Seablite or *Suaeda maritima* (L.) Dumort, a salt marsh plant growing in mangrove forest widely distributed on the landward margin of mangrove habitats of Thai Gulf and Southern of Thailand. Thai traditional medicine is using *S. maritima* root for abscess healing, allergic symptom relief and treatment of skin diseases. However, biological properties of *S. maritima* root are very sparsely reported. In this study was attempt to evaluate antioxidant and anti-inflammation properties besides presence of phytochemicals in *S. maritima* root. Roots were extracted with 95% ethanol by maceration. Total phenolic content (TPC) and total flavonoid content (TFC) of *S. maritima* root extract was determined by colorimetric absorbance of reaction mixture measurements. Antioxidant property of *S. maritima* root extract was evaluated by DPPH, NO radical scavenging and lipid peroxidation inhibition. In vitro anti-inflammatory of *S. maritima* root extract was evaluated by inhibition of NO production of LPS-induced macrophages. TPC and TFC were 37.39±0.46 mg of GAE/g and 67.41±0.27 mg of QE/g, respectively. Extract was strongly inhibited DPPH radical and lipid peroxidation (IC₅₀ = 0.22 ±0.2 and 2.75±0.5 mg/ml). However, *S. maritima* root extract was poorly inhibited NO radical (IC₅₀ > 1,000 mg/ml). *S. maritima* root extract was reduced NO production from LPS-induced macrophage cells (20.5±2.8%). There was 0.6 time of anti-inflammatory activity from triamcinolone acetonide at same concentration (0.1 mg/ml). Ethanol extract of *S. maritima* root was contained flavonoids as most of bioactive compounds and possessed preferable in vitro antioxidant and anti-inflammatory properties.

**Keywords:** antioxidant, anti-inflammatory, seablite root, *Suaeda maritima*, traditional medicine.

## INTRODUCTION

Halophytes are habitat about one percentage of land plants, which can be survive and breed under salinity of wetland as extreme condition [1]. Morphological, physiological and biochemical adaptations of halophytes both at a cellular and molecular level in the whole plant or in particular tissues are reduced harmful effects from excessive salinity [1]. There have been applied in ethno-pharmaceutical uses due to nutritional and biological benefits.
Active metabolites are often occurrence in halophytes, which is protected oxidative damage from salty and UV-irradiate environment such as phenolic compounds and/or some vitamins with antioxidant properties [2]. Thus, halophytes are food sources with health promoting properties by high nutritive value plus antioxidant metabolites [3]. Seablite or *Suaeda maritima* (L.) Dumort, a salt marsh plant growing in mangrove forest widely distributed on the landward margin of mangrove habitats of Thai Gulf and Southern of Thailand [4, 5]. Young leaves can be edible both fresh or cooked vegetable, which are quite salty taste. Local Thai cuisine has different preparing processes for reduce salty taste and providing various menu including traditional *S. maritima* salad, *S. maritima* curry with crabs, or scalded *S. maritima* with chili paste [5]. There is also use as animal feeding [6]. Leaf and stem extracts from *S. maritima* had possessed antioxidant properties assayed with total antioxidant capacity, DPPH radical scavenging activity, metal chelating, ferric reducing power and nitric oxide scavenging activity; and phenolic and ascorbic acid contents had contained [7]. Phytochemicals of leaf and stem extracts had contained higher amount of carbohydrates, protein, tannins, alkaloids and flavonoids [7]. Hepatoprotective effect with antioxidant property of ethanol extract *S. maritima* has been also report in animal model [8]. Thai traditional medicine is using *S. maritima* root for bone enrichment, hair loss prevention, abscess healing, allergic symptom relieves and treatment of skin diseases. However, biological properties of *S. maritima* root are very sparsely reported. In this study was attempt to evaluate antioxidant and anti-inflammation properties besides presence of phytochemicals in *S. maritima* root. Finding is providing bioefficiency of *S. maritima* root for its pharmaceutical applications.

**MATERIALS AND METHODS**

**Plant Collection and Preparation**

*S. maritima* were collected from salt pan area, which located nearby College of Allied Health Sciences, Suan Sunandha Rajabhat University, Samut Songkram, Thailand. Botanical characteristics of herbs were authenticated [4] by senior botanist. *S. maritima* root (1 kg) was washed, cutting in small pieces, dried in an oven at 45°C and grinding. Ground of *S. maritima* root was macerated with 95% ethanol (3 days) and concentrated under by evaporator under vacuum.

