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ETLINGERA ELATIOR AS A NATURAL DEODORIZER TOWARDS THE STEEPING OF ULVA LACTUCA SEAWEED

Prasetya Laurensius Luky*, Student
Master's Program of Aquatic Resources Management, Faculty of Fisheries and Marine Science, University of Diponegoro, Semarang, Indonesia

Agustini Tri Winarni, **Dewi Eko Nurcahya**
Department of Aquatic Resources Management, Faculty of Fisheries and Marine Science, University of Diponegoro, Semarang, Indonesia

*E-mail: lukyprasetya024@gmail.com

ABSTRACT
There are several challenges to utilizing *U. lactuca* as a seaweed steeping powder, such as an unpleasant odour caused by off-odor volatile compounds, i.e. the group of fatty acid derivatives, several aldehyde compounds, and some compounds containing sulphur. This research aimed to produce steeping of *U. lactuca* seaweed immersed in a natural deodorizer, Torch Ginger (*E. elatior*) extract, with different treatments to eliminate the off-odor scent. The research consisted of one factor, which was immersion using *E. elatior* extract with a concentration 0% (sample A), 10% (sample B), 20% (sample C), 30% (sample D), and 40% (sample E). The data was analyzed using SPSS v.21 of ANOVA. If there was any significant effect, the data were further analyzed using *Duncan Multiple Range Test* with significance level 5%. According to the research, the result showed that the immersion treatment in *E. elatior* extract had a significant effect ($p<0,05$) on the observed variables i.e. moisture, crude fiber, dietary fiber in the steeping, impurities, total of polyphenol, RSA DPPH, and sensory test on the steeping (color, flavour, taste, turbidity, appearance, and total), but not significantly affected ($p>0,05$) on the water extract observation variable. A concentration of 40% of *E. elatior* (Sample E) was concluded as the best treatment with characteristics as follows: moisture 3,89 ± 0,05%, crude fiber content 6,73 ± 0,03%, water-soluble dietary fibre 2,18 ± 0,01%, water-insoluble dietary fiber 24,58 ± 0,04%, crude impurities 3,48 ± 0,07, in-water extract 65,90 ± 44,43%, a total of phenolic 391,35%, and antioxidant activity 20,61%.

KEY WORDS
U. lactuca, seaweed steeping, natural-deodorizer, immersion, properties.

Seaweed steeping is an invention of herbal steeping. Seaweed steeping is different from other herb steepings due to demineralization in the powdering process. Demineralization is the removal process of minerals from the fresh seaweed that encounter the diminution and immersed in a low pH solution, likely in a solution produced from a fresh material such as a fresh fruit, fresh flower, or other parts of plant.

Vitamin C of *U. lactuca* increases fat metabolism, making it suitable for a diet supplement. *U. lactuca* is rich with bioactive compounds to reduce cholesterol, as an antiinflammation, antihypertension, and *antineuroplastic. U. lactuca* is also rich with pigmentation flavonoid compounds such as *violaxanthin*, *astaxanthin, lutein* (Kolanjinathan dan Stella 2011). Kolanjinathan dan Stella (2011) stated that the diversity of secondary metabolite compound in *U. lactuca* create a high antimicrobial activity on many pathogens' microorganism in human such as *Enterobacter aerogenes*, *Staphylococcus aureus, Bacillus subtilis, B. cereus, Eschericia coli, Salmonella thypii* and so on.

Utilization of *U. lactuca*, in addition to the explanation above, also requires considering the green macroalgae blooms becomes a severe problem in several countries. Green tides/ulvoid alga blooms, according to Handayani (2014) caused by *U. lactuca* green algae that are quickly reproduce and blooms because of the rapid proliferation (repetition of the cell

cycle). Green tides phenomenon negatively impacts the seawater ecosystem, as there is a competition about oxygen and sunlight that the below sea biota cannot survive because the surface is full of algae.

There is one big challenge in utilizing *U. lactuca* for medical, cosmetics, and powder preparations. The challenge concerns the unpleasant odor caused by the volatile compound of *U. lactuca*. Research about the unpleasant odor on *U. lactuca* had been performed by Sugisawa *et al.,* (1990) in Lekraj (2014) studied that volatile compound of green algae consisted of 67 compounds, including 12 hydrocarbon, 28 aldehyde, 10 terpen compounds, 7 alcohols, and 10 of sulphur compounds.

