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Study on Nutritional Composition on Firmness of Two Gherkin (*Cucumis sativus* L.) Varieties (Ajax & Vlasset) on Brine Fermentation

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Abstract Gherkin *(Cucumis sativus* L.*)* is an important cucurbitaceous vegetable. The pickling type gherkins are produced in Sri Lanka since 1988 for export market and it expanded over several agrological regions. Locally grown two gherkin varieties (Ajax and Vlasset) were tested for proximate composition (moisture, dry matter, ash, mineral, protein, fat, dietary fibre and carbohydrate) of raw fruits (AOAC methods) and within 6 month of brine fermentation, firmness measurements (FTA) were recorded and varieties were evaluated. Vlasset and Ajax varieties contained 96.30% and 95.54% moisture, respectively. The ash, protein and fat were higher ($p<0.05$) and dietary fibre, carbohydrate lower in Ajax. Mg, K and Zn content were higher ($p<0.05$) in Ajax noted as 16.60 ± 1.47, 194.0± 7.80 and 14.69± 0.40 respectively while Vlasset was noted lower values. Ca (10.62± 0.59) and Na (13.46 ±0.43) were greater in Vlasset while Ajax was given lower values. Both varieties showed K to be highest followed by Zn, Na and Ca while Mg amount was secondly highest in Ajax and lowest in Vlasset. Firmness variation of both exocarp and mesocarp of Vlasset has shown same pattern while giving maximum reading in the 2nd month after fermentation. Firmness variation of exocarp and mesocarp of Ajax was not followed same pattern while maximum value was recorded in 5th and 2nd month respectively. These findings indicated that Sri Lankan gherkins have similar nutrient values as cucumber. Even initial moisture content is higher in Vlasset than Ajax variety the better textural quality is apparent in Vlasset supported by physicochemical properties of higher dietary fibre, carbohydrate, minerals (Ca, Na) and having higher firmness in mesocarp tissue than exocarp.

Keywords: *gherkin, Ajax, Vlasset, brine, fermentation*

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1. Introduction

Pickling type gherkins are produced in Sri Lanka and expanded over several agrological regions ranging from dry to intermediate zone [8]. Brine fermentation is becoming popular, because it is an important preservation method due to its sensory qualities, processing strategies and economic aspects. Microbial fermentation is responsible for favorable food characteristics such as flavor, shelf-life and texture [2]. Texture is one of the most important quality attributes of pickling cucumbers which influences on product acceptance and quality. Pickling cucumbers of any type must be firm and crisp in order to get most consumer acceptance [12]. 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 to make it edible [11].

Present study was carried out in one of leading cucumber pickling company, which uses different gherkin varieties for brine fermentation. Brine consists with salt, Calcium Chloride, Acetic acid and B80 clay as main ingredients. There is a scarcity in scientific information on nutritional composition and quality of gherkin varieties which are commercially grown in Sri Lanka and this study was focused on determining proximate composition including minerals of fresh fruits and its relationship between firmness variations after fermenting of locally grown gherkin varieties while providing them same processing conditions.

2. Methodology

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. For the proximate analysis samples were prepared by dicing gherkin flesh with peel into cubes and drying them up to 10% moisture in dehydration oven at 60°C. Dried samples were milled by Fritsch Mill (0.5 mm), packed in polythene and stored at 12°C.

Brine fermentation was carried out in duplicate 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 as mentioned in [14]. During fermentation salinity is maintained 10% by incorporating salt to the liquid & the gherkins were continuously purged with 20ml/ min air for 3 weeks.

The proximate analysis of the samples for fat, fiber, ash and moisture were carried out using the methods described by AOAC methods [3]. Determination of moisture and dry matter content were done by AOAC 925.10 .Total ash content was determined according to the AOAC 923.03. Ca, Na, Mg, K & Zn amount were determined through AAS (Thermo Scientific iCE 3000). Dietary fibre was determined by AOAC 960.52.and total fat by majonnier ether extraction method (AOAC 922.06). Crude protein content was determined by the micro-Kjeldahl method (AOAC 978.04) and Carbohydrate by subtracting the total values of ash, fiber, fat and moisture from 100 (by difference).

Firmness was measured by using Fruit Texture Analyzer (GUSS-FTA, South Africa) for the fresh fruit and fruits after 1 to 6 months brining. For mesocarp (flesh) measurements fruits were cut through its longitudinal axis (2.5 cm thickness) and firmness was measured at three number of locations within the flat surface of each fruit by driving a 10 mm flat tipped probe perpendicularly into the cut surface/peel at 10mm/sec speed, 15mm reverse increment with the trigger threshold of 0.05 kg.

For exocarp (peel) measurements firmness was measured at three number of locations within outer surface of each fruits by driving a 10mm flat tipped probe perpendicularly into the cut surface/peel at 10mm/sec speed with the trigger threshold of 0.05 kg.

The collected data was finally analyzed by using, Minitab 17 package. Two sample T test and Onaway ANOVA were carried out for the parametric data analysis.

Table 1. The average nutritional content of the raw fruit (flesh and peel) for 100g of the fresh fruit as percentage on wet basis

Parameter	Vlasset	Ajax
Moisture%	96.30±0.12 [a]	95.54±0.1 [b]
Dry matter %	3.70± 0.27 [a]	4.46± 0.20 [b]
Ash%	0.40±0.03[a]	0.81±0.06 [b]
Minerals-mg/100g		
Ca	10.62± 0.59 [a]	7.76 ± 0.84 [b]
Na	13.46 ±0.43[a]	10.47± 0.62 [b]
Mg	9.00 ±1.01 [a]	16.60 ± 1.47 [b]
K	118.85± 5.94[a]	194.0± 7.80 [b]
Zn	14.09 ±1.49[a]	14.69± 0.40 [a]
Protein%	0.78 ±0.002 [a]	1.12±0.003 [b]
Fat%	0.44 ±0.15 [a]	0.68 ±0.03 [b]
Dietary fibre%	1.546±0.05[a]	1.37±0.15[a]
Carbohydrate%	0.54	0.48

[a,b] Values in the same row with different superscripts are significantly different at 0.05 level.

