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Salt origin and their saltiness: a time-intensity sensory characterization

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Abstract. Excessive salt consumption has been found to cause many negative effects on human health. To date, many researches have been conducted to reduce the sodium content of the diet. This study focused on the comparison of saltiness intensity and other parameters in time-intensity curves of four commercial grain salts in four regions of Viet Nam (Bac Lieu, Thanh Hoa, Sa Huynh, Vung Tau), one flower salt in Sa Huynh and a control sample with two particle sizes of 1-2 mm and 2-3 mm to find out their taste perception characteristics. A modified sensory evaluation technique focusing on time-intensity was used to train a panel to evaluate the temporal profile of saltiness of salt crystals. The results showed a significant difference in the perception ability and time intensity of saltiness in salt products by region and particle size. Sensory measures exhibited the differences in the specificity of salt samples by region and a strong correlation with their physical properties. Sa Huynh flower salt and sea salt showed different characteristics compared to other salt samples with higher intensity of salty taste, faster time to reach the maximum intensity, and shorter duration of salt taste intensity. These results demonstrated that flower salt could reduce the level of sodium intake while maintaining the saltiness perception in products, which is a potential ingredient in food, spices, etc.

Keywords: salt, salty taste, time-intensity, temporal profile, flower salt.

Classification numbers: 1.4.4, 1.5.4

1. INTRODUCTION

Sea salt is an important ingredient in food processing. Salt is used as a food additive for taste masking, flavor enhancement, texture improvement via interactions with various food components, functionality, nutrition, and food preservation [1]. Especially, sea salt is a primary dietary source of sodium, commonly used as an additive. As a component of cellular fluids in the human body, sodium-ion is essential for nerve impulse transmission, muscle contraction, osmotic and blood pressure regulation, and the transport of nutrients and water across cells [2, 3]. Therefore, salt plays an important role in daily life in general and in food in particular. However, excessive consumption of sodium is likely to cause adverse health effects such as hypertension, stroke, and coronary heart diseases, apart from reduced immunity [4, 5]. There have been many studies trying to reduce salt intake by different approaches [6, 7]. Along with that, today, with the need to develop and diversify products, the sensory aspect of the product is becoming more and more important. Therefore, it is necessary to have studies on sensory characteristics of various raw materials to serve as a basis for selecting suitable materials for the desired product. According to previous studies, the geographical origin, physical and chemical properties can affect the ability to perceive saltiness of different salts [8, 9]. The influence of salts on sensory properties and consumer acceptance of products has also been studied and found to be significant [10 - 12]. Hence, in order to meet the proposed needs, the building of sensory properties profile of salts should be carried out. However, until now, the sensory properties of Vietnamese salts have not been thoroughly studied.

Time-intensity (TI) is a well-known method for recording and obtaining the rate, duration, and intensity variations of a single specific attribute that changes during product evaluation [13]. This method provides temporal information about perceived sensations [14]. Thereby, the results show the dynamics in perception of aroma, taste, flavor or texture in foods. TI evaluation is commonly performed for trained panelists [15, 16]. The TI method has been widely used for very different food matrices such as dairy products [12], ice-cream [17], beverage [18, 19], and snacks [11].

In this study, we performed TI evaluation of salty taste of commercial salts in Viet Nam to investigate the temporal change of salty taste perception. Furthermore, the correlations of TI properties of commercial salts in Viet Nam based on harvest location and size were investigated. These results will support manufacturers to make a better choice in salt when reformulating food products, which in turn will contribute to a healthier food supply.

2. MATERIALS AND METHODS

2.1. Materials

A total of 6 salts (four commercial sea salts, one flower salt and one control salt) were evaluated. Four commercial salt samples were produced by solar method and collected from other production areas in Viet Nam, namely Thanh Hoa (Hoa Loc, Hau Loc District), Sa Huynh (Duc Pho District, Quang Ngai Province), Vung Tau (An Ngai, Long Dien District), and Bac Lieu (Long Dien, Dong Hai District) (Table 1). Flower salt was also collected commercially and derived from Sa Huynh (Duc Pho District, Quang Ngai Province). The control salt was produced by crystallizing the salt from saturated sodium chloride. All samples were vacuum-packed and stored at room temperature under conditions of low humidity (30 %).

