INTRODUCTION

Typhoid fever is an infectious diseases caused by gram-negative bacteria, *Salmonella typhi*, with the most common clinical manifestations in the form of fever, dizziness, nausea, vomiting, decreased appetite, abdominal pain, constipation or sometimes diarrhea and coated tongue with different clinical stage of the disease. Such symptoms could be considered mild to moderate [1]. The spread of typhoid disease can only be transmitted from human to human. A human carrier can easily transmit dormant germs in the intestine to others with contamination through drinks or food that comes into contact with patients or who have been infected with typhoid [2-4]. Diagnosis of typhoid in a patient is collaborated from history taking, symptoms and laboratory findings from blood, urine, or feces. Methods for diagnosing typhoid fever have been well-developed at a global level. Some studies have been tried and found one of the diagnostic test for typhoid fever by OMP latex with a sensitivity rate of 91.8% and specificity rate of 99.3% [5].

Prevalence of typhoid is still an issue. The highest incidence of typhoid is 100 / 100,000 cases per year in South-Central Asia and South-East Asia [6,7]. In Indonesia, based on study conducted by Leon R et all, in 2008, the average age group was 81.7 per 100,000 per year with an incidence rate of 148.7 in 2-4 year age group, 180.3 for the 5-15 year age group, and 51.2 per 100,000 per year for more than 16 years age with an average age of 10.2 years [8-10]. Highlighted that the risks factor of typhoid depend on family conditions such as sanitation, availability of clean water, individual hygiene habits, knowledge of the prevention and the spread of typhoid [11,12]. Along with the high incidence of typhoid fever, particularly in Indonesia, researchers have focused their study to discover other plants that can be used as medicinal therapy not only for infectious diseases, such as typhoid fever [13-15].

ABSTRACT

Nature is currently one of the medicinal agents used for treatment of some diseases, such as typhoid fever. The increasing number of antibiotic resistance strains has prompted researchers to find new modes of therapy for these diseases. Patients who suffer resistance to antibiotics need longer time for hospitalization to recover from that disease. Some studies focus on traditional therapy using plants, not only for typhoid fever, but also other infectious and metabolic diseases. According to the literature, there are 32 plants that have antimicrobial effect, anti-inflammatory, bactericidal, and phagocytic stimulation effects for *Salmonella typhi* which can be used as an alternative therapy for typhoid fever. All of the plants are found in Indonesia such as *Punica granatum*, *Carica papaya*, *Cocos nucifera*, *Cymbopogon citratus*, *Mangifera indica*, *Solanum lycopersicum*, *Solanum nigrum*, *Moringa oleifera*, *Luffa acutangula*, *Aloe vera*, *Psidium guajava*, *Allium sativum*, *Occimum gratissimum* and *Aegle marmelos*.

Keywords: Typhoid fever; Medicinal Plants; *Salmonella typhi*

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MINI REVIEW: MEDICINAL PLANTS FOR TYPHOID FEVER IN INDONESIA

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of acute toxoplasmosis, extract of Curcuma longa has anti-toxoplasmosis immunoglobulin G and immunoglobulin M [16,17]. Plectranthus scutellaroides and Coleus scutellaroides extract also has a good response as therapy for Candida albicans infection [18,19]. Tawali et al. (2019) also concluded that extract of Buni-Berry (Antidesma bunius) is effective in increasing PON1 expression in BALB/c mice fed with high fat diet [20]. Considering this condition, several studies are trying to bring their study to medicinal herbs or medicinal plants for typhoid management. As such, some plants in Indonesia can be extracted and then used as an antimicrobial agent particularly in destroying Salmonella typhi bacteria [21]. Previous study revealed that Thalassia hemprichii contains bioactive compounds that have the potential to be antibacterial and antioxidant [22-23]. Other study, in traditional medicine such as snakehead fish (Channa striata) can increase serum albumin levels in patients after surgery [24].

