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Sensory quality and physicochemical evaluation of two brine pickled cucumber (*Cucumis sativus* L.) varieties

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***Abstract*—** *Ajax and Vlasset gherkin (Cucumis sativus L.) varieties used in brine pickling were analyzed for its sensory attributes and physicochemical changes within 6 month of brine fermentation. Sensory characteristics (colour, texture, odour and overall acceptability) of brine fermented fruits were determined using five point hedonic scale. Uronic acid content (UA) and moisture variation were determined within 6 months. Ca and Na ion absorption was done for the fruits within fermentation and after de-brining.*

The results revealed that sensory perception of texture attribute among cultivars have apparent impact after brining. In view of all sensory parameters of varieties, 1st and 6th month Vlasset were obtained the highest sensory quality while the least preferred were obtained within 1st, 3rd and 6th month of Ajax.

A positive correlation (0.829) between Calcium and Sodium ion absorption were noted irrespective to the variety. The data obtained from the de-bring process showed lower retention of both Calcium and Sodium ion in Ajax than Vlasset which may lead to lower sensory quality. Calcium ion level of Ajax and Vlasset varieties have declined from 54% and 16.47% respectively while Sodium level of Ajax and Vlasset have declined from 84.13% and 55.547% respectively compared to before de-brining process. Irrespective to the variety UA was continuously decreased up to 3 months while it increased in both varieties up to 6month. Vlasset was noted to have higher UA content than Ajax before and after the fermentation period. Moreover a positive correlation was observed (0.858) between moisture and UA content.

Keywords*— *Ajax, brine fermented, sensory evaluation, Uronic acid, Vlasset.

I. INTRODUCTION

Cucumis sativus L. which is generally called as commercial cucumber thought to have originated in the southern Himalayan foothills region of Asia. Moreover cucumber production occurs in North Central America and Europe but half of world cucumber production occurs in Asia [1]. The pickling type gherkins are produced in Sri Lanka nearly 30 years for export market and it expanded over several agrological regions [2]. The immature fruits are used for the preparation of pickles [3] and cucumber for pickling must be grown from varieties known to have regular form, firm texture and overall good pickling characteristics. Ajax variety is having wide adaptability, high yield in early age and suitability for all grades. Vlasset is a popular hand pick hybrid that features a blocky fruit shape and length to diameter ratio in the 2.8 range which nicely matches the needs of many hand pick green and brine stock programs. Brining can defined as steeping of vegetable in a salt solution of predetermined concentration for a certain length of time. It involves transfer of various solutes between brine and porous solid phase, coupled with reaction within the liquid. Solutes transfer through micro pores (stomata) in the skin. It may control the rate of diffusion of the solutes in to and out of the cucumbers with reaction within the liquid [4]. Texture is an important attribute in pickling cucumbers which demands product acceptance and quality. Pickling cucumbers of any type must be firm and crisp in order to get most consumer acceptance. In the pickle industry, cucumbers are typically fermented in a brine containing ranging from 6% to 12 % NaCl and after fermentation excess salt is removed (de-brining) to make it edible.

Existing study was carried out in one of leading cucumber pickling company, with two gherkin varieties (Ajax and Vlasset) treated in brine fermentation with salt, Calcium Chloride, Acetic acid and B80 clay as main ingredients. Even though previous studies have been done with the nutritional composition [2] on fresh fruits there is a scarcity in scientific information on sensory quality of gherkin varieties, mineral changes, moisture and UA content variation during the fermentation period of commercially grown cultivars in Sri Lanka. This research was a comparative study on evaluating sensory attributes with the aspects of unrevealed chemical changes of

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locally grown Ajax and Vlasset gherkin varieties while providing them same processing conditions.

II. MATERIALS AND METHODOLOGY

2.1 Sample collection

Disease free, same maturity status (No 3, 32-42 mm diameter) fresh gherkin of Ajax (Nunhems seeds) & Vlasset (Seminis seeds) varieties, were obtained from local processor.