The challenge becomes the reason for immersion treatment using Torch Ginger (*Etlingera elatior*) on *U. lactuca*. Jaafar *et al*., (2007) in Lianah*, et al.,* (2020), stated that the *natural deodorizer* ability of Torch Ginger *E. elatior* correlated to essential oils and the constituent components. The extract of *E. elatior* in Dina *et al*., (2017) research showed the ability to reduce the smell of the beef during the storage period. Hendra and Oktaviani (2020) stated that *E. elatior* immersion in processed fish product eliminates the odour and add a unique flavour to the fish. The aromatic phenol and terpene compounds of E. elatior shall cover the off smell. The research aims to produce a *U. lactuca* seaweed steeping given a natural Torch Ginger (E. elatior) deodorizer with different concentrations. Analysis of moisture, crude fiber, dietary fiber in the immersion, extract in the water, impurities, total of polyphenol, RSA DPPH, volatile compounds, and sensory test on the steeping (color, flavour, taste, turbidity appearance, and total) from the steeping of *U. lactuca* seaweed in the immersion of Torch Ginger (*E. elatior*) were performed in the research.

MATERIALS AND METHODS OF RESEARCH

The primary material in the research was *U. lactuca* obtained from Kukup Beach in the karst beach area of Gunung Kidul regency. A fresh *E. elatior* was obtained from one of the Torch Ginger farms in Semarang. Other materials such as filter paper, aquades, and other chemical materials are required for the research analysis.

Equipment used in the research were Ohaus PAJ 1003 (US) analytical weighting scale, cabinet drying, Homogenizer WiseTis HG-15A (Germany), Spectrophotometer UV-Vis Hitachi Double Beem (Indonesia), Sonicator Branson CPX2800H (Switzerland), centrifuge (Germany), Iwaki (Japan) glassware, and Pyrex (France), porcelain disk, vacuum oven, OneMed (Germany) micropipette, Boeco Vortex mixer (Germany), GC-MS Agilent 7890A/5975C (US).

Meanwhile, the research materials including filter paper, filter cloth, aquades, gallic acid powder, follin-ciocalteau reagent powder, Na_2CO_3 powder, H_2SO_4 solution, NaOH solution, HCl solution, 95% Ethanol, Acetone solution, pH 8,2 buffer solution, methanol 70%, DPPH solution, BHA liquid, 98% Ethanol, and 95% quercetin.

Sample preparation for *U. lactuca*, demineralization was initially performed, followed by diminution, and grinding. As a preparation sample of *E. elatior*, drying was first performed, followed by extracting using aquades per the determined treatment. Therefore, sample A (immersion of *U. lactuca* in 0% *E. elatior* extract/without immersion), sample B (immersion of *U. lactuca* in 10%), sample C (immersion of *U. lactuca* in 20%), sample D (immersion of *U. lactuca* in 30%), sample E (immersion of *U. lactuca* in 40%), immersion process was after the demineralization process of *U. lactuca,* before the drying process. The obtained data from the observation was subsequently analyzed using SPSS of ANOVA (Analysis Of Variance). A further test was performed for any significant result, using DMRT (*Duncan Multiple Range Test*) with a significance level of 5%. Observation variables are as follows:

Physical Properties:

- Extract In the Water (SNI 3753:2014):

Water extraction was measured by dissolving 2 grams of *U. lactuca* into 200 ml of boiling water. Extract in the water content was measured using the following formula:

$$\text{Extract in the water (\%)} = \frac{W2-W0}{W1-W0} \times P\ X\ \frac{100}{100-KA} \times 100\%$$

- Crude Impurities (SNI 8169:2015):

Crude impurities were measured by weighing 250 grams of dried seaweed immersed in 2 L of clean water for 30 minutes. Physical dirt, likely dust or salts. Crude Impurities were measured using the formula:

$$\text{Crude Impurities (\%)} = \frac{Wd}{W0} \times 100\%$$

Where: W0 - weight of the sample used for analysis (g); Wd - weight of dirt and other foreign substances (g).

Chemical Properties:

- Moisture (SNI 2354.2: 2015):

Moisture was measured using the gravimetry method. The moisture resulted from the sample's weight that had been dried with the initial sample weight (± 2 gram) in 100 grams of material. Moisture was calculated using the formula as follows:

$$Moisture = \frac{B-C}{B\ -A} \times 100\%$$

Remarks: A - weight of empty disk, expressed in grams (g); B - weight of disk + initial sample, expressed in grams (g); C - weight of disk + dry sample, expressed in grams (g).

- Crude Fiber (SNI 3753:2014):

Crude fibre content was analyzed by hydrolyzing the sample using strong acid and base liquid. The carbohydrate, protein, and other hydrolyzed substances were dissolved. Then, the samples were filtered and washed using hot water containing acid and alcohol. After that, the samples were dried, burned, and weighed. The crude fibre was calculated using the formula as follows:

$$Crude\ Fiber\ Without\ Burning\ (A)\ (\%)\ = \frac{W2-W1}{W} \times 100\%$$

$$Fiber\ Ash\ (B)(\%) = \frac{W4-W3}{W} \times 100\%$$

$$Crude\ Fiber\ (\%) = \ A-B$$

Where: W - weight of the sample, expressed in grams (g); W1 - weight of filter paper, expressed in grams (g); W2 - weight of filter paper + sediment, expressed in grams (g); W3 - weight of empty disk, expressed in grams (g); W4 - weight of disk and ash, expressed in grams (g); A - crude fibre without burning, expressed in %; B - fibre ash, expressed in %.