**INDONESIAN ANTI-SALMONELLA OF MEDICINAL PLANTS**

Even though there are antibiotics that are sensitive to salmonella typhi, the level of resistance to other types still exist and total of case more increasing nowadays [25-27]. Likewise, the use of anti-typhoid vaccine as a preventive to high morbidity and mortality of typhoid has been widely used, but there are still limitations to it. Table 1 describes several types of plants that have been studied and proven to have anti-salmonella effects and can be used as herbal therapies for typhoid. Of the 32 types of plants that have been studied, these Indonesian typical plants which can be used as herbal therapy for typhoid cases. The majority of antimicrobial activity was assessed from the amount of inhibition zone on medium that had been provided using the MIC (Minimum Inhibitory concentration) test system [28]. Some research on herbs also compares the antimicrobial activity of the antibiotics as used for medicinal therapy to treat typhoid [29-33]. Last study in Indonesia conclude that Miana Leaves (Coleus scutellaroides. L) extract also gave a significantly effect treatment in Balb/c mice induced by Salmonella typhi. The result showed that there was a different pattern of TLR-4 Expression. There was a decrease in TLR-4 mRNA expression from Miana leaves extract treatment group and the mixed of antibiotic [34]. In Azadirachta indica, the zone inhibition of acetone and ethanolic stem bark extracts produced more effective results as compared to other extracts, including comparison with the common antibiotic such as amoxicillin, ciprofloxacin, ceftriaxone, chloramphenicol, and chloramphenicol with diameter zone ranges from 18-35 mm and 15-31 mm [35]. Rani P et al. (2004) categorized antimicrobial activity against Salmonella typhi on extracts of Aegel marmelos, Punica granatum, and Myristica fragrans fruit as strong antimicrobial with an inhibition zone of ≥9-15mm while Cichorium intybus, Solanum ningrum, Apium graveolens, Ocimum sanctum as moderate antimicrobial with an inhibition zone of ≥5-9mm [36]. A study conducted by Nkanwen (2009) proposed that Crinum purpurascens had bactericidal effects. The bactericidal or bacteriostatic categorization is based on MBC / MIC ratio. If the ratio is ≤ 4 it is categorized as a bactericidal agent; if it is > 4 it is categorized as bacteriostatic [37,38]. It is slightly different from water extract of Houttuynia cordata (HCWE) in its antimicrobial activity. These data suggest that HCWE is stable and beneficial in the treatment of bacterial infection including intracellular replicating pathogens [39,40]. In Cameroon, Roger et al. (2015) screened several potential plants to have antibacterial activity against Salmonella, one of the plants is Bidens pilosa [41,42]. This plant has antibacterial activity against Salmonella bacteria with the optimal inhibitory zone of 12.5 ± 0.4 mm at a concentration of 80mg / ml in the leaf extract using chloroform. Chemical constituent of Bidens pilosa are flavonoids, phenylacetylenes, alkaloids, steroids, triterpenoids and tannins. It has the potential in the leaf extract using chloroform with concentration of 100mg / ml with an inhibition zone that formed 8.8 mm compared to other bacteria such as Staphylococcus aureus, Pseudomonas aeruginosa, and E.coli [43]. Phytochemicals of Carica papaya with ethanol extracts such as alkaloids, saponins, flavonoids and glycosides contains magnesium, potassium, calcium and iron [44-46]. Cocos nucifera also has the highest antibacterial activity of the extract diethylether compared to other solvents extracts with inhibition zones formed 20 ± 0.5mm, even though also obtained the antibacterial activity of the extract against bacteria E.coli [49-53]. Comparing efficacy of Cymbopogon citratus and Carica papaya as enteric fever therapy against Salmonella in Bayelsa State and found that C. citratus is more effective against Salmonella typhi than C.papaya with inhibition zones in Salmonella typhi 22.67 ± 0.88 mm, S.paratyphi 22.33 ± 1.03mm, and S.typhimurium 21.17 ± 1.37 mm . In C.papaya the largest inhibition zone was 21.18 ± 0.88 mm in S.paratyphi bacteria [54]. Cymbopogon citratus contains some phytoconstituent such as flavonoids, phenolics, terpenoids, tannins, alkaloids and essential oils [55]. In other studies, Mangifera indica also has antibacterial activity of ethanol extract which has no critical different effect compared to medical therapy [56]. Musa et al. still concluded that M.indica can be an alternative therapy for typhoid cases with zone of inhibition formed at a concentration of 100mg / ml is 18mm better than amoxicillin and chloramphenicol, which has a zone of inhibition formed at the same concentration of 17mm and 12mm for each, although gentamycin still exhibits better results with 25mm inhibition