2.2 Sample Preparation

Brine fermentation was triplicated in 9000L plastic vats of cucumber with 2:1 pack out ratio (6000Kg gherkin: 3000L of fresh brine) of 10 % NaCl, 0.02% $CaCl_2$, 0.1 % acetic acid and 0.0028 % B-80 pure clay concentration were fermented using the controlled fermentation process of Etchells and others [5]. During this fermentation period salinity of the brine is maintained 10% range by incorporating salt to the liquid & the gherkins were continuously purged with 20ml/ min air for 3 weeks.

Brined fruits were analyzed at 1, 2, 3, 4, 5 & 6 months after brining for its UA%, Ca and Na ion absorption, moisture variations and sensory evaluations analysis.

2.3 Preparation of homogeneous sample for analysis

The gherkin flesh with peel was first diced into cubes of about 5mm x 5mm x 5mm size & dried up to 10% moisture content in dehydration oven at 60 ^{0}C. Dried samples were milled using a Fritsch Mill (sieve size 0.5 mm), packed in polythene and stored at 12 ^{o} C until use for the analysis of UA and moisture.

2.4 Sensory Evaluation

The brine fermented gherkins were assessed on 5 point hedonic scale for its sensory attributes of colour, odour, texture and overall quality. Fruits from 1 to 6 month after brine fermentation were taken from the both varieties and those 12 samples were evaluated for above four attributes by using 32 semi-trained panelists. The letter 'A' is denoted for Ajax and V" is denoted for Vlasset while corresponding number denote the month. Panelists scored scale ranging from 1 (not acceptable) to 5 (Standard).

2.5 Ion absorption amount of fermented cucumber

Ca^{++}& Na^+ absorption amount of fruits (peel + flesh) two varieties was measured using Inductively Coupled Plasma Mass Spectrometry (Thermo Scientific iCAP RQ ICP-MS) for the fresh fruit and fruits after brining (1,7,14,21,30,60,90 and 180 days). Ca^{++}& Na^+ amounts were tested according to the protocols of AOAC.985.35 and AOAC.984.27 respectively.

Above two tests were conducted for 6 month fermented and de-brining (up to 2% salinity) fruits for the determination of available Ca^{++}& Na^+ amounts in two varieties.

2.6 Uronic Acid (UA) content

Amount of UA (dry basis) for fresh fruit & 1 to 6 months after fermentation was detected by the method described in Bitter and Muir [6]. UA content was determined after acid hydrolysis of sample and reacting with Carbozol and corresponding concentrations were directly measured using spectrophotometer (Sigma Co., Germany-model No-UV-1601) at 530nm.

2.7 Moisture variation

Moisture of the fruits in both varieties was measured by AOAC 925.10 method for the fresh fruit and brine fermented fruits up to 6 month.

2.8 Data analysis

The collected data was finally analyzed by using, Minitab 17 package. Sensory data were analyzed using Kruskal-Wallis non parametric analysis to determine whether any significant difference (confidence interval of 95%) exists between selected samples. Then mean separation was carried out to identify significantly different having samples. The Mann Whitney test was carried out to identification of significantly different among varieties.

Two sample T test, Onaway ANOVA and Regression analysis were carried out for the parametric data analysis.

III. RESULTS AND DISCUSSION

3.1 Sensory evaluation

3.1.1 Best time period of the varieties

The average rank values graphically represented in Fig. 1 and the most preferred sample on colour attribute was noted from Vlasset variety (6 month fermentation).in line with analysis, sample V2 and V6 were observed highest average ranks for odour. In view of overall attribute Vlasset variety was showed better sensory quality compared to Ajax variety during 6 month of fermenting period (except 5th month).

Pursuant to the statistical evaluation results there was a significant difference of textural attribute among samples with time. Confirming to paired wise comparison texture attribute of V6-A3 & V1-A3 samples were having higher ($p<0.05$) average rank differences.

In consonance with all the sensory parameters for all samples, sample V1 & V6 have gained the highest sensory quality. Previous studies have shown that the sensory perception of texture (crispiness) among cultivars have apparent impact after brining [7]. In line with that the least preferred samples were A1, A3 & A6 among all the sensory parameters.