- Analysis of Dietary Fiber in the Steeping (AOAC 991.43.2007):

Analysis was performed in 0,5 grams sample of dried *U. lactuca*, with the help of pH 8,2 buffer reagent, amylase, protease, HCl, ethanol, and acetone. The process was conducted gradually, from heating and incubation until drying using an oven. The sample from the oven was then weighed and calculated using the formula as follows:

$$Dietary\ Fiber\ Rate\ (\%) = \frac{average\ weigh - residual\ average - (gram\ protein + gram\ ash)}{sample\ weight} \times 100\%$$

- Total of Polyphenols (SNI 06-6989.21-2004):

The total of polyphenols was measured using the spectrophotometry method. The method uses the preaction of pholine-ciocalteu and sodium carbonate solution (Na_2CO_3) as a control solution. Poliphenols content was measured with the absorbance wavelength of 765 nm. The total of polyphenols was calculated using the formula as follows:

$$Total\ poliphenols\ (\%) = \frac{D.sample\ -\ D.intercept \times V.sample\ \times d}{S.std\ \times m\ .sample \times 1000\ \times WDM.sample} \times 100\%$$

Where: D. sample - Absorbance of sample solution; D. intercept - Absorbance obtained for the bank solution concentration; S. std - Calibration curve slope; m. sample - Mass of test sample, expressed in grams (g); V. sample - Volume of sample extraction solution, expressed in millilitre (mL); D - Dilution factor; WDM sample - Sample weight based on dry matter, expressed in % (mass fraction).

- Volatile compounds (Hulburt, *et al.,* 2009):

Volatile compounds test using a Solid Phase Micro-Extraction method using *dimethyl sulfide* (100 ppm in methanol). The solution is then diluted into 200 ppb in hexane to produce a stock solution. Determined in standing phase 0,25 µm, Ion produced by the volatile compounds on U. lactuca, and E. elatior Ion then was observed in the 100 µs. The quantity of each volatile compound was determined from the area width, both *U. lactuca* and *E. elatior.*

- RSA test – DPPH (Vasi dan Austin, 2009):

It was analyzed using the method from Vasi and Austin (2009). The measurement of *radical scavenging activity* (RSA)-DPPH EBD was done following the procedure from Vasi and Austin (2009). Shortly, a total of 0.5 mL *U. lactiuca* with different concentrations (10,25,50, 75,100, 150, and 200 ppm) in ethanol 50% + 0,5 mL 2,2-diphenyl-1-picryl hydroxyl radical (DPPH)-100 µM. *Radical scavenging activity* DPPH was observed by reading the absorbance value on Z=517 nmUV-Vis spectrometer (UV-1601 Shimadzu). The experiment was done three times. Vitamin C, BHA and quercetin were used as a comparison. Radical scavenging activity DPPH can be calculated using the formula below:

$$\text{RSA DPPH (\%): } 1 - [\frac{OD\ sample}{OD\ blanko}] \times 100\%$$

- Multisensory Evaluation (SNI 01-2346-2015):

The test was performed with 30 panellists. The sample was in the steeping form and brewed with warm water (50^{o}C) with three strings. The samples were served in 16 ml. The evaluation was conducted towards colour, flavour, taste, turbidity, and total.

RESULTS AND DISCUSSION

Immersion of *E. elatior* did not give any significant effect (p>0,05) towards extract in the water. Extract in the water is the amount of powder that could be dissolved.

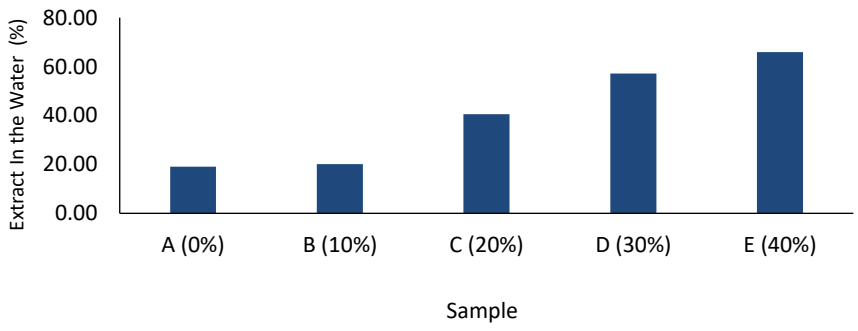

Figure 1 – Extract in the water in steeping *U. lactuca* seaweed under the soaking condition of *E. elatior*