**Evaluation of Bioactive Compounds**

Total phenolic content (TPC) of *S. maritima* root extract was determined by Folin-Ciocalteu method. Colorimetric absorbance of reaction mixture was measured at 760 nm. Range of gallic acid concentrations were used as standard curve. TPC was represented as mg of gallic acid equivalent (GAE) per g [9, 10, 11]. Total flavonoid content (TFC) of *S. maritima* root extract was determined by aluminium chloride colorimetric method. Colorimetric absorbance of reaction mixture was measured at 420 nm. Range of quercetin concentrations were used as standard curve. Flavonoid content was represented mg of quercetin equivalent (QE) per g [9, 12].

**In Vitro Antioxidant Assays**

DPPH radical scavenging activity: 2,2-diphenyl-1-picrylhydrazyl (DPPH) radical in present of *S. maritima* root extract (0.01-1 mg/ml) was reduced DPPH absorbance. DPPH radical (6×10⁻² M) and ascorbic acid were used as negative and positive controls, respectively [7, 8, 13]. Lipid peroxidation inhibition (LPI) activity: lipid peroxidation in present of *S. maritima* root extract (0.001-10 mg/ml) was reduced absorbance of ferric iron-thiocyanate complex. α-tocopherol was used as positive control [7, 8, 14]. NO radical scavenging activity: nitric oxide (NO) radical in present of *S. maritima* root extract (0.01-1 mg/ml) was reduced absorbance of Griess reagent reaction. Ascorbic acid was used as positive control [7, 8, 15]. Absorbance reaction mixture of all assays were monitored by micro-titer plate reader at maximum absorbance wavelength (λmax). Results was calculated from triplicate measurements and interpreted as 50% inhibitory concentration (IC₅₀) of *S. maritima* root extract.

**In Vitro Anti-Inflammatory Test**

Monitoring of NO inhibition produced from lipopolysaccharide (LPS)-induced macrophage cells was used to evaluate anti-inflammatory activity of ethanol extract from *S. maritima* root. Briefly, mouse macrophage cell (RAW264.7) was obtained from Thailand Institute of Scientific and Technological Research (TISTR), Pathum Thani, Thailand. Cells were seeded in high-glucose Dulbecco’s modified Eagle’s medium (containing 10% fetal bovine serum, 100 U/mL penicillin, and 100 µg/mL streptomycin) and incubated at 37 °C (containing 5% CO₂) in humidified incubator. After overnight culture in a 24-well plate (1 × 10⁵ cells/well, 500 µL medium/well), the cells were pre-treated with herbal mixture for 1 h and lipopolysaccharide (LPS) for an additional 24 h, the culture supernatant from each well was collected and used to measure NO production. 50 µl of culture medium and 100 µl of Griess reagents were added and incubated in a 96-well plate at room temperature (10 min). Absorbance of reaction mixture was then measured using a microplate reader [15, 16, 17]. Triamcinolone acetonide (0.1 mg/ml) was used as positive control. Results was calculated from triplicate measurements and interpreted as 50% inhibitory concentration. This study had exempted by Suan Sunandha Rajabhat University Ethic Committees, Thailand (COE.1-099/2022).

**STATISTICAL ANALYSIS**

Bioactive compounds, antioxidant and anti-inflammatory activities of *S. maritima* root were represented by descriptive
statistics and compared with controls.

RESULTS

After ethanol extraction, characteristics of *S. maritima* root extract was semi-solid and had dark brown color. TPC and TFC of *S. maritima* root extract were 37.39±0.46 mg of GAE/g and 67.41±0.27 mg of QE/g, respectively. Extract was strongly inhibited DPPH radical and lipid peroxidation (IC$_{50}$ = 0.22 ±0.2 and 2.75±0.5 mg/ml) and can comparable with ascorbic acid and α-tocopherol, respectively. However, *S. maritima* root extract was poorly inhibited NO radical (IC$_{50}$ > 1,000 mg/ml) (Table 1). *S. maritima* root extract was reduced NO production from LPS-induced macrophage cells (20.5±2.8%). There was 0.6 time of anti-inflammation activity from triamcinolone acetonide at same concentration (0.1 mg/ml). Therefore, anti-inflammation activity of extract was unevaluated in higher concentration due to color interference on absorbance measurement (Table 2).