zone [57]. This is because the phytochemical composition of mango leaves consists of alkaloids, phenols, flavonoids, saponins, tannins and contains minerals calcium, magnesium, potassium, phosphorus and sodium which are considered to have a role as antioxidants, anti-inflammatory and immunomodulators [58-59]. M.indica is a potential medical plant as antimicrobial, anti-cancer, cardio and radio protective, and recognition of memory [60]. In vitro investment of efficacy of some antibiotics and Mammordica charantia extract to find the stronger antimicrobial against S. typhi shows that M. charantia has the therapeutic potential as a typhoid fever treatment. When compared with Ampicillin, Chloramphenicol, gentamicyn, tetracycline and other types of antibiotics, M.charantia is more sensitive to S.typhi when considering it's zone of inhibition which reach 14mm, and not significantly different from ciprofloxacin with 16mm inhibition zone [61-62].
addition Adey et al. also histopathologically assessed the features of hepatocytes that had received herbal therapy for lemongrass leaf extract in mice and the results showed that there was a gradual recovery from hepatocyte cells in the liver when compared to those which did not receive herbal therapy [63]. Another study conducted in Nigeria by Etuk et al. assessed the effect and toxic dose of Psidium guajava extracts against mice infected with Salmonella typhi. The result demonstrated that giving 20-30mg/100g of guava extract will improve the clinical symptoms, especially fever. In comparison with giving 2.5mg/100g of mice body weight, the results of 24-hour symptoms of improvement were the same as giving 30mg/100g whereas on the 2nd day the condition became normal without any fever and after being observed until the seventh day the temperature remained stable. At a dose of 40mg-50mg / 100g side effects emerge in the form of behavioral changes such as insomnia and irritability but will not cause death [64-67]. Flavonoid in Psidium guajava is assessed to have antibacterial activity against Salmonella enteritidis with MIC 200 μg/ml [65]. Purba et al. [2018], also assessed the effect of extract of Solanumlycopersicum provision to Salmonella typhi. These studies concluded that there are differences in inhibitory zones formed at each concentration of S. glycopticum. Maximal inhibition zone was formed at a concentration of 1%.00% with the average of 32.67mm and is still low compared to the positive control using ceftriaxone with 48, 33 mm [68]. Zingiber officinale is also one of the plants that can be used as medicine for typhoid [69]. This is in accordance with the Oluduro study which assessed the antibacterial activity of Zofficinale, Allium Sativum and Momordica charantia through methanol, ethanol and aqueous extracts. The results showed that there was antibacterial activity on the Zofficinale methanol extract with inhibitory zones formed 5.4 mm at extract concentrations of 50 mg/ml and did not have an effect on the lower concentration [69]. Allium sativum gives the highest inhibitory zone in alcoholic extract with a concentration of 50 mg/ml inhibition zone formed 6.3 mm, while M. charantia is the largest inhibition zone on 11 mm on aqueous extract at the same concentration. The higher the concentration, the greater its inhibitory zone will be formed, however, there is no further research related to the toxic dose of this plant [70]. Crude extract of Allium sativum can also be used as an alternative antebacterial in Salmonella. This has been proven by Adebolu et al. [2011], with a diameter of inhibition zone that formed 23.8mm which is 0.2mm with streptomycin 24.00mm while gentamicin 22mm, chloramphenicol 20mm, ofloxacin 19.5mm and erythromycin 16mm [70]. Another study conducted by T.Ayogu (2008), assessed the combination of raw extract of garlic and ginger as a treatment for typhoid to be sensitive at 0.8g/ml concentration as antibacterial therapy even though the inhibitory zone formed was smaller than 20mm compared to 30mm chloramphenicol as the control [71]. In contrast to the above studies that assessed antibacterial activity in medical plants based on the formed inhibitory zones, Susanti R. et al. in her study tried to assess the effect of giving Alloe vera as an immunomodulator for ROS activity of macrophages in mice infected with Staphylococccium, which is one of the typhoid-causing bacteria [72]. The results revealed that administering A. vera has a significant effect on increasing ROS macrophages production in mice, however, further research is needed regarding NO and cytokines involved in immune response to Salmonella bacteria [73-74]. In line with this study, flavonoids, phenols, vitamins C and E were considered capable of reducing peroxidative damage by decreasing levels of mononcine TNF-α, IL-1, and IL-6 [75].

