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Development of Squash-Based Products for Food Security and Sustainable Livelihood

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Abstract

The study determined the level of acceptability of Squash Ice Cream along appearance, aroma, taste and texture. It also determined the sensory quality that evaluators liked most, customer's overall satisfaction of the product as well as its shelf-life. An experimental research design was used since recipes were formulated and controlled by the researchers and evaluated by 60 respondents from different groups (grade school pupils, high school students, college students, adults food experts and senior students).

The main gathering tool was a structured evaluation form. Weighted mean, frequency and percentage were used to analyze and interpret the data on the respondents' evaluation. Ranking was used to determine the most liked sensory characteristics of the product by the evaluators.

Along level of acceptability, and in terms of appearance, aroma and taste, the respondents rated ***Like Very Much (LVM)*** the Squash Ice Scream which implies that the sensory characteristics of the product are very much acceptable to the evaluators. In addition, in terms of product texture, respondents rated it as ***Like Moderately (LM)*** which signifies that the texture of the product is moderately acceptable. Overall, the Squash Ice Cream is very much acceptable with Treatment 1 as the most acceptable one with descriptive interpretation as ***Like Very Much (LVM).***

On the sensory quality of the Squash Ice Cream that was most acceptable by the respondents, the result shows that it is taste, followed by its aroma. This means that the taste was the distinguishing characteristic of the product.

In terms of the overall satisfaction of the product, most of the respondents were ***satisfied*** and these are along appearance, aroma, taste and texture.

The shelf life of Squash Ice Cream was determined using one environment which is refrigerated. Sealed ***Ice cream*** will stay fresh for two to four months in a zero-degree Fahrenheit freezer. On the other hand, ***once opened***, ice cream stays fresh for about six weeks when stored at zero degrees Fahrenheit.

The study concluded that the Squash Ice Cream was very much acceptable based on the sensory evaluation along appearance, aroma, taste and texture and could last for two to four months if refrigerated. Therefore, there is a high level of acceptability of Squash Ice Cream to the consumers and has a potential for commercialization.

Keywords: Squash-Based Products, Level of Acceptability of Squash Ice Cream, Sensory Qualities of Squash Ice Cream, Shelf life of Squash Ice Cream

Introduction

Squash is one of the most versatile and delicious foods available throughout the world, and it packs a serious punch in terms of health and medicinal benefits (Staughton, 2020). According to Learn.Eartheasy (2021) there are two main categories of squash namely, summer squash, which is harvested when immature, and winter squash, which spends more time on the vine and typically has a rigid exterior. In addition, OrganicFacts (2020) enumerated other functions of squash when it comes to culinary applications such that, squash is extremely versatile and is commonly used as an element of salads when fresh. They can be cooked as baked vegetables with meat, flattened into patties, fried, or included as a base flavor for soups. Squash seeds are also edible and can be made into many forms or their oils can be extracted. The shoots and tendrils of the plant can also be eaten as greens in a salad. Besides having a unique flavor, squash is actually really versatile and very easy to cook with. It can be used all year round and adds a special something to any meal (Schecter, 2019). Aside from its uses as viand, squash fruits can also be made into catsup, pastillas, leche flan, flour for bread, chips and curls (Department of Agriculture, Regional Field Office No. 02, High Value Crops Development Pro-gram, 2017).

In Central Visayas, the DA 7 has been distributing seeds of high value crops to different cities and municipalities, to include squash. Apayao was the second top producer of squash fruit with 22.2 percent (Philippine Statistic Office, Agriculture and Fisher Statistics, 2018).

Despite of the health benefits of squash, such as improving cardiovascular health, increasing strength and fitness, maintaining a healthy weight and build hand–eye coordination as well as its culinary functions, it is observed that there is lack of buyers and market access. The researchers conducted a product development particularly the Squash Ice cream that will utilize and maximize squash as main ingredient. Through this study, squash will expand its marketability and provide sustainable livelihood to the people and community through development of squash-based products.

