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Sensory Evaluation and Microbiological Analysis Squash (*Cucurbita maxima L.)* Pickles

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Abstract: Squash (Cucurbita maxima) is an agricultural product produced in the Philippines which is known as rich in vitamin A and C. Pickled vegetables are known in Bicol Region, Philippines as "atsara" which is considered the easiest way of preserving vegetables especially in the abundant season of vegetable. Papaya is one of the products that has been into pickles that serve as appetizers, particularly with meat during meal time. In this new innovative process, the Squash (Cucurbita maxima) can be processed into pickled products as revealed to the sensory evaluation conducted by 30 panelists. It is revealed that Treatment 1 has an appealing quality attribute to the panelists in which 500 grams of squash were added with 250 grams of sugar, 400 grams of vinegar, 100 grams of pineapple and 10 grams' salts. It is also noted that the 400 grams of vinegar is just enough to improve the crunchiness of texture of the product. Furthermore, this study revealed that the increased weight of squash in the same pickling solution affects the flavor of the products. With regards to the microbiological analysis results suggest that the pickled squash is within the marginal quality (10^2- 10^4 CFU/g), with Aerobic Plate counts of 5.1 x 10^2 CFU/ml. However, coliform count was identified therefore it is recommended that during processing good manufacturing Practices (GMP) must be strictly applied.

Keywords: Sensory, Evaluation, Microbiology, Pickled Squash.

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I. INTRODUCTION

Pickling is one of the simplest and easiest methods of food preservation especially for perishable fruits and vegetables. Pickling is the easiest method of preserving vegetables. Production and consumption of traditional vegetable-based fermented pickles have a long worldwide history including populations from different cultures, i.e., Asians, Africans, Latin Americans, and recently North Americans and Europeans due to their desirable sensory attributes and high nutritive value, as well as extended shelf-life (El Sheikha, 2018a, El Sheikha, 2018b, El Sheikha, Montet 2014a, leBlanc, Vignolo, Todorov, & de Giori, 2013b, Li, et.al., 2015, Ray, et al., [2014[1,2,3,4,5,6 &7]].

The term "pickle" in Southeast Asia is usually used for fruits and vegetables preserved with vinegar and salt. Preservation methods such as pickling is a technology that is considered the oldest technology (Battock and Ali, 1991) [8] to add flavor and improve the taste of food biologically (Jyoti, 2011; Vichai,n.d.). Euromonitor (2006) [9,10] defined pickled products as fruits or vegetables preserved in vinegar or brine. Pickles are considered high-acid food. Acid can be added in the form of vinegar or produced naturally by fermentation process. Pickled products are used as food adjuncts and function as appetizers. It also aids in digestion by stimulating the flow of gastric juices (Millesca, A., (2021)[11]. In the Philippines special in Bicol Region the most common vegetable that is used for pickling ifs the Papaya. Pickled products are usually used by the Bicolanos as an appetizer especially with meat food However, in this study squash (*Cucurbita maxima*) use as the main raw material in preparing pickled products. The pickled squash undergoes sensory evaluation to find out its acceptability to the consumer.

Squash (Cucurbita maxima) is an agricultural product produced in the Philippines particularly in the Partido Area of Camarines Sur and commonly known as "kalabasa". This vegetable is known as rich in vitamin A and C. In Bicol Region, Philippines squash is not just used as viand but also prepared as snack food like pastillas, chips, puto and baked products like cupcakes, pandesal. Squash (Cucurbita maxima belong to the plant family that includes melon and cucumber, and come in many varieties. Some varieties of squash also produce edible flowers. While each variety may have a distinct shape, color, size and flavor, all varieties share some common characteristics. Regardless of variety, all parts of the squash are edible, including the flesh, seeds and skin or rind (Moreno, R. B., 2015) [12].

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Sensory evaluation has been defined as a scientific discipline used to evoke, measure, analyze, and interpret human reactions to meat sensory characteristics as perceived by sight, smell, taste, touch, and hearing by the Institute of Food Technologist. (Gatchalian M.M., (1999[13] Food acceptability is affected by many factors, which may be related to the individual, the food, or the environment in which the food is consumed. Acceptability is a subjective measure based on hedonics (pleasure), which in turn is influenced by the sensory properties of the food, previous exposure to it and subsequent expectations, contextual factors, an individual's culture, physiological status (i.e., hunger, thirst, and presence/absence of illness), and many other variables. The measurement of food acceptance is highly complex and relies on psychometrics (scales) and behavioral models (food-choice models). (Bayogos, B. (2024)[14]. In this study, the researcher uses an experimental method in order to determine the acceptability of pickled products through sensory testing. However, before sensory evaluation the pickled squash was subjected to microbiological analysis in order to safeguard panelist from harm or food poisoning.