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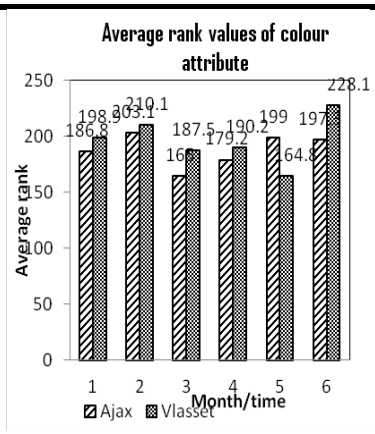

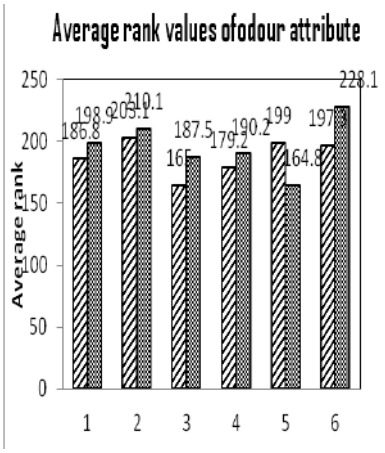

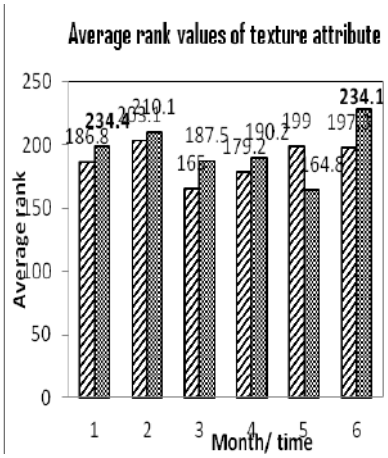

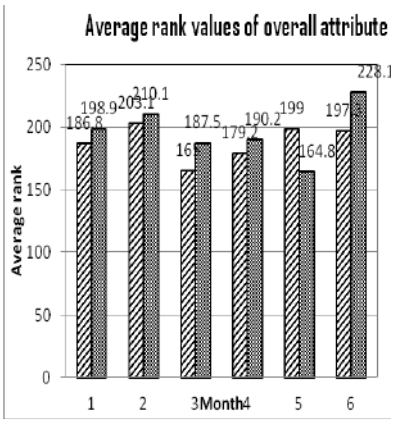

Fig. 1: Average rank values of colour, odour, texture & overall attribute in Ajax & Vlasset varieties

3.2 Ion absorption of fermented cucumber in two varieties

3.2.1 Ion absorption with time

Under this analyzing concentration of Ca^{++} and Na^{+} ions in both gherkins fruit samples were detected within 6 month of fermenting period. Measured ion concentrations using ICP-MS are given in fig. 2 and 3. Measured Calcium and Sodium ions were changed irregularly during fermentation period irrespective to the variety. Even though sodium ion concentration is lower in raw fruits than calcium throughout the fermentation period sodium ion concentration in fruits were significantly greater than the calcium ion amount in the fruits. Due to osmosis water will move from cucumber to the salt solution. In view of Walter and others [8] fruits immersed in supra-osmotic solution had lost about 14% of its weight after 23hrs.Results can be expected due to semi permeable nature of plant cell membrane. Irrespective to the varieties there was a positive correlation of between Calcium and Sodium ion amount in gherkin food. The Pearson correlation of between Na+ ppm and Ca++ ppm were obtained as 0.829 value while having a liner regression model of $y= 0.0048x^{1.9515}$ with $R^2 = 0.9003$ (x= Ca++ ppm & Y= Na+ ppm).

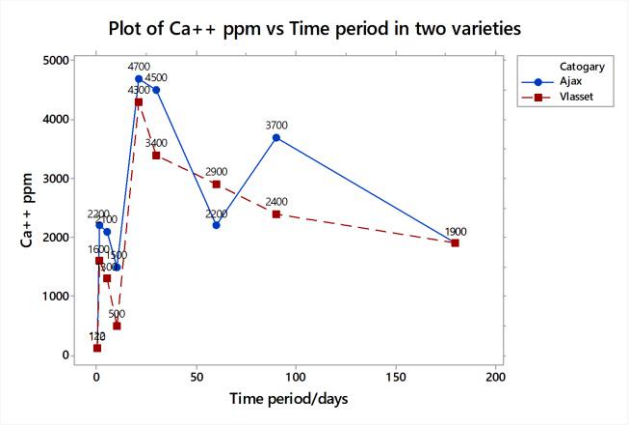

Fig.2: Variation of absorbed Ca^{++} ions in both gherkins fruit samples with time.