In the study conducted by Natarajan (2005), apart from rootstock extract, leaf extract also has antibacterial activity with inhibition zone formed by 11 mm using methanol in Salmonella typhi A [76]. S. Marasini et al. (2015) also assessed some fruits and vegetables that have strong antibiotics that are considered to have antibacterial activity against several microbes, including Salmonella typhi based on the formed zone of inhibition [77]. In Mangifera indica, the largest inhibition zone formed in the methanol extract of 12 mm compared with Hexane, chloroform, acetone extract [78]. In L. Acutangula n-hexane extract gives the larger inhibitory zone compared to other solvents with an inhibition zone formed 9mm, the inhibition zone formed on the same chloroform and acetone extract, that is 7mm [79]. Doughari(2007), Moringaoleifera also had lower antimicrobial activity on leaf extract using acetone compared to ethanol extract and was able to form a 7mm inhibition zone on acetone extract and 8 mm with ethanol at a concentration of 100 mg / ml [80-85]. Manilkara zapota also has antibacterial activity including Salmonella typhi on stem bark and leaves extracts using ethyl acetate solvent. However, the result of the formed inhibitory zone is still lower compared to kanamycin [86-87]. In addition to Manilkara zapota, Ocimum gratissimum also has antibacterial activity against Salmonella [88-91]. Other plants like Solanum nigrum was analyzed the phytochemical and its effect as an antimicrobial against Salmonella typhi, and the results of that study indicated capability of managing typhoid fever, paratyphoid fever, salmonellosis and other nosocomial infections [92-94]. Phytochemical composition of liquid samples from S. nigrum consist of Sapponins, tannins, sterols, cardiac glycosides, flavonoids, terpenoids, alkaloids, and phenolic compounds [95-97]. Like Snigrum, Aplum gravelens also has antibacterial activity compare with gentamycin. Shown by alcoholic extract of A. gravelens in 25 °C with 200mg/ml the mean inhibition zone is 15 ± 0 Ad and in 37 °C with the same concentration inhibition zone mean ± 0.5 Ad is 14:33 but still less than inhibition zone of gentamycin with 17.3 ± 0.17 Ae [98,99]. A study from Nandagopal et al. (2007) also shows that root extract of Chichorium intybus L antibacterial effect against Salmonella typhi with maximum inhibition was observed with hexane solvent (19.2 ± 0.43mm). This result is better than inhibition zone of chloramphenicol with inhibition zone is 14 ± 0.23 mm as a negative control [100]. Ibuken et al. (2007), evaluates antimicrobial of Citrus aurantifolia for Salmonella typhi from aqueous extract with inhibition zone of 21 mm less than ciprofloxacin with 30 mm [101]. Terminalia bellerica also has anti-Salmonella activity. Compare with other plants such as Zofficinale, Arecemosus, P. kuruva and V. vinefera, T. bellerica have the highest diameter of inhibition zone with 20.0 ± 0.9 mm [102].