Each salt (500 g) was sieved for 20 minutes and the material between 2.00 - 3.00 mm, and 1.00 - 2.00 mm of mesh size was used for evaluation. The classification of salt samples into two grain sizes aims to reduce errors due to the influence of particle size and physical properties on sensory properties.

2.2. Methods

Based on the analysis results of the sodium content in salt products, each salt sample was dosed with 20 mg of sodium per assessor [20]. The mass of each salt sample is specified in

Table 1. Each salt sample is pre-measured, contained in a white plastic spoon and coded with a set of 3 digits.

Table 1. Harvest location and weight of salts.

Samples	Harvest location	Weight of samples (g)
M1	Control sample	0.0514 ± 0.0005
M2		0.0518 ± 0.0005
BL1	Bac Lieu	0.0637 ± 0.0005
BL2		0.0629 ± 0.0005
FS1	Flower salt (Sa Huynh)	0.0692 ± 0.0005
FS2		0.0697 ± 0.0005
TH1	Thanh Hoa	0.0639 ± 0.0005
TH2		0.0631 ± 0.0005
SH1	Sa Huynh	0.0651 ± 0.0005
SH2		0.0649 ± 0.0005
VT1	Vung Tau	0.0593 ± 0.0005
VT2		0.0590 ± 0.0005
Numbers “1” and “2” exhibited in name samples represent grain sizes of 1-2mm and 2-3mm, respectively.		

A panel of 11 panelists was trained in the formation of sensory memory and equalization until consensus ($p < 0.30$) and repeatability ($p > 0.05$) in saltiness perception of salt and time-intensity scales (a total of 12 two-hour sessions). The perceived intensity was recorded on a structured linear scale from 0 to 15 corresponding to control sample concentrations in solution of 0 = none, 5 = 10 g/L, 10 = 20 g/L, 15 = 30 g/L, as the results of the panel’s discussion and consensus. The panel was also trained to perform TI trials in 2 two-hour sessions. After training, an evaluation of the panel was conducted. Each panel evaluated 3 salt samples in triplicate. The results were then analyzed by three-factor ANOVA (salt - panelists - repeatability) to determine the performance of the panels on describing saltiness.

For temporal saltiness profile, 11 trained panelists evaluated salts monadically in a randomized balanced block design. Each panelist evaluated each salt in triplicate. In each assessment session, each member evaluated 12 different samples. Maximum evaluation time for each sample was 3 minutes. The panelist took the full amount of the sample in mouth and started evaluating the intensity of saltiness in 5-second intervals. Panelists evaluated the intensity on a scale from 0 to 15 until the intensity gradually decreased to 0. The break between samples was 5 minutes, panelists used unsalted crackers and water to clean the palate. The evaluation was performed on the Compusense program (Compusense, Guelph, Ontario, Canada) in a standard sensory evaluation room with noise cancelation, positive air pressure and separated laboratory booth with white light.

The evaluation result obtained from Compusense software is an average curve showing the change in intensity over time, as well as the parameters indicating characteristics in the saltiness perception of salts: time to maximum intensity (Tmax), maximum intensity (Imax), total duration time of the stimulus (Ttotal), area under the curve (AUC), increase angle (Inc.Angle), increase area under the curve (Inc.Area), decrease angle (Dec.Angle), and decrease area under the curve (Dec.Area).

2.3. Statistical analyses

Data were examined by two-way ANOVA and Tukey's Honestly Significant Difference (HSD) test to evaluate the differences between means at a 5 % significance level ($p < 0.05$) (R software version 4.0.2 (CRAN)). The Pearson's linear correlation coefficient and principal component analysis (PCA) on the TI test data were used to examine the relationship between TI parameters and the differences between samples.

3. RESULTS AND DISCUSSION

Table 2 shows the results of a three-factor ANOVA analysis on the saltiness evaluation sensibility of the panel. In general, a high value of p ($p > 0.05$) for panelists and repeatability and low value of p ($p < 0.05$) for samples showed that the panel was reliable and accurate when evaluating salt samples.

Table 2. Ability to estimate salty taste intensity of panel.