3. Results and Discussion

3.1. Nutritional Composition

The average nutritional content of the raw fruit (flesh and peel) are presented in the Table 1 for 100g of the fresh fruit as percentage on wet basis. Moisture levels of food products have a bearing on their dry matter content.

Moisture content of Vlasset variety was greater ($p<0.05$) than Ajax variety. Studies have shown that *Cucumis sativus* has the highest moisture (97.80±0.59) content among selected cucurbits [7]. The dry matter of Ajax variety (4.46±0.20) was greater than Vlasset variety (3.70±0.27). Ash content of Ajax variety (0.81±0.06) was greater than the Vlasset variety (0.40±0.03). According to UK government publications [15] ash content of cucumbers were noted to have 0.4% and it is closer to the value obtained in Vlasset variety. There was a significant different ($p<0.05$) in mineral content of Ca, Na, Mg and K content of two varieties according to the two sample T test while Zn amount was not shown significantly difference. Mg, K and Zn content of Ajax variety were greater than the Vlasset variety. Both Ca & Na amount was greater in Vlasset variety than other. Both varieties showed the amount of K to be highest followed by Zn, Na and Ca while Mg amount was secondly highest amount in Ajax and lowest amount in Vlasset. Most vegetables contain substantial amounts of minerals, particularly calcium, and potassium. Calcium ions helps to prevent softening in fermented cucumber slices and Calcium firmness effect shown in cucumbers are probably similar in other processed fruits and vegetables [13].

Studies have shown that the increasing K concentration in nutrient can markedly increase fresh and dry weight on cucumber. Potassium also increases the thickness of epidermal layer of cells, adding insect and disease resistance and improves shipping and keeping qualities of thin skinned fruits and vegetables [5].

The Protein content of Ajax (1.12±0.003) was significantly ($p<0.05$) higher than Vlasset (0.78 ±0.002). The fat content of Ajax (0.68±0.03) was significantly ($p<0.05$) higher from Vlasset (0.44 ±0.15). These results are accordance to [1] and [14] that the fat content of cucumbers was noted to have 0.6%.According to [10] dietary fiber content of vegetables content ranges from 0.8 to 8% while cucumbers are having 0.8% dietary fibre content.Vlasset (0.54%) was noted to having higher carbohydrate amount than Ajax (0.48%). Vegetables are generally rich in carbohydrates but not in proteins (l-5%) and lipids (0.1-1.0%). They vary in chemical composition even within one variety, depending on the species, conditions of growth, etc [9].

3.2. Firmness Measurements

Measured firmness was changed irregularly during fermentation period. The results obtained from Fruit Texture Analyzer are given in the Table 2.

Measured firmness was changed irregularly during fermentation period. According to the data there is a significant ($p<0.05$) difference among exocarp & mesocarp of two varieties. Firmness of Ajax and Vlasset exocarp was significantly different within 2, 4 and 5 months of fermentation. Considering raw fruit Ajax was having higher exocarp value while Vlasset was having higher mesocarp value. Irrespective to the variety and location, the fruits after 2 month of fermentation are having higher firmness than the 1st and 3rd month. Considering mesocarp firmness, Vlasset variety was noted

to maintain higher firmness throughout fermentation than Ajax. According to the Walter [14] salt induced softening was inversely related to the natural calcium concentration in tissue and monovalent cations increases softening. This may be the reason of softening texture of Ajax variety because it has lower calcium content at the initial stage than Vlasset and also having higher monovalent ions include potassium ion than the Vlasset.

Table 2. Firmness measurements of two gherkin varieties within 6 months

Time	Ajax (kg/cm)		Vlasset (kg/cm)	
	Exocarp	Mesocarp	Exocarp	Mesocarp
Fresh	10.019 ± 0.811^{a}	5.228 ± 0.632^{abc}	9.957 ± 0.787^{a}	5.810 ± 0.743^{ab}
1month	6.381 ± 1.502^{def}	4.523 ± 0.605^{bcd}	6.994 ± 0.337^{bcdef}	5.428 ± 0.886^{abc}
2 month	6.753 ± 0.773^{cdef}	5.237 ± 0.552^{abc}	8.479 ± 0.741^{ab}	6.539 ± 0.744^{a}
3 month	6.391 ± 1.143^{def}	3.147 ± 0.543^{e}	7.657 ± 0.575^{bcde}	6.247 ± 0.827^{a}
4 months	7.839 ± 1.375^{bcd}	4.800 ± 0.679^{bc}	6.193 ± 0.815^{ef}	5.394 ± 1.332^{abc}
5months	8.181 ± 1.095^{bc}	4.136 ± 1.191^{de}	5.715 ± 1.278^{f}	4.404 ± 1.102^{cde}
6month	5.926 ± 0.645^{f}	3.167 ± 0.552^{de}	5.599 ± 0.624^{f}	4.439 ± 0.666^{cde}

Values are mean±SD, n = 9

^{a,b,c,d,e,f} Values in the same column with different superscripts are significantly different at 0.05 level.

4. Conclusion

Although both gherkin varieties are supplied with same brine fermentation conditions, the results obtained from firmness measurements proved to have a better-quality products from the variety Vlasset than Ajax.

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