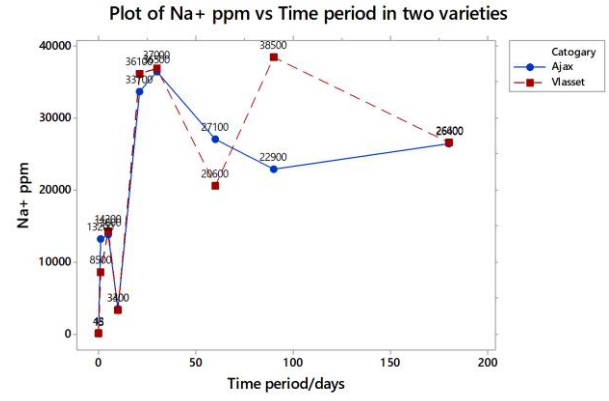

Fig.3: Variation of absorbed Na^{+} ions in both gherkins fruit samples with time.

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3.2.2 Ion absorption of brined cucumber before and after de-brining

Using ICP-MS the determination of available Ca^{++}& Na^{+} amounts in fruits were conducted for 6 month brined gherkins of two varieties, before and after de-brining up to 2% salinity. Measured ion concentrations before & after de-brining up to 2% salinity are shown in the Fig. 4.

As reported by de-brining process, after de-bring have great impact on both Calcium and Sodium ion concentration of Ajax variety. Even though both are supplied the same conditions there is a rapid decrease of both ion content in Ajax variety. Calcium ion level of Ajax and Vlasset varieties have declined from 54% and 16.47% respectively compared to before de-brining process. While Sodium ion level of Ajax and Vlasset varieties have declined from 84.13% and 55.547% respectively compared to before de-brining process. This may be due to the breakdown of cell permeability, variation of surface (peel) characters of varieties. It may be due to higher concentrated ion levels of Ajax which are bounded to the peel area or etc.

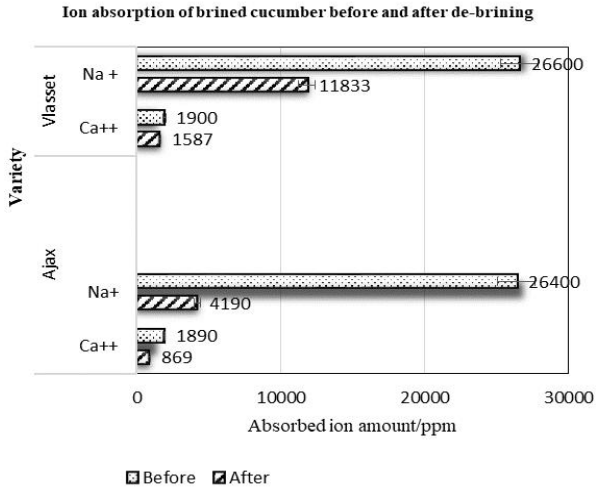

Fig. 4: Ion concentration of brined cucumber before and after de-brining (6 month period) up to 2% salinity.

3.3 Uronic acid content

Under this study UA content in both gherkin varieties were conducted because the amount of UA is related to the cell wall component pectin. UA content can be determined after acid hydrolysis of sample and reacting with Carbozol. Corresponding concentrations can be directly measured by using spectrophotometer.

Irrespective to the variety uronic acid content continuously decreased up to 3 months (Fig.5). These results are coincided with firmness variation of 3 month and 6 month in mesocarp tissues of both varieties. It was suggested that the resistance of plant tissues high in Calcium to breakdown by fungal pathogens is due to calcium pectate complex formed [8]. From 3 month to 4 month UA content was increased in both varieties and in Ajax this increment was continued up to 5 months and gradually decreased.

