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EVALUATION OF THE BRINE PRESERVATION METHOD OF SEA GRAPES (*Caulerpa lentillifera*) AS A COMMERCIAL PRODUCT

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ABSTRACT

The aim of this study is to evaluate this commercial product in relation to the preservation materials, the preserved product biomass, individual weight and length of the fronds, and the effect of soaking time and water temperatures on the frond "crispiness". There was no significant difference between different soaking times (from 30s to 2 minutes) on the weight and the length of the fronds ANOVA (p=0.88) and (p=0.81) after the initial period. Furthermore, tap water and ice water treatments during rehydration process had no significant effect on the fronds crispiness (ANOVA p=0.560). These results show that the preserved product using high concentration of brine produces a product with consistent biomass, size, and amount of the fronds. However, the temperature of the freshwater used in rehydration has no effect on the quality of the product, in contrast to the claims made by the company on the packaging instructions

Keywords: Sea grapes, *Caulerpa lentillifera*, soaking time, crispiness

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1. INTRODUCTION

The biggest limitation for edible seaweed such *Caulerpa* is that they are perishable products. This commodity is easily damaged when it unpacked properly and only last for less than a week. According to [1], sea grapes is primarily affected by low temperature and osmotic pressure. Furthermore, it can be spoilt if stored in a refrigerator or if washed in freshwater. Therefore, to date, *Caulerpa* is mostly consumed in the fresh form and is transported locally. [2], stated that several countries had a similar major problem when the *Caulerpa* transferred for the long distance from harvest gate to the markets. The study also suggested that different handling and post-harvest processing may extend the shelf life of sea grapes, although details of the specific methods were not supplied.

One of the existing options for maintaining shelf life is preservation of the product using a high concentration of salt or brine. Traditional salting for food such as dry salting and using brine are ancient preservation methodsthat are crucial for food safety [3]. Food preservation is also

used to maintain quality, extend shelf life, and prevent spoilage [4]. Currently, preserving and trading *Caulerpa* is emerging in several countries. In Vietnam, one leading company (TriTin) is focusing on manufacturing and trading fresh sea grapes, dehydrated sea grapes, and sea grapes preserved in brine. For the sea grapes in brine, the product can last for six months to a year according to the product description. This enables it to be transported long distances to many countries. The aim of this study is to evaluate the properties of the Vietnamese company's product in regards to preservation materials such as brine concentration and the characteristic of preserved *Caulerpa*.

2. MATERIAL AND METHOD

This study used the preserved sea grapes product as edible seaweed that is made in Vietnam by Tri Tin Company. Since 2004, the company has been growing, processing, and trading sea grapes of the species *Caulerpa lentillifera*. The original seed of *C. lentillifera* was brought from Japan, after which it was successfully bred and farmed before being processed as a commercial product. The product of sea grapes has been evaluated in several countries such as Australia, China, France, Germany, Japan, Korea, Singapore, Thailand, and the US. Currently, there are three main products of sea grapes: fresh sea grapes, dehydrated sea grapes, and sea grapes in brine. However, this study will evaluate sea grapes in brine which comes in two types of packages: 20 grams packed in a plastic bag (sachet) and 200 g sea grapes in a plastic jar (Figure 1. a and b). All the experiments regarding to these products was conducted in the laboratory of the Marine Aquaculture Facility Unit (MARFU) James Cook University, Townsville, Queensland Australia.

Figure 1: a. Preserved sea grapes in brine packaged in 20 g plastic bag.b. Preserved sea grapes in brine packaged in 200 g plastic jar.

Based on the consumption instruction (the same for both products), the preserved sea grapes are soaked for three minutes in tap water to become "refreshed". After soaking for 3 minutes, an additional 3 minutes is recommended in ice water for "crispiness". As the contents of the 200 g plastic jar and 20g sachet were found to be similar (see Section 2.1 below), the study focussed mostly 20 g sachet product for all experiments to characterise the product.

Effect of soaking time on frond characteristics

Effect of soaking time on the rehydration process for the size of fronds was determined by measuring the weight and length of fronds at different soaking times. The measurements were conducted at 0 seconds, 30 seconds, 1 minute, 1.5 minutes, 2 minutes, 3 minutes, and 4 minutes. Each of the time treatmentshad six replicates that were destructively sampled from the soaking container. The data for this experiment wasanalysed using

a one-way ANOVA for weight and length separately.