<table>
<thead>
<tr>
<th>Sample / Assay</th>
<th>TPC</th>
<th>TFC</th>
<th>DPPH</th>
<th>NO</th>
<th>LPI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethanol extract</td>
<td>188.34±2.96</td>
<td>19.24±1.59</td>
<td>0.06±0.00</td>
<td>1.30±0.2</td>
<td>502.4±21.97</td>
</tr>
<tr>
<td>α-tocopherol</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0.39±0.10</td>
</tr>
<tr>
<td>Ascorbic acid</td>
<td>-</td>
<td>-</td>
<td>0.03±0.01</td>
<td>0.25±0.05</td>
<td>-</td>
</tr>
</tbody>
</table>

Table 2: Anti-inflammation activity and cytotoxicity of *S. maritima* root extract

<table>
<thead>
<tr>
<th>Sample / Conc. (mg/ml)</th>
<th>Inhibition of NO production (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.001</td>
</tr>
<tr>
<td>Ethanol extract</td>
<td>ND</td>
</tr>
<tr>
<td>Triamcinolone acetonide</td>
<td>27.8±4.9</td>
</tr>
</tbody>
</table>

a Inhibition of NO production from lipopolysaccharide (LPS)-induced macrophage represented as percentage; b Sample color was interfered NO measurement; ND = Not determined

DISCUSSION

There was first report on antioxidant and anti-inflammation of *S. maritima* root rather than leaf, which had been already reported [5-8]. We had confirmed antioxidant and anti-inflammation activities that may corresponded to Thai medicinal used such as, abscess healing, allergic symptom relieves and dermatitis treatment. In case of skin infection, *S. maritima* root is need to evaluate for anti-microbial activity against pathogenic bacteria including *Staphylococcus aureus* and *Cutibacterium acnes*, and pathogenic yeast including *Candida albicans* and *Malassezia furfur*. The use of *S. maritima* root on bone enrichment and hair loss prevention is still scientific unsupported. Some of halophytes were reported in uses of traditional medicine and confirmed on relating biological properties. Roots of the halophyte *Polygonum maritimum* L. are used in traditional medicine in Asia, Europe and Africa to treat inflammation and diabetes and scientific data on antioxidant, anti-inflammation and anti-diabetic properties had supported [18, 19]. *Limonium* spieces are important halophytes containing a variety of bioactive compounds of medicinal interest. *Limonium* root extracts from some species including *L. bellidifolium*, *L. globuliferum*, *L. gmelinii*, *L. lilacinum*, *L. sinuatum* and *L. iconicum* were potent antioxidant properties along with various assays including DPPH and ABTS radical scavenging and metal chelating properties [20].

The *Limonium* root extracts had found as active inhibitors of key enzymes such as, acetylcholinesterase, butryrylcholinesterase, amylase, tyrosinase and glucosidase, which are play roles in various diseases [20]. In addition, L. gmelinii root extract had protective responded to oxidative stress in brain and can improve motor functions both in vitro and in vivo model [21]. Hence, we are suggested that further studies will be conduct on evaluation of key enzyme inhibition by *S. maritima* root and its bioactive compound characterizations.

CONCLUSION

Ethanol extract of *S. maritima* root was contained flavonoids as most of bioactive compounds and possessed preferable antioxidant and anti-inflammation properties.

ACKNOWLEDGEMENTS

We are sincerely thanking to Suan Sunandha Rajabhat University, Bangkok, Thailand for research funding and technical supports. We are thankful to Asst. Prof. Dr. Pimporn Thongmuang, College of Allied Health Science, Samut Songkhram Education Canter, Suan Sunandha Rajabhat University, Samut Songkhram, Thailand as senior pharmacist was provided herbal identification.

CONFLICT OF INTEREST

There is no conflict of interest in this study

REFERENCES

3. Bernal J, Mendiola JA, Ibáñez E, Cifuentes A. Advanced analysis of