	Panelists	Samples	Repeatability	Panelists: Repeatability	Samples: Repeatability	Panelists: Samples
p.value	0.9146	7.26E - 136	0.1958	0.9043	0.9413	0.2712

Based on the obtained results, it can be seen that the panel reached a consensus result because there was no difference at the significance level $\alpha = 0.05$. At the same time, the p.value of the panelist factor was also relatively high, equal to 0.9146. This indicates a degree of confidence in the results among the panelists.

The p.value of samples demonstrates the ability to distinguish products with significant differences. The p.value was smaller than 0.01, indicating that the panelist can differentiate the various salt samples. The samples used in the evaluation were different enough for the panelists to distinguish. This difference was evident in the score of samples analyzed by the panel.

The repeatability indicates whether there was a difference in panelists or products between repetitions. At a significance level of 0.05, a high p.value confirmed that there was no difference between repetitions. The p.values of the interaction between panelists / samples and repeatability were high ($p = 0.9043$ and 0.9413, respectively) presented the stability of the panel and samples in the evaluation results between 3 repetitions.

Table 3. Ability to perceive saltiness over time of panel (p.value).

	Panelists	Samples	Repeatability	Panelists: Repeatability	Samples: Repeatability	Panelists: Samples
Imax	0.4275	2.49E – 49	0.2632	0.4106	0.9354	0.3698
Tmax	0.6173	6.50E – 113	0.8397	0.2078	0.8296	0.7854
Ttotal	0.1729	9.85E – 255	0.2527	0.5601	0.6850	0.8356

Table 3 shows the results of a three-factor ANOVA analysis on the consensus on the ability to perceive salty taste over time of the panel. There was no difference in p.values of panelists, repeatability and the correlation panelists - repeatability, samples - repeatability, panelists - samples at the significance level $\alpha = 0.05$. This indicates a high consensus among panelists and panel stability in assessments. The p.value of samples indicates the difference in salty taste intensity between salts with the same sodium content at the significance level $\alpha = 0.05$.

To conclude, after training, the panel showed high reliability, consistency, and discriminant ability for evaluating the saltiness of salt samples.

Figure 1 presents the average time intensity curve of salts. The salty taste intensity of salts in the TI curve graph had a general tendency to increase rapidly over the first 20 seconds and reach the Imax value, then gradually decrease to 0. The maximum saltiness intensity of salts ranged from 6 to 13 points on a 15-point scale with which the panel was acquainted and trained.

Table 4 presents the time-intensity parameters of sea salts in Viet Nam. There was a significant difference in salty taste intensity between samples in terms of geographical location and size. With the same sodium content, the FS and SH salts had a higher Imax than other salts. The 1 - 2 mm samples had a higher Imax than 2 - 3 mm samples from a commercial salt. Simultaneously, Imax of the control sample was significantly lower than the other samples. This could be due to the fact that the chemical compositions in salts affected the taste perception. Production conditions in each locality caused the difference in the size and chemical composition of salts, leading to the difference in saltiness [20]. The findings agree with Yang and Lawless (2005), who revealed that sodium, magnesium, and potassium contents all affected the ability to perceive the salty taste of salt [21].

