these plants when added to rice starter culture, could contribute to increase the antioxidant capacity of the rice beverages.

Antibacterial activity

In the present study the medicinal plant extracts except that of *L. lavandulaefolia* at the tested concentration of 2mg/ml showed good antibacterial activity. The antimicrobial potential of *L. lavandulaefolia* needs to be further evaluated with higher concentration ranges against the test organisms. Pierozan *et al.* (2009) investigated antimicrobial activity of *L. lavandulaefolia* essential oil. The lowest MIC was observed when *S. aureus* was exposed to 2.31 mg/mL of *L. lavandulaefolia* essential oil, while the highest MIC value was obtained when *Shigella flexneri* was exposed to a higher concentration of 9.25 mg/mL of the same essential oil, *Serratia marcescens* and *Enterococcus faecalis* were not inhibited by the essential oil thus demonstrating that *L. lavandulaefolia* may be effective as a bacteriostatic agent against Gram-positive microorganisms [26]. Highest antibacterial activity was demonstrated by *S. dulcis* which recorded a highest inhibition zone in case of *S. aureus*. Previous reports on antibacterial activity of ethanol extracts of

S. dulcis cited mild activity which asserts that the 80% methanol extraction in the present study is significantly effective than the ethanol extracts [27, 28]. In another report different solvent (petroleum ether, toluene, chloroform, methanol, ethanol, and water) extracts of *S. dulcis* showed activity against both the Gram positive and Gram negative bacteria, which indicated the presence of broad spectrum of antibiotic compounds harbored in the plant [29]. The present study asserts the fact that *S. dulcis* has excellent antimicrobial property and can act as potent anti-microbial agent. *P. zeylanica* and *C. D. Don* likewise show fairly good antibacterial activity. Similar finding was cited by Devi *et al.* (2011) who carried out antibacterial activity of methanolic and chloroform extracts from the *P. zeylanica* against five different organism of *Streptococcus aureus*, *Staphylococcus aureus*, *Bacillus spp.*, *Pseudomonas aeruginosa*, and *E.coli* using disc diffusion method and found that methanolic extracts were more active against the tested organisms and concluded that the active ingredients of the plant parts are better extracted with methanol than other solvents like chloroform. The methanol extracts contain alkaloids, coumarins and tannins that have antibacterial properties [30]. Antibacterial properties of certain species of *Clerodendrum* such as *C. inerme* [31], *C. viscosum* [32] and *C. Infortunatum* [33] have been previously reported. The fern *T. clarkei* C.F. Reed has also demonstrated very good antibacterial activity with highest inhibition towards *B. cereus*. However, we could not find any literature related to the antibacterial property in particular concerning *Thelypteris. clarkei* C.F. Reed and *Clerodendrum. D. Don*.

Conclusion

The present study supports the notion that the medicinal plants added in the starter rice cake in West Garo Hills have excellent antioxidant capacity and show good antibacterial property and could thus aid to increase the antioxidant capacity and antimicrobial potential of the rice beverage. It is worth noting that *L. lavandulaefolia* showed the highest antioxidant activity (RSC-98.51%) and *S. dulcis* showed the highest antibacterial activity (In. z 41.10mm against *S. aureus*). All the other plants showed effective antibacterial activity against the *S. typhi*, *B. cereus* and *S. aureus*. Thus the present study established that the medicinal plants possess considerable antioxidant potential and antibacterial property and could emphatically contribute to increase the therapeutic value of the rice beverage.

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