The main objective of the study was to develop squash-based products for food security and sustainable development. Specifically, the study aimed to (1) determine the level of acceptability of Squash Ice Cream in terms of sensory characteristics such as appearance, aroma, taste and texture, (2) determine customer's overall satisfaction of the product, (3) sensory quality of the product that evaluators liked most, and (4) determine the shelf life of "Squash Ice Cream,

The research paradigm shown in Figure 1 presents the conceptual framework of this study which adopts the Input-Process-Output-Outcome (IPOO) Model.

The input variables were the level of acceptability of the "Squash Ice Cream", the consumers' evaluation on the product, the consumers' overall satisfaction of the product and the shelf life of the product.

Descriptive analysis of the survey data comprised the process and the identification of the level of acceptability of "Squash Ice Cream".

The output will be Development of Squash-Based Products (Squash Ice Cream). Further, other outputs of the study are standardized production process, shelf life information, technology utilization, strengthening community relationship, patented products and process and journal article paper and presentation.

Food security and sustainable livelihood as well as improved quality of life in the community will be the outcomes of the study.

Level of Acceptability of Squash Ice Cream in terms of the sensory characteristics: - Appearance - Aroma - Taste - Texture Shelf life of the Squash Ice Cream Customer's Overall Satisfaction	Survey	Shelf-life information Standardized production process Technology Utilization Strengthening Community Relationship Patented Product and Process Journal Article and Paper for Presentation	Food Security and Sustainable Livelihood Improved Quality Life

Figure 1. The Research Paradigm

Review of Literature

The different literature and related studies provided a more detailed and exhaustive presentation of the framework of this study.

Squash Origin and Concept

Squash is one of the oldest known crops–10,000 years by some estimates of sites in Mexico. The seeds and flesh later became an important part of the pre-Columbian Indian diet in both South and North America. Virginia and New England settlers were not very impressed by the Indians' squash until they had to survive the harsh winter, at which point they adopted squash and pumpkins as staples (Library of Congress, 2019). The word "squash" comes from the Narragansett Native American word askutasquash, which means "eaten raw or uncooked (Robbins, 2020).

The squash range extends from the central United States south to Argentina, with the highest species diversity in Mexico, which is believed to be the origination point of the genus. Around 20 species of wild squash grow among the temperate to tropical climates throughout their native range. This vegetable was unknown in Europe until the late 16th century, with the first known record of squash in the Old World which occurred in 1591. However, long before the Old World debut of squash, it was highly valued and widely cultivated by indigenous people in the Americas (Foreman, 2017). People probably started using squash as soon as they got to Central America, maybe about 13,000 BC. But they weren't eating the squash, which originally tasted bitter and was even poisonous. They used squash dried and hollowed out, as cups and bottles, and maybe as floats for fishing nets. Not very long after that, maybe about 10,000 BC, people started farming squash, making squash one of the earliest plants to be farmed. People probably didn't start to eat squash until several thousand years later, after breeding it to be sweeter and not

dangerous. The Norte Chico people, further south in Peru, farmed squash to eat (and also for fishing floats and containers) about 3000 BC (Car, 2017).

Bédard and Fafard (2015) stated that squash is classified as either summer or winter varieties, depending on when they are harvested. *Summer squash* (mainly C. pepo) are harvested before maturity, when they are still small and tender; common varieties are zucchini and yellow crookneck. Winter squash (mainly C. maxima, but also C. pepo, C. moschata or C. mixta) are harvested at full maturity (3-4 months after planting), when the rind is hard; common varieties are acorn squash and butternut squash. Winter squash has a higher carbohydrate content and is more nutritious. Squash grows rapidly, producing abundant foliage and a well-developed but rather superficial root system. Summer squash is normally seeded directly in the field, just like winter squash if the growing season is long enough. *Winter squash* can be stored at about 10°C, under dry, well-ventilated conditions. Squash species crossbreed readily; numerous cultivars vary enormously in shape, colour, size and texture. Moreover, Staughton (2020) emphasized that winter squash should have very firm skin and will be hard to touch. Slight discolorations and flaws are normal. In the nineteenth century, merchant seamen returned from other parts of the Americas with many new varieties. This resulted in the various colors, shapes, and sizes that are available today. Vine crops like squash requires an abundant supply of moisture for their maximum plant and fruit development. Although it is tolerant to drought, regular irrigation during dry season is highly recommended to obtain higher yield (Entrepinoys, 2014).