According to Bigueja, (2022) [15] consumers globally are becoming more concerned about food safety, hence food products must have undergone microbiological analysis not only for the safety of consumers but also determine whether the food processors applied good manufacturing practices. According to Lee et. Al, (2017)[16] pickled products the microbiota have been studied that shows the predominant genus was Lactobacillus or Leuconostoc, regardless of the pickling time. However, in this study Aerobic Plate Count, Rapid Yeast and Molds, Staphylococcus aureus, Coliform Count and Salmonella Count in Food have been determined.

II. MATERIALS AND METHODS

A. Research Procedures

A new product was developed using squash with other ingredients. Experimental method was used to determine the best formulation in the processing of the squash pickles. Five (5) treatments and 3 replicates were prepared. Each treatment with the different weight of squash and same concentration pickling solutions (Table 1). Likewise, the pickled products were packed in the glass jars and determined the sensory attributes of the product. The finished product underwent sensory evaluation in which the worth of the new product was assessed if it is acceptable to the consumers in terms of appearance, texture, flavor and aroma. The most acceptable products submitted to the Department of Science and Technology (DOST) for proximate chemical and nutritional analysis.

Table 1. Concentration of Pickling Solution

Ingredients	T1	T2	T3	T4	T5
Squash(g)	500	600	700	800	900
Sugar(g)	250	250	250	250	250
Vinegar(g)	400	400	400	400	400
Pineapple Juice	100	100	100	100	100
Salt(g)	10	10	10	10	10
Red onion(g)	50	50	50	50	50
Ginger(g)	35	35	35	35	35
Garlic (g)	50	50	50	50	50
Black pepper(g)	10	10	10	10	10
Red bell pepper(g)	75	75	75	75	75
Green pepper(g)	75	75	75	75	75
Raisin(g)	100	100	100	100	100
Carrots(g)	100	100	100	100	100

B. Preparation of the Squash for Pickling

The matured squash with a firm rind were selected. The selected squash was washed and removed the pulp and seeds and were cut/ sliced into strips. The strips were washed and drained and set aside ready for the fermentation process.

C. Preparation of the Pickling Solution

All the needed ingredients were prepared. The vinegar was boiled. While boiling the other ingredients were added and removed from the fire. The pickling solution was cooled until 80^0C then was mixed to the striped squash. The products were packed. This procedure was applied into 5 treatments using different concentrations of pickling solution as shown in Table 1.

D. Sensory Evaluation

The Three (3) formulations were subjected to a preference test and determined using the 9-point hedonic scale (1-dislike extremely, 5-neither like nor dislike and 9-like extremely). The most preferred formulation was used in determining the characteristics or attributes of the products such as: appearance, aroma, texture, flavor and overall acceptability.

E. Microbiological Analysis.

The analysis of aerobic plate count, rapid yeast and molds count, staphylococcus count, coliform count, total plate count and salmonella was determined using the Official Analytical Chemists method (AOAC 2021 Ed.). The Analysis was carried out in the DOST V

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Laboratory. This microbial parameter is the FDA requirements.

F. Statistical Analysis.

Data collected were subjected to statistical analysis using, weighted mean, Standard Deviation (SD) and the Analysis of variance (ANOVA) at p< 0.05 level of significance.

III. RESULTS AND FINDINGS

A. Sensory Evaluation of Pickled Squash (PS)

Sensory characteristics of the product are important quality parameters, which influence the status of the finished product on the market, and whether consumers, whom it is intended for, will like and buy the product. Results of scientific research have shown that quality and important sensory characteristics of the product, can be identified and controlled with the descriptive II International Congress "Food Technology, Quality and Safety" 326 analysis or by consumers testing can be examined if the overall product quality or the selected property of the product were affected by carried out modification (Bahamonde et al., 2007; Grunert et al., 2008; Grujić and Spaho, 2010; Grujić and Grujić, 2011) [17, 18,19,20]. As the aim of this research is to pickle squash to harmonize with market needs and consumers' expectations. Expected quality and nutrients were identified and described.

Table 2. Level of Acceptability of Pickled Squash Using Treatment 1.