MATERIALS AND METHODS

This study, compared to other literature from many research focus on finding plants as a therapeutic agents from natural sources for the treatment of typhoid. Some studies related medicinal plants had been published to be
safe, less side effect and efisien for treating the diseases. This review was composed by literature searching on medicinal plants for typhoid fever in other country from the databases PubMed and Google Scholar with the keywords included “Salmonella typhi”, “Typhoid fever”, “Herbal Medicine”, “Medicinal plants for typhoid fever”, “anti-salmonella activity of plants”, “antibiotics resistance for typhoid fever” etc.

**CONCLUSION**
The phytochemical functions of some plants have been discovered, but the phytopharmaceutical benefits of other plants need to be studied, especially plants in Indonesia as potential treatment for typhoid fever. Flavonoids are the most phytochemical of the plants and have an antimicrobial effect for bacteria caused typhoid fever. There are 32 plants in Indonesia with antimicrobial effects that can be used as medicinal therapy for typhoid fever.

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**CONFLICT OF INTEREST**
The authors declare that they have no competing interests.

<table>
<thead>
<tr>
<th>No.</th>
<th>Plants</th>
<th>Local Name</th>
<th>Uses</th>
<th>Extraction</th>
<th>Effects</th>
<th>MIC</th>
<th>Zone Inhibition</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Azadirachta indica</td>
<td>Buah Mamba</td>
<td>Bark</td>
<td>Ethanol &amp; Methanol</td>
<td>Growth inhibition of bacterial on medium DPPH radical Scavenging Lipid Peroxidation</td>
<td>NM</td>
<td>20-25mm</td>
<td>35,103</td>
</tr>
<tr>
<td>2</td>
<td>Aegel marmelous</td>
<td>Buah Maja</td>
<td>Fruit Pulp</td>
<td>Methanol</td>
<td>Strong antimicrobial agent</td>
<td>≥256 µg/mL</td>
<td>≥9-15mm</td>
<td>36,104</td>
</tr>
<tr>
<td>3</td>
<td>Punica granatum</td>
<td>Buah Delima</td>
<td>Dried fruit peel</td>
<td>Methanol</td>
<td>Strong antimicrobial, antidiarrheal</td>
<td>≥32µg/mL</td>
<td>≥9-15mm</td>
<td>105</td>
</tr>
<tr>
<td>4</td>
<td>Myristica fragrans</td>
<td>Buah Pala</td>
<td>Fruit</td>
<td>Methanol</td>
<td>Strong antimicrobial</td>
<td>≥64µg/mL</td>
<td>≥9-15mm</td>
<td>27,30,36</td>
</tr>
<tr>
<td>5</td>
<td>Crinum purpurascens</td>
<td>Lili Jawa</td>
<td>Leaves</td>
<td>CH2Cl2/OH</td>
<td>Bactericidal</td>
<td>6mg/mL</td>
<td>25mm</td>
<td>37-38</td>
</tr>
<tr>
<td>6</td>
<td>Houttuynia cordata</td>
<td>Tanaman Pangkal Racun</td>
<td>Powder</td>
<td>Water</td>
<td>Phagocytic stimulation effect</td>
<td>NM</td>
<td>NM</td>
<td>39-40</td>
</tr>
<tr>
<td>7</td>
<td>Bidens pilosa</td>
<td>Ketus</td>
<td>Leaves</td>
<td>NM</td>
<td>Against typhoid fever</td>
<td>512µg/mL</td>
<td>12.5 ± 0.4 mm</td>
<td>41,43-44</td>
</tr>
<tr>
<td>8</td>
<td>Carica Papaya</td>
<td>Pepaya</td>
<td>Leaves</td>
<td>Chloroform</td>
<td>Potential Natural antibacterial compounds</td>
<td>NM</td>
<td>8.8mm</td>
<td>45-48, 54, 106</td>
</tr>
<tr>
<td>9</td>
<td>Cocus nucifera</td>
<td>Kelapa</td>
<td>Crude</td>
<td>Diethylether</td>
<td>antibacterial against s.typhii with high zone of inhibition</td>
<td>NM</td>
<td>20±0.5mm</td>
<td>49-52</td>
</tr>
<tr>
<td>10</td>
<td>Cymbopogon citratus</td>
<td>Serai</td>
<td>Leaves</td>
<td>Ethanol</td>
<td>highest zone inhibition as antibacterial against s.typhii</td>
<td>5-50mg/ml</td>
<td>22.67±0.88 mm</td>
<td>53-55, 107-109</td>
</tr>
<tr>
<td>11</td>
<td>Mangifera Indica</td>
<td>Mangga</td>
<td>Leaves</td>
<td>Ethanol</td>
<td>antimicrobial activity against s.typhii</td>
<td>100mg/ml</td>
<td>18mm</td>
<td>56,58-60,110</td>
</tr>
</tbody>
</table>