The squash has a low commercial value in Canada, although its popularity has been growing over the past 30 years. There are now more than 6,500 ha of land planted with squash every year; the crop is worth more than $40 million. Over 90% of squash sales come from fresh squash; the rest is from processed squash products. Squash is also increasingly being used as a tourist attraction in the agri-tourism industry. Quebec and Ontario are the two main squash producers in Canada (Bedard and Fafard, 2015).

Squash, botanically known as Cucurbita maxima L., is commonly grown in the Philippines throughout the year. It is usually grown in home gardens and in commercial scale for its fruits, young shoots, flowers and seeds. In some places, intercropping squash with other crops such as corn, sugarcane, and coconut is practiced. Like other cucurbits, squash is recognized as an important source of vitamins and minerals. For optimum yield and profit, squash is planted in rice-based lowland areas from October to December, and May to July for hilly areas. Planting squash in these months will avoid the peak population of insect pests and the high incidence of plant diseases (Juan Magsasaka, 2012). According to the Philippine Statistics Authority (PSA, 2020) the average retail price of squash per kilogram for 2019 and 2018 were closer at PhP 30.94 and 32.95, respectively. In 2019, the lowest and highest prices per kilogram were in March and December at Php 21.50 and Php 38.94, respectively. In 2018, lowest retail price was in April at PhP 23.40 per kilogram and highest was in August at PhP 46.67 per kilogram.

Squash Usage and Benefits

Squash is a healthy choice to replace foods that are high in calories and cholesterol. Summer squash for weight loss is a very good choice, as it is fat-free and very low in calories (Ameya, 2019). It is also high in antioxidants, particularly beta-carotene, vitamin C, and polyphenols. These nutrients help our bodies fight a number of chronic diseases, including type 2 diabetes, cardiovascular disease, and certain cancers. They are also rich in fiber and water, making them both hydrating and good for the gut (Robbins, 2020). According to WebMD, the vitamin C and beta-carotene found in squash may help to slow the progression of muscular degeneration and reduce the chances of related vision loss. Foods rich in vitamin C can also

help prevent cataracts.

Fiber-rich squash is also a great source of potassium, which helps the body keep sodium in check, can help ease muscle cramps, and promotes heart health. Winter squash is a little higher in carbs than the summer squash (zucchini and patty pans), so people with diabetes should keep an eye on their intake (Fox, 2015). It is also a rich source of vitamin C, which prevents premature aging and cancer as well as inhibits cell division. It also contains vitamin A which provides protection against lungs and oral cavity cancers. Squash is also responsible for stimulating hair growth. It prevents hair breakage and promotes optimum growth (Amaya, 2019). Thus, from the health benefits of squash mentioned above, it is clear that squash is definitely a healthy and tasty choice to be a part of our diet.

Culinary and Commercialization of Squash

In recent years, processing has added value to this vegetable. Fresh fruits are no longer simply cooked and served in households. Squash is now served as soup and pies in hotels, cafes and restaurants. Not only that, squash soup is now being canned and fruits are even processed into noodles. Even the roasted seeds are popular as snack food (Pinoyentre, 2015). According to Good Food, seasonal, healthy and wonderfully versatile squash is an essential ingredient in many savoury and sweet dishes.

To cook squash, there are things to consider depending on its variety. Summer squash is generally divided into four groups—crookneck, zucchini (green and yellow), straightneck, and scallop (pattypan). They have thin, edible skins and soft seeds, and are high in vitamins A and C, and niacin. The tender flesh has a high water content, sweet and mild flavor, and requires little cooking. For best flavor, choose small squash (4 to 6 ounces each) with blemish-free skin. They keep well refrigerated in a plastic bag for no more than five days. Due to their high water content, they do best when cooked with dry-heat methods such as stir-frying, grilling, or sautéing to avoid the mush factor. Cooking by steaming, simmering in a sauce, baking, or deep-frying is perfectly acceptable. It must be peeled before cooking/eating, or the flesh should be scooped out of it after cooking. It can be roasted, braised, steamed, boiled, microwaved, and simmered (Rolek, 2021).