Quality Attributes	Weighted Mean	Standard Deviation (SD)	Description
Appearance	7.91	0.80	Like Very Much
Flavor	7.55	1.64	Like Very Much
Texture	7.53	1.54	Like Very Much
Aroma	7.25	1.77	Like Moderately
Overall acceptability	7.93	1.04	Like Very Much

Table 2 shows the level of acceptability of pickled squash as to 500 grams of Squash added to pickling as evaluated in terms of appearance, flavor, texture, aroma, and overall acceptability. As to appearance, flavor, texture and overall acceptability was rated 7.91, 7.55. 7.53 and 7.93 respectively, and described as Like Very Much. On the other hand, the panelist evaluated aroma (7.25) as Like Moderately. This implies that the processes involved in the Study indicates a positive expression that the product is acceptable to the consumers, hence, squash can be processed into pickles or as locally known in Bicol Region Philippines as "atsara". As to the texture, treatments 1 was rated very much. Hence, it can be noted that the pieces of squash are firm and plump. Radman, (2023) [21], stated that texture is one of the most important parameters for pickled vegetables, because vegetables that are too soft, tender and tough are undesirable. In this study, texture analysis of pickled squash showed that the Pickled Squ8ash retained its firmness.

Table 3. Level of Acceptability of Pickled Squash Using Treatment 2

Quality Attributes	Weighted Mean	Standard Deviation (SD)	Description
Appearance	6.87	1.69	Like Moderately
Flavor	7.06	1.72	Like Moderately
Texture	7.49	1.82	Like Very Much
Aroma	6.96	1.92	Like Moderately
Overall acceptability	7.28	1.57	Like Moderately

As specified in Table 3, the pickled squash to 600 grams of squash added to the pickling solution in terms of texture was rated very much. While on appearance, flavor, and aroma, were moderately appealing as indicated by their mean scores of 6.87, 7.06, 6.37, and 6.96 respectively. The overall acceptability with mean score of 7.28 and with Standard deviation of 1.57, described as liked moderately means that the product was obviously acceptable to the potential customers.

Table 4 shows the level of acceptability of pickled squash as to 700 grams of squash added to pickling as evaluated in terms of appearance, flavor, texture, aroma, and overall acceptability. The texture received the highest score 7.40 with SD of 1.92 and flavor received the lowest score of 6.34 with SD. Generally, all attributes were rated as Like moderately. This results noted that the increase of squash added to pickling solution the flavor is affected.

Table 4. Level of Acceptability of Pickled Squash Using Treatment 3

Quality Attributes	Weighted Mean	Standard Deviation (SD)	Description
Appearance	7.03	1.57	Like Moderately
Flavor	6.34	2.05	Like Moderately
Texture	7.40	1.92	Like Very Much
Aroma	6.8	2.24	Like Moderately
Overall acceptability	7.56	1.79	Like Moderately

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Table 5 presented the result of sensory evaluation on pickled squash as 800 grams of squash added to pickling solution in terms of appearance, flavor, and aroma and overall acceptability were moderately likeable as indicated by their mean scores of 7.00, 6.28, 7.00 and 6.84 respectively. Moreover, flavor the lowest score of 6.28 with SD of 1.94 which indicate that the increase of added squash on the pickling solution where flavor was affected while appearance and texture and aroma were not affected.

Table 5. Level of Acceptability of Pickled Squash Using Treatment 4.

Quality Attributes	Weighted Mean	SD	Description
Appearance	7.00	1.70	Like Moderately
Flavor	6.28	1.94	Like Moderately
Texture	7.56	1.97	Like Very Much
Aroma	7.00	1.98	Like Moderately
Overall acceptability	6.84	1.90	Like Moderately

As specified in Table 6, the pickled squash to 900 grams of squash added to the pickling solution in terms of appearance, flavor, texture and aroma, and overall acceptability were moderately appealing as indicated by their mean scores of 6.53, 6.06, 7.09 and 7.377 respectively. The texture is extremely appealing to the panelist with a mean score of 7.78 and with Standard deviation of 1.23. This result signifies that the amount of 400 grams' vinegar added to the process of pickling the squash is just enough to attain the favorable texture of pickled squash. Furthermore, as compared to treatment 3 and 4 the flavor was affected with an increase of squash added to the pickling solution. As shown in the Table 5 Flavor only receives a 6.06 score.