**Table 1. REVIEW OF INDONESIAN MEDICINE PLANTS IN ANTI SALMONELLA**
<table>
<thead>
<tr>
<th>No.</th>
<th>Common Name</th>
<th>Species Name</th>
<th>Part Used</th>
<th>Extraction</th>
<th>Activity</th>
<th>Concentration</th>
<th>Reference(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>Momordica</td>
<td>charantia</td>
<td>Leaves</td>
<td>Methanol</td>
<td>potent antimicrobial agents against S. typhi</td>
<td>NM</td>
<td>14mm</td>
</tr>
<tr>
<td>13</td>
<td>Psidium</td>
<td>guajava</td>
<td>Leaves</td>
<td>Water Extract</td>
<td>ability to treat the clinical symptoms of salmonella infection in rats</td>
<td>NM</td>
<td>NM</td>
</tr>
<tr>
<td>14</td>
<td>Solanum</td>
<td>lycopersicum</td>
<td>Fruit</td>
<td>Ethanol</td>
<td>Growth inhibition of salmonella typhi</td>
<td>NM</td>
<td>32.67mm</td>
</tr>
<tr>
<td>15</td>
<td>Zingiber</td>
<td>officinale</td>
<td>Leaves</td>
<td>Methanol</td>
<td>low activity against S. typhi</td>
<td>1.0mg/ml</td>
<td>5.4mm</td>
</tr>
<tr>
<td>16</td>
<td>Aloe vera</td>
<td></td>
<td>Leaves</td>
<td></td>
<td>Immunostimulator, Increase activity of macrophage and monocyte t (in vitro), activated ROS (in vivo)</td>
<td>NM</td>
<td>NM</td>
</tr>
<tr>
<td>17</td>
<td>Allium</td>
<td>Sativum</td>
<td>Raw</td>
<td>Water</td>
<td>Produce higher antimicrobial activity</td>
<td>0.01%</td>
<td>23.8mm</td>
</tr>
<tr>
<td>18</td>
<td>Euphorbia</td>
<td>fusiformis</td>
<td>Root stock</td>
<td>Acetone</td>
<td>Antimicrobial agent s. typhi</td>
<td>NM</td>
<td>12mm</td>
</tr>
<tr>
<td>19</td>
<td>Lagenaria</td>
<td>siceraria</td>
<td>Fruit peel</td>
<td>Aqueous</td>
<td>Antimicrobial agent s. typhi</td>
<td>&gt;125 0μg/ml</td>
<td>±17mm</td>
</tr>
<tr>
<td>20</td>
<td>Solanum</td>
<td>tuberosum L</td>
<td>Fruit peel</td>
<td>Chloroform</td>
<td>Antimicrobial agent s. typhi</td>
<td>NM</td>
<td>9mm</td>
</tr>
<tr>
<td>21</td>
<td>Ananas</td>
<td>comos</td>
<td>Fruit peel</td>
<td>Chloroform</td>
<td>Antimicrobial agent s. typhi</td>
<td>NM</td>
<td>9.3mm</td>
</tr>
<tr>
<td>22</td>
<td>Luffa</td>
<td>acutangula</td>
<td>Fruit peel</td>
<td>Methanol</td>
<td>Antimicrobial agent s. typhi</td>
<td>NM</td>
<td>9mm</td>
</tr>
<tr>
<td>23</td>
<td>Ocimum</td>
<td>sanctum</td>
<td>Leaves</td>
<td>Ethanol</td>
<td>Antibacterial activity</td>
<td>250-500μg/ml</td>
<td>11-13mm dan 16-24mm</td>
</tr>
<tr>
<td>24</td>