Irrespective to the time Vlasset was noted to have higher UA content than Ajax. D-galacturonic acid determines the pectin content present in the sample. Even though proportion of total dietary fibre contributed by vegetable is less than legumes it has higher soluble fraction. Pectin is basically water soluble, the extent of solubility depends on the degree of esterification of galacto uronic acid and makeup of the side chain [9]. Therefore pectin can find not only soluble fraction but also insoluble fraction of dietary fibre.

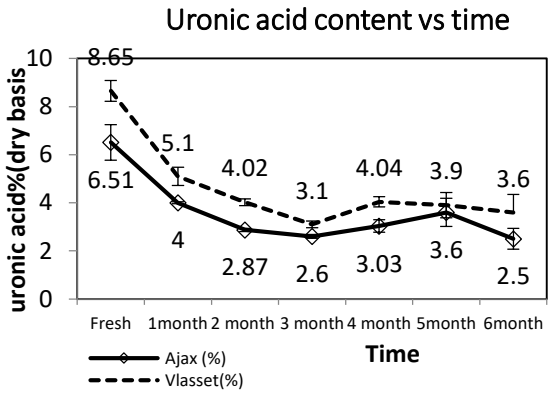

Fig.5: UA percentage of two varieties within fermenting time as dry matter basis

3.4 Moisture variation

Fig. 6 shows the change of moisture content of two varieties during fermentation period. Irrespective to the varieties initial moisture content has continuously declined up to 2 months and after it changes within 84 to 87 % moisture range with an unpredictable nature. Table 1 shows the moisture loss as a percentage of moisture in initial fresh fruit sample.

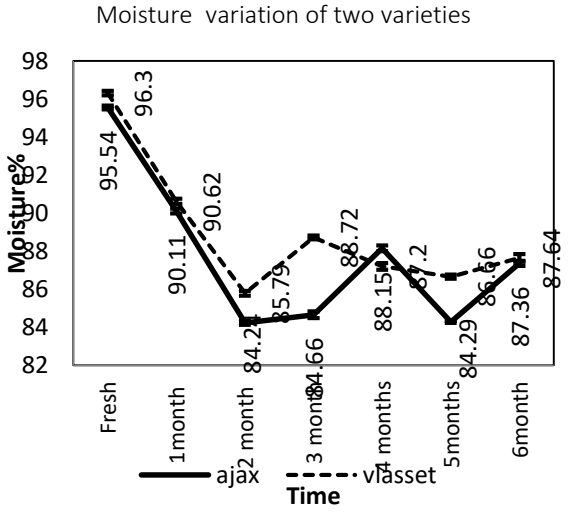

Fig.6: Moisture variation of two varieties within fermentation period.

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Table.1: Percentage of moisture loss respect to initial fresh fruit sample

Month	% Moisture loss compared to initial fresh fruit	
	Ajax	**Vlasset**
1	5.68±0.01	6.43±0.01
2	11.83±0.07	12.52±0.01
3	11.39±0.02	12.09±0.03
4	7.73±0.05	8.46±0.06
5	11.78±0.02	12.47±0.01
6	8.56±0.08	9.28±0.01

In lined with this results Vlasset variety is having higher moisture loss throughout the fermenting period. Hence it may be the reason for increasing its sensory properties than the variety Ajax. Higher moisture loss was noted at the end of the 2nd month for Ajax and Vlasset giving 11.83% and 12.52% respectively.

According to Walter et al [8] fruits immersed in supra-osmotic solution had lost about 14% of its weight after 23hrs.Moreover there is a strong positive correlation of 0.858 between moisture content and UA content of samples (P-Value = 0.000). Moisture levels of food products have a bearing on their dry matter content. The higher the moisture content the lower the dry matter yield [2]. In this study moisture content of Vlasset variety was greater than the Ajax variety during 6 months of fermenting period instead records in 4 months.

IV. CONCLUSION

Although both gherkin varieties are supplied with same brine fermentation conditions, the results obtained from sensory evaluation proves to have a better quality product from the Vlasset gherkin variety.UA and moisture content of Vlasset variety showed higher percentage during the fermentation period than the Ajax variety. Besides there is a positive correlation was between moisture and UA content of gherkin fruits. During the de brining process Vlasset variety remains higher amount of Calcium and Sodium ions with respect to Ajax which may be the reason for its higher texture quality.

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