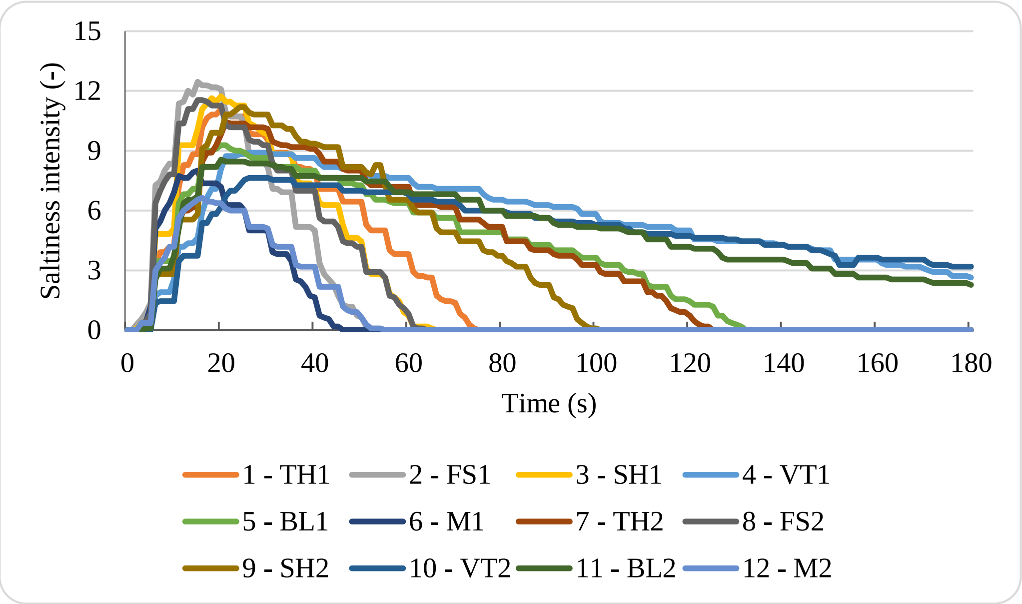

Figure 1. Time intensity curves of different salts.

The time to reach maximum intensity (Tmax) of salts ranged from 13 to 26 seconds. The analysis of Tmax revealed a significant difference in Tmax value between the different origin salts. Tmax value of samples from Vung Tau, Sa Huynh, and Bac Lieu was higher than those from other locations. The control and FS samples had the lowest Tmax. At the same time, the Tmax value of 1 - 2 mm samples was greater than that of 2 - 3 mm samples.

Table 4. Average of time-intensity curve parameters for saltiness of salts at the equal sodium content.

Sample	Tmax (s)	Imax (-)	Ttotal (s)	AUC (-)
BL1	20.00 ± 0.52^{bc}	9.45 ± 0.32^{e}	151.00 ± 6.06^{b}	650.03 ± 61.01^{d}
BL2	20.67 ± 0.58^{b}	8.43 ± 0.21^{f}	176.00 ± 1.00^{a}	921.42 ± 28.73^{b}
FS1	14.67 ± 0.58^{d}	12.70 ± 0.34^{a}	49.33 ± 0.58^{g}	329.12 ± 22.43^{h}
FS2	15.00 ± 0.31^{d}	11.61 ± 0.19^{bc}	61.00 ± 1.00^{efg}	380.88 ± 10.06^{g}
M1	13.67 ± 0.31^{d}	7.79 ± 0.23^{g}	49.33 ± 6.51^{g}	199.33 ± 7.90^{i}
M2	15.33 ± 0.58^{d}	6.91 ± 0.39^{h}	53.33 ± 3.21^{fg}	194.51 ± 19.14^{i}
SH1	20.00 ± 0.35^{bc}	11.70 ± 0.14^{b}	67.67 ± 5.97^{ef}	386.18 ± 7.54^{g}
SH2	25.00 ± 1.00^{a}	11.15 ± 0.14^{c}	97.00 ± 2.65^{d}	571.79 ± 15.26^{e}
TH1	18.67 ± 0.31^{c}	11.15 ± 0.27^{c}	71.67 ± 1.53^{e}	431.42 ± 29.60^{f}
TH2	20.67 ± 0.58^{b}	10.45 ± 0.10^{d}	124.00 ± 5.29^{c}	661.64 ± 41.28^{d}
VT1	25.67 ± 0.58^{a}	9.12 ± 0.19^{e}	176.00 ± 1.00^{a}	973.24 ± 45.64^{a}
VT2	24.33 ± 1.08^{a}	7.46 ± 0.24^{g}	175.67 ± 0.58^{a}	861.36 ± 51.81^{c}
Sample	Inc.Angle (-)	Inc.Area (-)	Dec.Angle (-)	Dec.Area (-)
BL1	27.32 ± 4.12^{cd}	89.43 ± 1.96^{c}	4.04 ± 0.66^{ef}	560.60 ± 29.88^{c}
BL2	25.04 ± 4.65^{de}	87.21 ± 3.10^{c}	2.24 ± 0.26^{f}	834.21 ± 23.09^{a}
FS1	45.01 ± 2.24^{a}	94.50 ± 1.15^{c}	14.34 ± 0.91^{a}	234.62 ± 12.91^{g}
FS2	42.37 ± 2.06^{a}	89.89 ± 3.30^{c}	13.54 ± 0.47^{a}	290.98 ± 13.40^{f}
M1	34.53 ± 4.17^{b}	56.08 ± 3.98^{d}	8.69 ± 0.17^{bcde}	143.26 ± 14.07^{h}
M2	27.56 ± 1.56^{cd}	56.12 ± 5.39^{d}	9.63 ± 0.13^{abcd}	138.39 ± 4.91^{h}
SH1	34.53 ± 2.30^{b}	116.30 ± 7.47^{b}	13.67 ± 1.02^{ab}	269.88 ± 20.08^{f}
SH2	26.09 ± 1.37^{de}	133.61 ± 8.92^{a}	8.54 ± 0.66^{cde}	438.18 ± 18.74^{d}
TH1	35.86 ± 3.77^{b}	94.88 ± 7.55^{c}	11.32 ± 0.68^{abc}	336.54 ± 37.47^{e}
TH2	31.79 ± 0.67^{bc}	99.08 ± 5.92^{c}	5.57 ± 0.33^{def}	562.56 ± 45.70^{c}
VT1	22.05 ± 1.99^{ef}	118.71 ± 3.74^{ab}	2.56 ± 0.19^{f}	854.53 ± 61.34^{a}
VT2	19.77 ± 2.49^{f}	85.30 ± 4.95^{c}	1.74 ± 0.19^{f}	776.06 ± 55.20^{b}