<td>Moringa</td>
<td>oleifera</td>
<td>Leaves</td>
<td>Ethanol</td>
<td>Antimicrobial agent</td>
<td>8mg/ml</td>
<td>8mm</td>
</tr>
<tr>
<td>25</td>
<td>Manilkara</td>
<td>zapota</td>
<td>Leaves</td>
<td>Ethyl acetate</td>
<td>Antibacterial Activity</td>
<td>512μg/ml</td>
<td>9mm</td>
</tr>
<tr>
<td>26</td>
<td>Ocimum</td>
<td>gratissimum</td>
<td>Leaves</td>
<td>Water Extract</td>
<td>Antimicrobial agent and antidiarrheal</td>
<td>0.1%</td>
<td>26 mm</td>
</tr>
<tr>
<td>27</td>
<td>Solanum</td>
<td>nigrum</td>
<td>Plants</td>
<td>Methanol</td>
<td>Antimicrobial activity</td>
<td>0.50g/ml</td>
<td>NM</td>
</tr>
<tr>
<td>28</td>
<td>Apium</td>
<td>graveolens L</td>
<td>Plants</td>
<td>Ethanol</td>
<td>Antimicrobial activity</td>
<td>200mg/ml</td>
<td>14.3-15mm</td>
</tr>
<tr>
<td>29</td>
<td>Cichorium</td>
<td>intybus</td>
<td>Roots</td>
<td>Hexane</td>
<td>Antimicrobial activity</td>
<td>100μg/ml</td>
<td>19.2±0.43 mm</td>
</tr>
<tr>
<td>30</td>
<td>Citrus</td>
<td>auranitifolia</td>
<td>Fruit</td>
<td>Aqueous</td>
<td>Antimicrobial activity</td>
<td>512μg/ml</td>
<td>21mm</td>
</tr>
<tr>
<td>31</td>
<td>Terminalia</td>
<td>belerica</td>
<td>Fruit</td>
<td>Water extract</td>
<td>Antisalmonella agent</td>
<td>12.5 mg/ml</td>
<td>20.0±0.9 mm</td>
</tr>
<tr>
<td>32</td>
<td>Glycyrrhiza</td>
<td>glabra</td>
<td>Seed</td>
<td>Methanol</td>
<td>Antimicrobial activity</td>
<td></td>
<td>103</td>
</tr>
</tbody>
</table>

**NM**: Not mentioned

**REFERENCES**


http://dx.doi.org/10.1016/s0367-326x(01)00261-1


http://dx.doi.org/10.18052/www.sciexpress.com/ILN S12.16


http://dx.doi.org/10.1590/1414-431X20154773

http://dx.doi.org/10.13040/IJPSR.09758232.9(4).1628-1631


http://dx.doi.org/10.7537/jissn.1545-0740

http://dx.doi.org/10.5897/PP2013.0291


https://doi.org/10.3923/pjbs.2003.195.197

https://doi.org/10.9734/JAMPS/2017/31126

https://doi.org/10.3390/ijms18040897

https://doi.org/10.1186/s12906-017-1802-4

https://doi.org/10.3923/ajdd.2014.85.89

https://doi.org/10.3329/icpjt.v5i10.29523


https://doi.org/10.1155/2017/1583510


http://dx.doi.org/10.5897/PP2013.0291

https://doi.org/10.3923/ajdd.2014.85.89

https://doi.org/10.3329/icpjt.v5i10.29523


94. Dhama, K., Tiwari, R., Chakraborty, S., Saminathan, M., Kumar, A., Karthik, K., ... & Rahal, A. (2016). Evidence based antibacterial potentials of medicinal plants and