Extract in the water showed the ability of the granule of seaweed steeping to disperse and dissolve in the water. The higher the percentage of extract in the water, the easier the U. lactuca seaweed steeps to dissolve in the water. The drying process increases the soluble dietary fibre content by decreasing the crude fibre content of powder, which could reduce the percentage of extract in the water (Gonzalez-Jimenez, *et al.,* 2022). The crude fibre and

protein content affect the amount of extract in the water. The lower the crude fibre content, the higher the extract in the water rate. The escalation of protein content also increases the extract in the water rate. Crude fiber is filled with non-soluble fractions. Meanwhile protein has hydrophilic and hydrophobic sides, which influence the extract in the water rate (Yaich, *et al.,* 2011),

The immersion in *E. elatior* significantly affected crude impurities (p<0,05). Figure 2 shows the crude impurities of *U. lactuca* seaweed steeping.

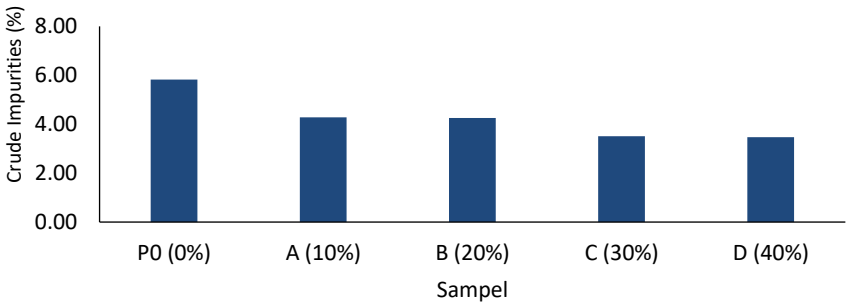

Figure 2 – Crude Impurities in steeping *U. lactuca* seaweed under the soaking condition of *E. elatior*

The rate of impurities influences the pace of the drying process of seaweed. A seaweed which still has a high impurity would be harder to dry because of the mineral content and other physical impurities that make *U. lactuca* becomes moist and slimy. The slime would cover the surface of the seaweed and obstruct the water evaporation of *U. lactuca* (Wahyuni, 2018). Crude Impurities refer to the amount of polluter/impurities absorbed or stuck to the dry *U. lactuca*. Crude impurities were measured by observing the physical dirt in the water to immerse the dry *U. lactuca* for 30 minutes. Nowadays, seawaters contain various pollutants. Various physical impurities, such as beach sand and metal in the water, may pollute the *U. lactuca seaweed*. *U. lactuca* naturally contains many minerals (Kurniawan, *et al*., 2019). Decreasing crude impurities rate is influenced by the immersion in the acid solution, i.e., *E. elatior*. Immersion in an acid solution would reduce the physical impurities, likely physical dirt and mineral. The mineral has a high solubility in organic acid or low-pH liquid (Perangin-angin, *et al*., 2015).

E. elatior under soaking condition influence water content significantly (p<0,05). Figure 3 shows the water content of *U. lactuca* seaweed steeping.

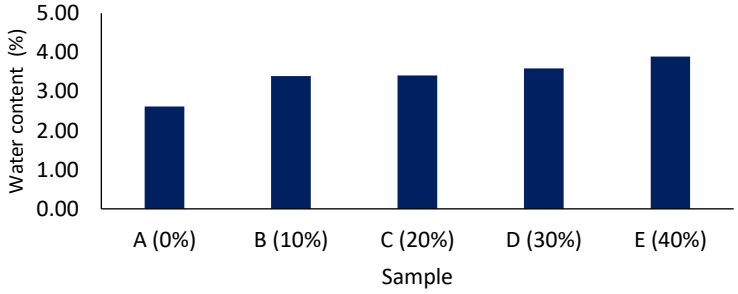

Figure 3 – Water content in steeping *U. lactuca* seaweed under the soaking condition of *E. elatior*

Low or high-water content will affect the quality of the final product. This is because molecules in the water are reactive molecules and easily react with components inside and outside food products. This characteristic is highly related to hydrogen molecules in the water (Saputri and Purwayantie, 2022). The water content of *U. lactuca* seaweed steeping is one of the main components determining the quality of soaking water. The water content in *U. lactuca* seaweed steeping determine the flowability of seaweed *U. lactuca* and consequently

determined wettability and solubility. The water content will increase along with the increase in soaking of *E. elatior*, caused by the rise in water content and *E elatior* extract. Fresh *U. lactuca* has a water content of about 16.9%, and when it dried the water content will decrease by about 10% to 20%., while the water extract of *E. elatior* has a water content of about 95%, so that the water content increases (Sukandar, et al., 2010; Da Costa, et al., 2016).

E. elatior under soaking condition significantly influence crude fibre content ($p<0,05$). Figure 4 shows crude fibre content in *U. lactuca* seaweed steeping.