Effect of water temperature on frond characteristics

In order to evaluate the claims of using ice water to make the product crispier, a test needed to be developed to quantify the crispiness. The fronds were measured by the angle formed after soaking time in the tap water and the ice water. The experiment formally compared the angle formed by the fronds at the different times after it has been soaked 3 minutes in the tap water and 3 minutes in the tap plus 3 minutes in the ice water. Time treatments were 0 minutes, 5 minutes, 10 minutes, 20 minutes, and 30 minutes with ten replicates for each treatment. Wide angles formed by fronds describe the fronds are fresher (rigid), while the narrow angles represent the frond is flaccid (Figure 2. a and b). The angles formed by the fronds was photographed and then measured by protractor. The angle data between the two water treatments and time was analysed using a two-way ANOVA.

Figure 2: a. The angle formed by a frond at 0 minutes after soaked in the tap water. b. The angle of a frond was measured at 5 minutes after soaked. Frond in figure a has wider angle (rigid) than a frond in figure b (flaccid).

Statistical analyses

All data collection was recorded in excel spreadsheet before being processed in S-plus 8.0 for statistical analyses. There are several statistical methods implemented for different data sets in this study. T-test was used to determine whether there was a difference in the brine concentrations from two different packages of preserved sea grapes. For the weight and the length of the fronds, regression analysis is used to see if the variation of the length can be explained by weight variation during three minutes of soaking time (n = 195 replicate fronds). The effect of different treatments of soaking time on the weight and length of the fronds was analysed with one-way ANOVA (n = 6 replicate fronds). Furthermore, two-way ANOVA is used to see the significance of the effect of water temperatures on the crispiness of the fronds (n = 10 replicate fronds).

3. RESULT

Effect of time on frond characteristics

There is no significant effect of different soaking time on the weight and length of the fronds, t-test (p=0.88) and (p=0.81). However, both of weight and length had the maximum size at 180 seconds (3 minutes).

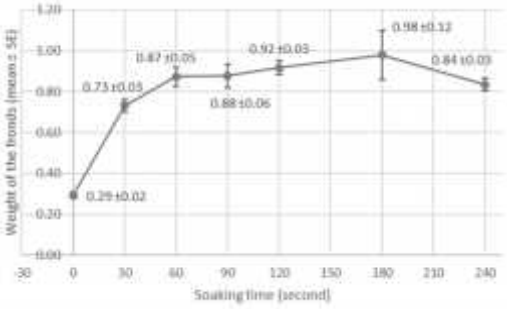

Figure 3a. The weight of the fronds in the different soaking time (mean ±SE)

The average weight of the fronds with 3 minutes soaking time is 0.98 ±0.12 SE.

In the same soaking time, the average of the length is 9.01 ±0.85 SE.

At 0 second, the weight is 0.29 ±0.02 SE. When the soaking time at 30 seconds the weight increased sharply to 0.73 ±0.03 SE and rise to 0.87 ±0.05 SE at the 60 seconds soaking time. The weight of the fronds rises continuously from 0.88 ±0.06 SE at 90 seconds (1.5 minutes) to 0.92 ±0.03 SE at 2 minutes and reach to the maximum weight 0.98 ±0.12 SE at 3 minutes soaking time before declined slightly to 0.84 ±0.03 SE (Figure 3a).

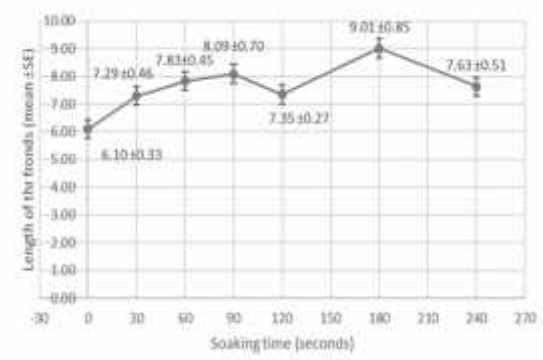

Figure 3b. The Length of the fronds in the different soaking time (mean ±SE)

Effect of water temperature on frond characteristics

Crispiness of the fronds was determined by measuring the angles that formed at different times after soaked, for which there was no effect of different water temperature on the crispiness of the fronds (ANOVA, F = 0.75, p=0.560), as determined by the angles formed by the fronds (Appendix 6 and 7). However, there was a strong effect of soaking time on rigidity (Fig. 4: ANOVA, F = 30.88, p<0.01).At 0 minutes, prior to soaking, the fronds formed biggest angles for both tap water and tap plus ice water (48.5 ±5.96 SE) and (55.9 ±4.16 SE). At 5 minutes after soaking, the fronds show less rigidity, based on the angles formed of 36.2 ±4.83 for tap water and 33.8 ±2.37 for tap plus ice water (Figure 4).