Slices of squash can be added to sandwiches or sprinkled on salads. These vegetables can also be pureed to make highly nutritious and delicious squash soup. Winter squash can be roasted in the oven with maple syrup. Desserts like squash pudding can also be prepared using squash (Ameya, 2019). Squashes were baked, cut and moistened with animal fat, maple syrup, and honey according to the Library of Congress, (2019). Squash can also be used in the manufacture of catsup, aby foods, confectionaries, noodles and many others.

An experimental research was conducted by Moreno (2015) to determine the sensory acceptability of mashed squash (Cucurbita Maxima) of different proportions in making ice cream in terms of appearance, aroma, texture, taste and general acceptability. Five treatments were formulated in the study- four of which utilized mashed squash at various proportions and one treatment was used as the control variable which contains no mashed squash at all. The respondents of the study were the 20 Food Technology students and 10 faculty members of West Visayas State University Calinog Campus who were selected through random sampling. The respondents evaluated the finished products using a modified sensory evaluation score sheet based on Six Point Hedonic Scale. The statistical tools used were the means, standard deviation, Wilcoxon Signed Rank Test. The 0.01 alpha level was used as the criterion for acceptance or rejection of the null hypothesis. The result of the study led to the conclusion that there is a significant difference that existed in the level of acceptability of mashed squash in making ice cream in terms of appearance, aroma, and

general acceptability, therefore the null hypothesis is rejected. However, no significant difference in the level of acceptability of using mashed squash in making ice cream in terms of taste and texture.

Methodology

Research Design. This study used an experimental research design specifically, completely randomized design. Experimental recipes were formulated and controlled by the researchers. Likewise, the descriptive design was used since the products are evaluated in terms of their level of acceptability along appearance, aroma, taste and texture.

Research Instrument. The researchers used sensory evaluation sheet in the form of a score card in a rating scale format to gather the needed data for the study. The score card was supplemented with written comments of the evaluators on the product so as to gather the most accurate evaluation and to enhance the discussion of the result. The Score for the level of acceptability ranged from 1 to 9 wherein 1 (Dislike Extremely) is the lowest score and 9 (Like Extremely) was the highest.

Population and Sampling. Sixty (60) individuals were purposively chosen as the sensory evaluators. The participants include Grade School Pupils (6 -11 years old), High School Students (12-17 years old), College Students (18-21 years old), Adults (22 -59 years old) and Senior Citizens (60 years old and above) and food experts. Ten (10) individuals were involved for each category.

Locale of the Study. The respondents of the study are the residents from the City of Batac, Ilocos Norte (specific Barangays are Quiling Sur, Dariwdiw and Billoca). Batac is a landlocked component city in the coastal province of Ilocos Norte.The city has a land area of 161.06 square kilometers or 62.19 square miles which constitutes 4.71% of Ilocos Norte's total area. Batac City Mayor Albert D. Chua says the city government has allocated PHP100 million to boost the local agriculture sector for the year. Among the priority areas of concern include increasing productivity on rice, corn and other high value crops like garlic, onions, squash and many more. The three barangays mentioned are considered top squash growers and producers in the City of Batac.

Data Collection Procedures. Evaluators were given three treatments of the Squash Ice Cream and rated them according to the evaluation tool. The treatments were rated according to taste, texture, aroma and appearance. The comments and suggestions were used for the improvement and development of the product. All treatments were the same in procedures but they vary on the measurement of certain ingredients**.**

Table 1. Treatments of Squash Ice Cream

Ingredients	Treatment 1	Treatment 2	Treatment 3
Mashed squash	250 gms	500 gms	750 gms
Evaporated milk	240 ml	240 ml	240 ml
Condensed milk	240 ml	240 ml	240 ml
All-purpose cream	240 ml	240 ml	240 ml
Vanilla	¼ tsp	¼ tsp	¼ tsp

The evaluators had to eat or taste separately the Squash Ice Cream, first Treatment 1, and next Treatment 2 and lastly Treatment 3.