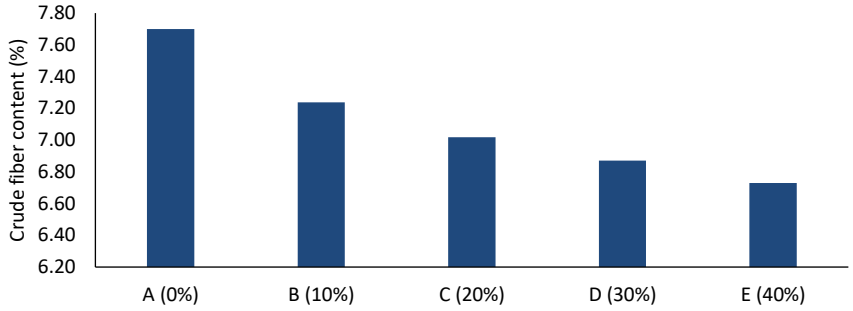

Figure 4 – The crude fibre content in steeping *U. lactuca* seaweed under the soaking condition of *E. elatior*

The crude fibre content of *U. lactuca* differed from other ulva's varieties. This crude fibre content composed the cell wall of *U. lactuca* and made it more rigid and compact than the cell wall of *U. linzea* and *U. compresa* (Ismail and Mohamed, 2017). Crude fibre is a portion of insoluble water of dietary fiber. The preliminary treatment of seaweed under soaking conditions lowers the crude fibre content in instant seaweed steeping drinks. This is because the crude fiber in fresh *U. lactuca* comes from carbohydrate content (starch polysaccharides) and comes from plant cell walls, such as cellulose and lignin (non-starch polysaccharides). Starch polysaccharides in *U. lactuca* is reported up to 54,93% (Sirbu, *et al.,* 2020), while Da Costa*, et al.,* (2018) mentioned that fresh *U. lactuca* can have starch polysaccharides up to 62,93%.

E. elatior under soaking condition significantly influence water-soluble dietary fibre content ($p<0,05$). Figure 5 shows the water-soluble dietary fibre content of *U. lactuca* seaweed steeping.

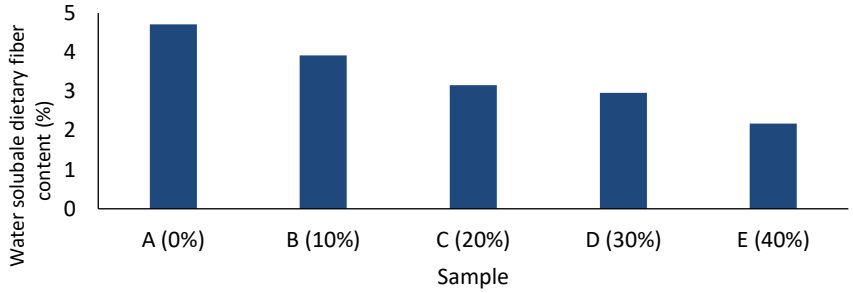

Figure 5 – Water-soluble dietary fibre content in steeping *U. lactuca* seaweed under the soaking condition of *E. elatior*

The water-soluble dietary fibre content of *U. lactuca* seaweed will increase its dispersibility when it is soaked in the water. *U. lactuca* is known due to its high water-soluble dietary fibre content, reaching up to 27,20%. The water-soluble dietary fibre content of *U. lactuca* is polysaccharides such as rhamnose (31%), cellulose (9.4%), glucuronic acid (19,2%), and glucose (9,2%) (Qing, *et al.,* 2016). The decrease in water-soluble dietary fibre

and the increase in U. lactuca steeping is caused by E. elatior containing less water-soluble dietary fibre. However, *E. elatior* also had polysaccharides that comprise plant petals, including rhamnose, galacturonate, and glucan. Still, the percentage is less than in *U. lactuca* (Rackheeree, et al., 2018).

E. elatior under soaking condition significantly influence water-insoluble dietary fibres ($p<0,05$). Figure 6 shows the water-insoluble dietary fibres of *U. lactuca* seaweed steeping.