Table 6. Level of Acceptability of Pickled Squash Using Treatment 5

Quality Attributes	Weighted Mean	SD	Description
Appearance	6.53	1.87	Like Moderately
Flavor	6.06	1.79	Like Moderately
Texture	7.78	1.23	Like Very Much
Aroma	7.09	1.60	Like Moderately
Overall acceptability	7.37	1.84	Like Very Much

Generally, all pickled squash treatments received favorable texture (crunchiness) scores of like very much. The result of this present was similar to the following studies: According to Brenes et al. (1994)[22], fruit softening is induced via the addition of acid, the effect being stronger with lactic acid than with acetic acid. In their study, the effect of acid on fruit hardness was greater at lower PHs and consequently at higher acid concentrations. According to the LSD test, the lowest values for work of cutting were found in the alcoholic vinegar samples, which had, significantly ($p < 0.01$), the highest titratable acidity. On the other hand, MacFeeters et al. (1989)[23] reported that salt softens low-acidity vegetables such as cucumbers. The LSD test also showed that the alcoholic vinegar sample had significantly ($p < 0.01$) the highest salt content in the pickle juice, indicating that the salt was probably extracted from the plant material, which could have an effect on softening and reducing the chopping values.

Based on the results, the processed of pickling squash generally, acceptability to the panelists, hence this product can be included in the list of fermented or pickled vegetables

B. Significant difference on the sensory attributes of pickled squash

The result of the sensory evaluation was subjected the F – test and it was computed using a five percent (5%) level of significance. The results of the F – test of the sensory attributes of the bottled pickled squash are shown in Table 2.

Table 7. Analysis of Variance (ANOVA) on Sensory Attributes of pickled Squash with 5 Treatments

Attributes	*F*	*P-value*	Decision
appearance	17.61633	8.7300	NS*
flavor	19.65615	1.3600	NS*
texture	47.606.99	7.2100	NS*
aroma	18.21562	1.3600	NS*
Overall acceptability	19.67681	4.81317	NS*

*NS- Not Significant

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As reflected in Table 7, the p-value of all Attributes are greater than the ($p<0.05$) level of significance therefore the null hypothesis is accepted. Hence, the pickled squash at different treatments has no significant difference. This result implied that pickled squash can be processed at different concentrations of pickling solution and are acceptable to the consumers. However, it is also recommended that products should be subjected to shelf life analysis because storage time can affect the keeping quality of the product and can change other attributes of the pickled products.

C. Microbiological analysis of Squash (Cucurbita maxima) Pickles

According to the Guidelines for Food Microbiological Examination of Ready-to-eat Foods (CFS, 2014) [30] Enterobacteriaceae are useful indicators of hygiene and of post-processing contamination of heat processed foods. Furthermore, their presence in high numbers ($>10^4$ per gram) in ready-to-eat foods indicates that an unacceptable level of contamination has occurred or has been under processing.

Table 8. Microbiology Pickled Squash in Glass Jar

Microorganism	Results	Method
Aerobic Plate Count	5.1 x 10^2 CFU*/g	TM-M-008 with reference to AOAC 990.12, 21st Ed
Rapid Yeast and Molds	<10 CFU*/g	TM-M-008 with reference to AOAC 2014.05, 21st Ed.
Staphylococcus aureus	<10 CFU*/g	TM-M-008 with reference to AOAC 2003.07, 21st Ed.
Coliform Count in Food	<10 CFU*/g	TM-M-008 with reference to AOAC 990.12, 21st Ed.
Salmonella Count in Food	Not detected in 25 g sample	TM-M-008 with reference to AOAC 2014.05, 21st Ed

As shown in Table 8 results of the study suggest that the pickled squash is within the marginal quality (10^2- 10^4 CFU/g), with Aerobic Plate counts of 5.1 x 10^2 CFU/ml. However, pathogenic strains of coliforms should be absent. Members of the Enterobacteriaceae group occur in the environment as well as in the gut of humans and animals. Microbial indicators are more often employed to assess food safety and sanitation rather than quality. Lowering the moisture content of the product is needed to prevent the growth of microorganisms. It is clear that the potential for E. coli to survive for extended periods in acidified vegetable products with a pH below 4 clearly exists; pasteurization for some acidified food products may be needed to ensure safety (Igbabul B, Hiikyaa O, Amove J (2014) [24].

IV. CONCLUSION AND RECOMMENDATION

Five treatments of pickled squash of varying weight using the same pickling solution were successfully prepared and evaluated. Results of sensory evaluation Treatment revealed acceptable quality attributes in terms of appearance, flavor, texture and aroma and overall acceptability particularly in which the 500 grams of squash were added 250 grams of sugar, 400 grams of vinegar, 100 grams of pineapple and 10 grams' salts and with other ingredients. It is revealed that the increase of squash added to the pickling solution the flavor is affected as shown in the result of sensory evaluation. Therefore, the findings warrant further investigation or consideration. On the other hand, results of the sensory evaluation revealed that the potential customers liked its texture very much due to its crunchiness which made it more appealing. Hence, with the right amount of ingredients added in the processing of pickled squash, shows that squash can be included for the product of "atsara" or pickled (fermented) vegetables.

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