The following numerical ratings and their descriptive ratings were used by the evaluators.

9 Like Extremely (LE) 5 Neither Like nor Dislike (NLD)

8	Like Very Much (LVM)	4	Dislike Slightly (DS)
7	Like Moderately (LM)	3	Dislike Moderately (DM)
6	Like Slightly (LS)	2	Dislike Very Much (DVM)
		1	Dislike Extremely (DE)

Statistical analysis plan/Data analysis plan. Weighted Mean was used to determine the level of acceptability of the Squash Ice Cream in terms of appearance, aroma, taste and texture. The results were interpreted using the following scale of mean values and their descriptive rating.

Range of Means	Descriptive Interpretation (DI)
8.51 – 9.00	Like Extremely (LE)
7.51 – 8.50	Like Very Much (LVM)
6.51 – 7.50	Like Moderately (LM)
5.51 – 6.50	Like Slightly (LS)
4.51 – 5.50	Neither Like nor Dislike (NLD)
3.51 – 4.50	Dislike Slightly (DS)
2.51 – 3.50	Dislike Moderately (DM)
1.51 – 2.50	Dislike Very Much (DVM)
1.00 – 1.50	Dislike Extremely (DE)

Ranking was used to determine the sensory quality of the product that evaluators liked most.

All data gathered were stored in a Google drive to ensure the security of information. On the other hand, all printed evaluation tools and other related files will be shredded and disposed properly after recording and analysis of results.

The analysis of data and interpretation of the results were confined to the gathered data. The data were analyzed using the MS Excel to make the analysis and findings accurate that led to valid and meaningful conclusions and recommendations.

Results and Discussion

This portion presents the level of acceptability of squash ice cream in terms of appearance, aroma, taste and texture

Level of Acceptability of Squash Ice Cream in terms of Appearance

In terms of appearance, the respondents rated *Like Very Much (LVM)* the Squash Ice Cream with an overall mean of 7.53. The result implies that the appearance of the product is very much acceptable to the evaluators for treatments 1 and 2 with weighted means of 7.72 and 7.62, respectively. However for treatment 3 with 7.27 weighted mean, it was moderately acceptable by the evaluators.

The highest rating was given by the senior citizens with an overall mean of 8.53 (***Like Extremely)***. However, the high school students rated the product with the lowest rating of 6.80 (***Like Moderately).*** This signifies that eye appeal of food products are essential for high school students and this is further supported by **MacDougall (2021)** in his study that food appearance determined mostly by surface color is the first sensation that the consumer perceives and uses as a tool to either accept or reject food.

Table 2. Respondents' Acceptability of the Squash Ice Cream in terms of Appearance (n=60)

Respondents	Treatment 1		Treatment 2		Treatment 3		Overall Mean	
	Mean	DI	Mean	DI	Mean	DI	WM	DI
Grade School	7.60	LVM	8.00	LVM	7.80	LVM	7.80	LVM
High School	6.60	LM	7.30	LM	6.50	LM	6.80	LM
College	7.30	LM	7.40	LM	6.30	LM	7.00	LM
Adult	8.50	LVM	7.80	LVM	7.80	LVM	8.03	LVM
Food Experts	7.70	LVM	6.60	LM	6.80	LM	7.03	LM
Senior Citizen	8.60	LE	8.60	LE	8.40	LVM	8.53	LE
TOTAL	7.72	LVM	7.62	LVM	7.27	LM	7.53	LVM

Legend:

Range of Mean	Descriptive Interpretation (DI)	Range of Mean	Descriptive Interpretation (DI)
8.51 – 9.00	Like Extremely (LE)	4.51 – 5.50	Neither Like nor Dislike (NLD)
7.51 – 8.50	Like Very Much (LVM)	3.51 – 4.50	Dislike Slightly (DS)
6.51 – 7.50	Like Moderately (LM)	2.51 – 3.50	Dislike Moderately (DM)
5.51 – 6.50	Like Slightly (LS)	1.51 – 2.50	Dislike Very Much (DVM)
		1.00 – 1.50	Dislike Extremely (DE)