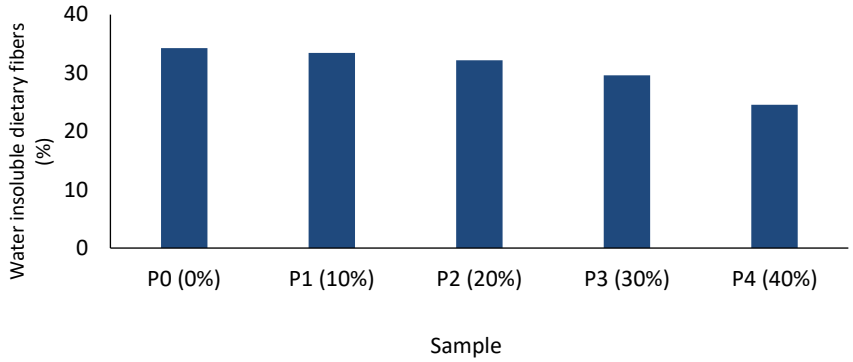

Figure 6 – Water-insoluble dietary fibres in steeping U. lactuca seaweed under the soaking condition of E. elatior

Insoluble dietary fibre is part of the plant cell wall. Insoluble dietary fibre includes crude fibre, resistant starch, and non-starch polysaccharides. Insoluble dietary fibre in fresh *U. lactuca* is known to be 34.37%, including a small part of ulvan components, ulvan is a polysaccharide that makes up the cell wall of *U. lactuca*, and as much as 24.2% of ulvan is water-insoluble dietary fibre (Qing, et al., 2016). The decrease in crude fibre content in *U. lactuca* seaweed steeping is thought to be caused by a decline in the β chain 1 - 4 linked D glucose. This chain is a chain that contributes to the insoluble dietary fiber content in plants and contributes 25% of the crude fiber content. Moreover, the decrease in lignin content also contributes to water-insoluble dietary fiber (Perry and Ying, 2016).

E. elatior under soaking conditions significantly influences total phenolics ($p<0,05$). Figure 7 shows the total phenolics of *U. lactuca* seaweed steeping.

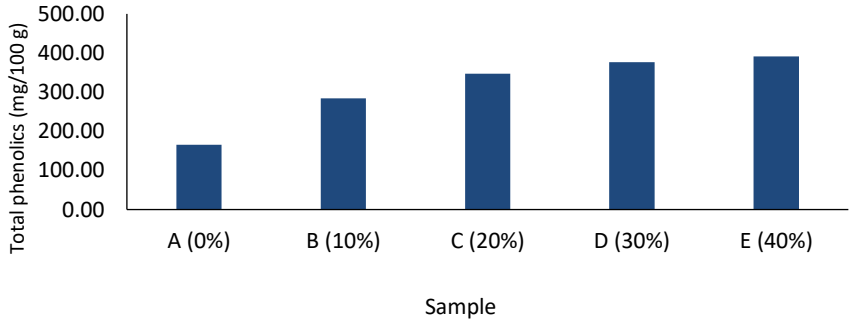

Figure 7 – Total phenolics in steeping *U. lactuca* seaweed under the soaking condition of *E. elatior*

Phenolic compounds are secondary metabolites that can bind at least one hydroxyl group. *U. lactuca* is known to have a high total phenolic. Bromophenol is the type of phenol compound found in green algae such as *U. lactuca*. Moreover, it also has hydrolyzed tannin compounds consisting of various phenolic compounds such as gallic acid, elagic acid, and bromophenol (Besednova, et al., 2020). The increase in total phenolic content is due to reduced aromatic groups in steeping *U. lactuca* seaweed. There are only a few aromatic hydroxyl groups (phenolic compounds) in *U. lactuca.* Phenol compounds found in *U. lactuca* are phenolic acid compounds such as gallic acid (9.25-19.74%), chlorogenic acid (3.83-5.39%), gentisic acid (14.62%), protocatechuic acid (1.31-3.26%), p-hydroxybenzoic acid

(4.03-5.05%), and vanylic acid (32.42%-47.15%) (Pangestuti, et al, 2021), with an increase the immersion of *E. elatior* (water extract) phenolic compounds will increase in type. *E. elatior* contains the following types of phenolic compounds: catechins (40.69 mg/100 g), eriodictyol (1.78 mg/100 g), gallic acid (35.47 mg/100 g), isoquercitrin (55.36 mg/100 g), quercetin (12.64 mg/100 g), rutin (11.66 mg/100 g), tannic acid (15.17 mg/100 g), previous research by Ghasemzadeh, et al., (2015) reported the presence of other phenolic compounds, such as caffeic acid (58.25 – 88.46 mg/100 g), luteolin (46.69 mg/100 g), and myricetin (5.66 – 35.75 mg/100 g) (Whangsomnuek, et al., 2019).

E. elatior under soaking conditions influences antioxidant activity (RSA-DPPH) significantly (p<0,05). Figure 8 shows antioxidant activity (RSA-DPPH) in steeping *U. lactuca* seaweed.