Values are means ± standard deviation of triplicates. Values with different letters in the same column are significantly different ($p < 0.05$).

Ttotal was known as the time from onset until the taste of salt is no longer felt. Ttotal was greater than 3 minutes for the salts from Vung Tau and Bac Lieu, and less than 2.2 minutes for the remaining samples. Panelists perceived that samples VT2, BL2 did not completely dissolve in the mouth after 3 minutes, possibly due to the low dissolution rate. The control and FS samples had the lowest Ttotal to saltiness taste for both sizes. Size-different salts of the same commercial product also exhibited significant differences in salinity tasting times. This result suggested that the larger size salts had long lasting saltiness compared to smaller size salts. These results showed that the factors of size and harvest location have a great influence on saltiness perception time of salts.

The area under the curve (AUC) shows a significant difference between the salts. For both sizes, the AUC value of FS and control samples was significantly lower than the others. Samples with higher AUC values also had longer Ttotal. Quilaqueo *et al*. (2015) also found a similar relationship between AUC and Ttotal to perceived salty taste [22]. AUC represents total amplitude in the perception process, which helped to demonstrate the difference in the saltiness perception of salts based on origin and size more clearly.

The Inc.Angle and Dec.Angle represent the change in rate of saltiness intensity over time. FS had the highest Inc.Angle and Dec.Angle for both grain sizes, which were significantly different from the other salts. Salts from Vung Tau and Bac Lieu had the smallest Inc.Angle and Dec.Angle. This indicates that the intensity change of FS was faster, leading to a shorter Tmax and Ttotal compared to the other samples. It is explained by the porous crystalline structure of FS, which makes it easy to dissolve [23]. The smaller salts had a larger surface area, which translated to higher solubility and thus had higher Inc.Angle and Dec.Angle.

The Inc.Area had no significant difference between BL, FS, TH salts. This showed that the total amplitude of saltiness perception from the start to the maximum salinity of the salts was not significantly different. However, the Dec.Area values of salts were drastically different. It demonstrates the difference in saltiness perception after reaching the maximum value. Specifically, samples from Bac Lieu and Vung Tau gradually declined in the salty taste intensity, thereby prolonging the perceived time. On the other hand, for control, FS, and SH samples, the saltiness intensity decreased quickly and the sensing time was shorter than the other samples. The Inc.Area and Dec.Area values were highly dependent on the solubility of the salts during the evaluation. The results were highly consistent with the study of their solubility in artificial saliva, in which SH and control salts had a higher solubility while Bac Lieu and Vung Tau had a lower solubility [20].

The sensory properties of salt based on size and location of production were analyzed. These origin and size factors affect the physical properties (such as size, crystal structure) of salts due to crystallization conditions such as temperature, wind, composition of seawater, as well as farming conditions. The saltiness of salt is not only contributed by sodium but also inherited by other chemical components. Due to the effect of salt solubility, the smaller samples have a shorter stimulus time, but the Imax is greater than that of the larger size. FS exhibited differences in sensory properties, with the highest Imax and the shortest Ttotal. From the same origin, the tendency to change salinity perception was the same for different sizes, but the values of the evaluation indicators were different. This was represented by the same time-intensity curve shape. Different commercial salts had distinct saltiness time-intensity. This showed the specificity and diversity of salty taste in salt products on the Vietnamese market.