After 10 minutes the fronds became flaccid, indicated by the small angles for both water treatments (22.2 ±2.45 and 21.7 ±1.84, tap and ice respectively). Following that, the angles formed by the fronds that soaked in the tap water after 20 minutes is narrow (21.9 ±2.30) compare to the angles of the fronds that soaked in the tap plus ice water (26.4 ±1.90). The similar state also occurred in the 30 minutes after the fronds were soaked. Based on the data above, it can be concluded that the fronds are flaccid at 10 to 30 minutes after soaked on two different water temperature.

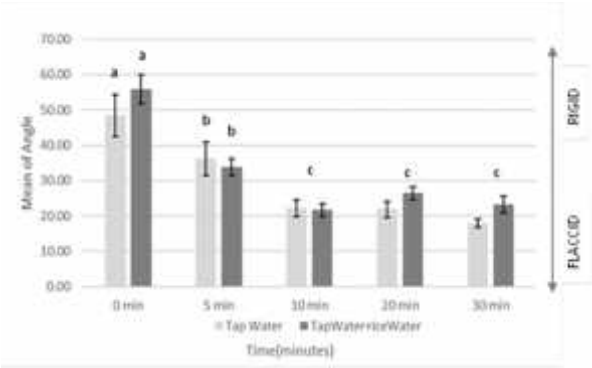

Figure 4. The angles formed by the fronds in the different times after 3 minutes soaked in the tap water and 3 minutes in the tap plus 3 minutes in the ice water (mean±SE). Column with the same letters are not significant

4. DISCUSSION

Both of the weight and lengths of the fronds had the maximum size at 3 minutes soaking time. This fact is aligned with consumption instruction from the product package. The instruction recommends 3 minutes soaking time in the tap water to refresh the fronds. However, the increasing rate of the weight after 30 seconds to 3 minutes of soaking time were very low,

indicating that a much shorter time is actually needed. A similar result also existed for the length of the fronds. There was a slight rise in the length of the fronds after 30 seconds to 1.5 minutes before it falls at 2 minutes and it was going up to maximum length at 3 minutes of rehydration. This finding indicates that the different soaking time treatment between 30 seconds, 1 minutes until 3 minutes have no significant effect to improve the weight and the length of the fronds. Therefore, 1 to 2 minutes of soaking time might be suggested to rehydrating the preserved *Caulerpa lentillifera.*

In the serving instruction, it suggested that the sea grapes should be soaked in ice water for 3 minutes if there is a desire to obtain crispiness after the initial soaking for 3 minutes in tap water. On the other hand, I found no effect of water temperature on the crispiness. Furthermore, according to the serving instruction, 30 minutes after soaking time (tap water & ice water) the fronds will start to shrink again. However, the experiment shows the fronds already formed small angles after 5 minutes particularly at 10 and 20 minutes. The angles formed at these times have a similar result with the angles formed at 30 minutes. All the angles are below 30 degrees which indicate the fronds are flaccid. Therefore, it is better to give no recommendation that the product is kept for more than 3 minutes prior to use.

It may be concluded that dehydration of the fronds started when they emerged from soaking water for 10 to 20 minutes. The previous study found that water loss from seaweed is affected by atmosphere exposure when they emerged from the water and desiccation occurred during the time of exposure [5]. Besides that, loss of water can also be influenced by temperature through evaporation. Evaporation rate is higher in the day than at night or summer than winter [6], but also depends on humidity. Similar with that, during the experiment, these factors also occurred and affected all the fronds when they were taken out from the water.

The effect of cold-water temperatures to the fresh food such as fruits and vegetables is reported in post-harvest method [7]. Hydro-cooling is an effective way to reduce the heat that causes water loss and wilting from the product. As it mentions before that seaweed capture the nutrient in solution from all the part of their body. Therefore, by absorbing ice water, sea grapes may maintain the freshness of their body that has been exposed to room temperatures. However, the effect of ice bathing for the sea grapes is very limited against time exposed at temperature and atmosphere exposure.

5. CONCLUSIONS

There is no effect of different soaking time to improve the size of the fronds. Rehydrating the fronds at 1 to 2 minutes had a similar effect with 3 minutes of soaking time. Furthermore, water temperature treatments had no effect to maintain the crispiness after 5 minutes of soaking time. These results indicate that there is a small window of time when the product is at its best – i.e. similar to the fresh product – and that the recommendations relating to manipulating the product for different texture etc. are not validated by the data. It will be interesting as a next step to compare the different nutritional/biochemical profiles of product prepared in different ways to understand whether there are any positive

or negative effects on the mineral content for extended treatment in water or different temperatures.

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