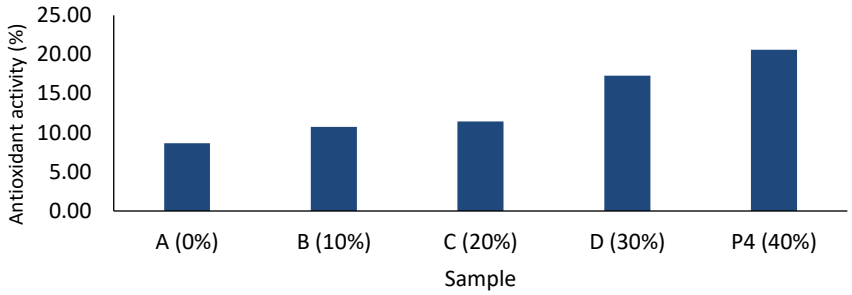

Figure 8 – Antioxidant activity in steeping *U.lactuca* seaweed under the soaking condition of *E. elatior*

Table 1 – Volatile compounds in steeping *U.lactuca* seaweed under the soaking condition of *E. elatior*

Sample A		Sample B		Sample C		Sample D		Sample E	
Volatile compounds	Percentage (%)	Volatile compounds	Percentage (%)	Volatile compounds	Percentage (%)	Volatile compounds	Percentage (%)	Volatile compounds	Percentage (%)
Acetophenone 4 methoxy	5,912	*Benzyl alcohol*	15,231	*Tetrahydro-benzo[c]tiophene*	19,041	*Silane methoxy metil*	14,771	*Silane*	19,789
1-Ethoxy-2-methylpropane	17,486	*Hydroperoxide*	5,710	*Propyl-thionophosphoraziridine*	2,419	*Semicarbazide*	6,020	*Semicarbazide*	0,542
methoxy phenyl	7,500	*Glycoaldehide dimer*	6,355	*Propane*	20,020	*Trimethylsilyloxy benzoic anhydride*	6,324	*Succinimide*	6,162
carboxylic acid	14,734	*Trimethylsylil oxi benzoate*	5,505	*Trymethylsiloxybenzoic acid*	4,221	*Tetrasiloxane*	4,457	*Cyclotrisiloxane*	6,161
3,3 di isopropoxy 1,1,1 5, hexamethyltrisiloxane	2,239	*Tridecaflourooxypropane*	2,717	*Acetonitrile*	0,429	*Carbamic acid*	1,706	*Hydrazinecarbonamide*	2,211
trimethylsilyl phenyl	2,723	*Methyltrisilane*	3,853	*2-ethylclaridine*	3,062	*Heptamethyl Tetraoxatetrasilocan*	6,260	*Heptamethyl Tetraoxatetrasilocan*	6,916
heptamethyl tetraoxatetrasilocan	9,315	*Heptamethyl Tetraoxatetrasilocan*	6,485	*Hydroacetic acid*	1,380	*1-Propanol*	1,440	*Silanamine*	1,564
pyrrole-2 one methoxyphenyl 5,5 diphenyl	0,793	*Hydroxyacetic acid*	1,434	*Carbamic acid*	0,650	*Glycidol*	1,730	*Cefaclor*	1,449
Pentaethylcyclopentasiloxane	1,901	*1-Propanol*	1,636	*Heptamethyl Tetraoxatetrasilocan*	6,047	*Hexadecanoic acid*	9,229	*Hexadecanoic acid*	12,651
Pentaethylcyclopentasiloxane	1,901	*Acetic acid*	1,803	*Ethanamine*	1,037	*Guanidine*	1,178	*Guanidine*	1,616
Carbamic acid	1,819	*Hexadecanoic acid*	11,747	*Glycidol*	0,842	*Octadecanoic acid*	31,859	*Octadecanoic acid*	33,117
Pentadecanoic acid	9,034	*Butanal*	0,468	*Hexadecanoic acid*	9,696	*Imidazole*	2,696	*1-Heptadecanamine*	6,480
Tetraacetyl d-xylonic nitrile	0,343	*Octadecanoic acid*	30,098	*Octadecanoic acid*	22,392				
Octadecanoic acid	21,807	*Heptadecanoic acid*	6,049	*Methyltetradecanoate*	5,081				
Heptadecanoic acid	3,.354	*Butenedioic acid*	0,909	*Butenedioic acid*	1,296				

Preliminary treatment in steeping with combrang extract generally increased antioxidant inhibitory activity. This is because *E. elatior* flowers have high antioxidant activity. Research conducted by Ghasemzadeh, *et al*., (2021) reported that in fresh *E. elatior* flower has up 26,82%- 53,69% (Sukandar, *et al.,* 2010) water extracted from *E. elatior* flower has antioxidant inhibitory activity RSA-DPPH 62,1% to 76,4%, while *U. lactuca* has 4,34% to

43,18% (Shovviyah, 2019). Antioxidant activity (RSA-DPPH) of *U. lactuca* is primarily contributed by ulvan (54,9% to 73,20%) (Mo'o, *et al.,* 2020).