The principal component analysis (PCA) was used to reveal the correlations between salty taste temporal variables. The relationships between TI properties of evaluated salts are shown in Figure 2. The first two principal components accounted for 96.9 % of the total variance (Dim 1 = 78.65 % and Dim 2 = 18.25 %). Dim 2 was mainly influenced by Inc.Area while Dim 1 was characterized by others parameters such as Imax, Dec.Angle, Inc.Angle, Tmax, AUC, Dec.Area, and Ttotal. Dim 1 highlights the contrast in intensity with the time of salty taste perception and the area of the curve. The results in Table 5 showed that these sensory properties were significantly correlated with each other at the significance level $\alpha = 0.05$.

The distribution of salts as a function of TI parameters is shown in Figure 2. The salt clustering revealed differences in the correlation between salt samples and salty taste parameters. Examining the two PCA graphs together, it is observed that the control samples (M1 & M2) were distinct from the other salts, indicating significant differences among the TI parameters. The samples were divided into 4 groups, with significant differences in time-intensity attributes.

Group 1: including FS1, FS2, SH1, TH1 characterized by high Imax, Inc.Angle, and Dec.Angle.

Group 2: including VT1, BL2, VT2 distinguished by high Tmax, Ttotal, Dec.Area, and AUC.

Group 3: including SH2, TH2, BL1 characterized by high Inc.Area.

Group 4: including M1, M2 characterized by the lower parameters.

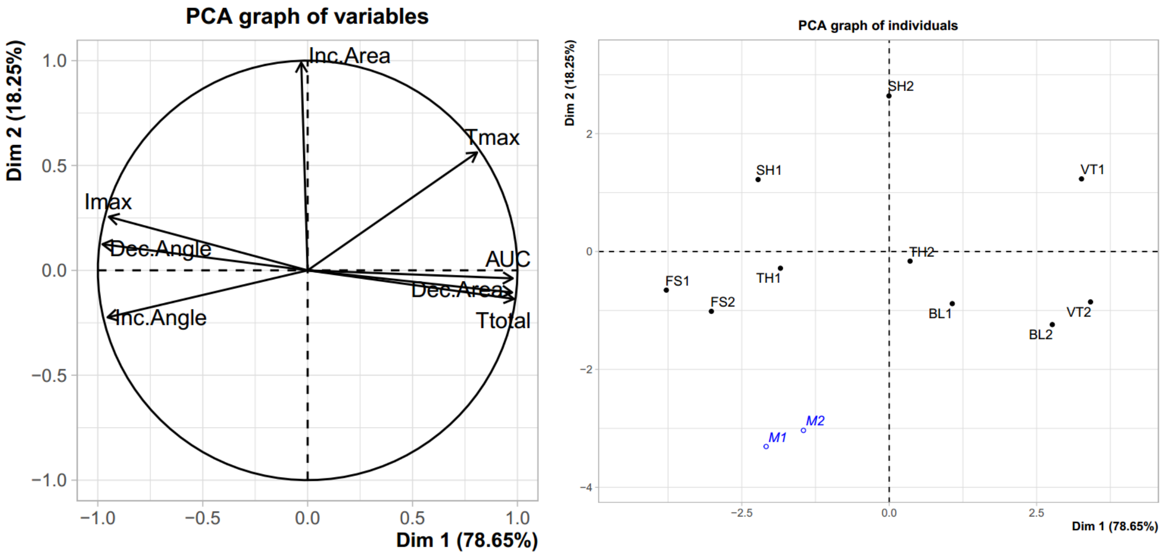

Figure 2. PCA correlation circle of time-intensity parameters (graph of variables) and salt samples in function of TI parameters (graph of individuals).

The PCA results showed a negative correlation between parameters Imax, Dec.Angle, Inc.Angle and other parameters such as Tmax, Ttotal, AUC, and Dec.Area. These results were consistent with previous studies by Vella *et al*. (2012), Rama *et al*. (2012), and Quilaqueo *et al*. (2015) on salty taste intensity assessment by TI method [9, 11, 22]. The results revealed that the higher the saltiness of salts, the faster the saltiness reaches its maximum, hence the sensing time and total stimulation time were smaller. High saltiness, rapid change in intensity, and short duration of stimulation were characteristic features of the FS samples. This showed a difference in the salty taste of flower salt compared to the other salts. It is similar to the salty taste analysis of flower salt compared to some sea salts from around the world [9, 11, 22].