The most common volatile compounds are aldehydes with octane type with fresh plant aroma, heptane with bitter aroma, and pentadecanal with a fresh aroma and waxy. All of them are fatty acid-derived compounds that have a sour-savoury aroma. *U. lactuca* has a fresh and sweet woody aroma. *U. lactuca* is less greasy than other algae, but its surface is waxed. Green algae are also sourer than other types of algae. Heat treatment usually derivates fatty acid compounds into volatile compounds (volatilization). This is because of the water content loss (Uribe, et al., 2019). The volatile compounds in steeping *U. lactuca* are shown in Table 1.

Based on Table 1, it can be seen that there are volatile compounds that are lost and arise with an increase in the concentration of *E. elatior*. Fatty acid derivative components such as octadecanoic acid are found in samples A to sample E with fluctuating amounts. The volatile compounds that dominate from samples A to E are heterocyclic compounds resulting from combustion. Sanchez-Garcia, et al., (2020) processed *U. rigida* by vacuuming, boiling, and steaming methods produce derivation of fatty acid compounds, dominance of sulfur compounds, aldehyde compounds, and hydrocarbon compounds. This research has succeeded in eliminating sulfur compounds that will be evaporated when seaweed group *Ulva sp* is processed at high temperatures. Fatty acid components are the most common volatile compounds in steeping *U. lactuca* seaweed. Fatty acid components have antifungal activity against several bacteria, such as *Candida albicans, Aspergillus flavus, Aspergillus fumigatus,* and *Bacillus subtilis* (Chandrasekaran, et al., 2011). The new compounds that emerged based on silico analysis detected in samples D and E were silane compounds and their derivatives. Silane compounds are compounds produced from burning polysaccharides in *U. lactuca*. Silane has an antibacterial effect. In samples D and E, volatile antifungal compounds were also found in silico i.e., guanidine. Guanidine may interact with the *sterol-C24-transmethyltransferase* enzyme in fungi. Interaction with *sterol-C24-transmethyltransferase* of the lanosterol chain on the sterol side can destroy fungal cells thereby preventing fungal infections on the skin (Baugh, 2022).

Variant analysis showed that the treatment had a significant effect ($p < 0.05$) on the overall sensory hedonic test produced. Figure 9 shows the overall hedonic test sensory score of steeping *U. lactuca* seaweed.

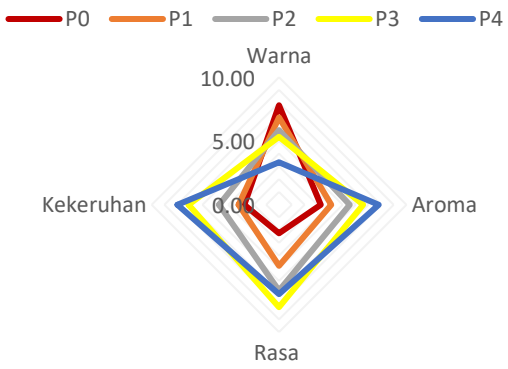

Figure 9 – Hedonic test sensory of steeping *U. lactuca* seaweed under the soaking condition of *E. elatior*

The whole sensory multi-hedonic test is performed using the hedonic sensory test. In this study, the average overall sensory hedonic quality test scores on samples A, B, C, D, and E, respectively, were 2.58 (dislike), 3.25 (dislike), 5.33 (neutral), 6.80 (like), and 7.98 (very like). Naturally, fresh *U. lactuca* has a darker green colour than other types of green algae, such as *Ceulerpa sp.,* and *Boergesenia sp.* When processed into powder, various studies identified the colours as *olive green*. When brewed *U. lactuca* powder will be lemon green. Increased *E. elatior* in *U. lactuca* steeping liquid makes the green colour slightly

greenish (Udayangani, et al., 2018). *U. lactuca* will emit a bitter aroma typical of green vegetables when it cooks. Soaking fresh aromatic ingredients such as *E. elatior* during the cooking process of fresh *U. lactuca* can reduce the distinctive aroma of seaweed. Beside reducing fishy aromas, the distinctive and pleasant aroma of *E. elatior* can also stimulate appetite (Silalahi, 2016). Lianah, et al. (2020) reported that soaking food products with an extract *E. elatior* flower can add a distinctive sweet and sour taste and cause a different sensation. Turbidity is a physical representation of the mineral content in steeping *U. lactuca*. Mineral content itself is one of the essential parameters in food products. The mineral content in steeping seaweed is the composition of food that is seen for bioavailability. Bioavailable minerals must be in or easily dissolved in water to be used in the body (Hayati, 2012).

CONCLUSION

Based on this research, it is known that the soaking treatment of *E. elatior* extract has a significant effect ($p < 0.05$) on the observed variables, namely water content, crude fiber content, food fiber content in steeping, impurities, total polyphenols, RSA DPPH, and sensory tests on steeping (colour, aroma, taste, appearance turbidity, and overall). However, there was no effect ($p>0.05$) on the observed variables of extracts in water.

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