Salts from Bac Lieu and Vung Tau (group 2) showed a different trend of high Ttotal and AUC, which were characterized by a slow increase in saltiness and long duration time. This result is completely consistent with the records during the evaluation, according to which the salts from Bac Lieu and Vung Tau with the size of 2 - 3 mm had not been completely dissolved and could be tasted salty at the end of the evaluation. However, these samples had a lower salinity than the other commercial salts. According to a previous research, the salts from Vung Tau and Bac Lieu had a higher sodium content, which was accompanied by a large shape due to the high projection area and maximum ferrite diameter [20]. As a result, the larger the size of the salts, the longer it took to reach the Imax, as well as the total time of saltiness perception due to their poor solubility.

Table 5. Correlations between TI parameters.

	Tmax	Imax	Ttotal	AUC	Inc.Angle	Inc.Area	Dec.Angle	Dec.Area
Tmax	1	-0.09	0.77*	0.83*	-0.76*	0.7*	-0.65*	0.79*
Imax		1	-0.38	-0.2	0.7*	0.62*	0.66*	-0.26
Ttotal			1	0.97*	-0.78*	0.27	-0.92*	0.98*
AUC				1	-0.69*	0.44	-0.83*	1*
Inc.Angle					1	-0.11	0.87*	-0.71*
Inc.Area						1	0.01	0.37
Dec.Angle							1	-0.86*
Dec.Area								1

**: The correlation coefficient is significant at the 0.05 level*

The grouping results contribute to the confirmation that the salty taste of salts is not only due to sodium but also due to other chemical components. Therefore, the salty taste perception was different between salts. When combined with the physical and chemical properties described in our previous study, the findings indicated the impact of these properties on the saltiness of salts. Namely, the higher the salt dissolution rate, the higher the perceived maximum saltiness [20]. When comparing morphological parameters and time-intensity properties of salt grains, it was found that the Imax value negatively correlated with morphological parameters such as projected area, roundness, maximum Feret's diameter, and surface index [20]. This means that the salt with smaller projected area, square grain shape, smoother and less rough surface had greater Imax and vice versa. Besides, despite having the same sodium content, salt samples with higher potassium and magnesium content had higher Imax, but shorter Tmax and Ttotal. It demonstrated that potassium and magnesium increased salinity and reduced total salinity sensing of salts. As a result, they are used as a sodium replacement to reduce sodium intake while maintaining the saltiness in food [7, 24]. The physical and chemical properties of salts in our previous study clearly explained the higher maximum salinity intensity and faster dissolution rate in the mouth of Sa Huynh flower salt compared to other salts in Viet Nam.

4. CONCLUSIONS

Five sea salts and flower salts with two different grain sizes of 1 - 2 mm and 2 - 3 mm from four provinces in Viet Nam were compared for their temporal salty taste assessed by a specially trained panel. There was a difference in the temporal saltiness perception of different salts, which involved both perceived intensity and stimulus time. The correlation between the properties demonstrated that salt samples with higher salinity intensity had shorter sensing time and faster intensity changes, and vice versa. The results also revealed that harvest location and size could affect the saltiness of salts. Despite having the same sodium content, there were differences in the sense of saltiness between the salt samples. This shows that it was not just sodium that affects the saltiness of salts. There was a difference in the saltiness of salts produced by different processes, specifically between sea salt and Sa Huynh flower salt. The difference in salty taste contributed to the diversity of salt products on the Vietnamese market. Along with the research on physical and chemical properties, this research found trends of changing the perception of saltiness, providing a suitable strategy for today's increasing food demand.

Credit authorship contribution statement. Nguyen Huu Lan: Methodology, Data curation. Nguyen Thi Ngoc Huong: Formal analysis, Validation. Pham Huu Thinh: Formal analysis, Data curation. Doan Ngoc Thuc Trinh: Methodology, Writing - original draft. Lai Quoc Dat: Conceptualization, Supervision. Nguyen Hoang Dung: Supervision, Writing - review editing.

Declaration of competing interest. The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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