Level of Acceptability of Squash Ice Cream in terms of Aroma

The respondents rated *Like Very Much (LVM*) the Squash Ice Cream with an overall mean of 7.58. The result implies that the aroma of the product is very much acceptable to the evaluators for treatments 1 and 2 with a weighted mean of 7.87 and 7.57, respectively. However, treatment 3, with 7.32 weighted mean was moderately acceptable by the evaluators.

Table 3. Respondents' Acceptability of the Squash Ice Cream in terms of Aroma (n=60)

Respondents	Treatment 1		Treatment 2		Treatment 3		Overall Mean	
	Mean	DI	Mean	DI	Mean	DI	WM	DI
Grade School	8.10	LVM	8.10	LVM	7.60	LVM	7.93	LVM
High School	7.70	LVM	7.20	LVM	7.10	LM	7.33	LM
College	7.40	LM	6.90	LM	6.90	LM	7.07	LM
Adult	8.20	LVM	7.90	LVM	7.70	LVM	7.93	LVM
Food Experts	7.70	LVM	7.20	LM	6.50	LM	7.13	LM
Senior Citizen	8.10	LVM	8.10	LVM	8.10	LVM	8.10	LVM
TOTAL	7.87	LVM	7.57	LVM	7.32	LM	7.58	LVM

Legend:

Range of Mean	Descriptive Interpretation (DI)	Range of Mean	Descriptive Interpretation (DI)
8.51 – 9.00	Like Extremely (LE)	4.51 – 5.50	Neither Like nor Dislike (NLD)
7.51 – 8.50	Like Very Much (LVM)	3.51 – 4.50	Dislike Slightly (DS)
6.51 – 7.50	Like Moderately (LM)	2.51 – 3.50	Dislike Moderately (DM)
5.51 – 6.50	Like Slightly (LS)	1.51 – 2.50	Dislike Very Much (DVM)
		1.00 – 1.50	Dislike Extremely (DE)

The highest rating was given by the adults, senior citizens and grade school pupils with overall means of 8.20 and 8.10 (***Like Very Much),*** respectively. However, the college students rated the product with the lowest rating of 6.80 or ***Like Moderately (LM).*** This is to show that college students are very particular to

the aroma of their food choices. In addition, the study of Forde (2016) emphasized that food odors have been shown to influence food choices, portion selection, and can promote a specific desire to consume certain foods. He also added that even when satiated, the sight or smell of a desirable food can stimulate appetite.

Level of Acceptability of Squash Ice Cream in terms of Taste

The respondents rated *Like Very Much (LVM*) the Squash Ice Cream with an overall mean of 7.68. The result implies that the taste of the product is very much acceptable to the evaluators, especially for treatments 1 and 2 with weighted means of 7.97 and 7.78, respectively. However, for treatment 3 with 7.30 weighted mean, it was moderately acceptable by the evaluators.

The highest rating was given by the senior citizens with an overall mean of 8.33 with a descriptive interpretation of *Like Very Much (LVM)*. However, the high school students rated the product with the lowest rating of 6.83 or *Like Moderately (LM).* This signifies that high school students give importance to the taste of their food choices and how the food satisfies their palate. This is further supported by the article of Lewis (2022) wherein taste is often the most important factor in customers deciding whether or not they like a product, and that fancy labels and ethical claims can only do so much in drawing in and keeping customers but how the product tastes will ultimately be the deciding factor for many consumers.

Table 4. Respondents' Acceptability of the Squash Ice Cream in terms of Taste (n=60)

Respondents	Treatment 1		Treatment 2		Treatment 3		Overall Mean	
	Mean	DI	Mean	DI	Mean	DI	WM	DI
Grade School	8.00	LVM	8.20	LVM	7.80	LVM	8.00	LVM
High School	7.10	LM	6.90	LM	6.50	LS	6.83	LM
College	7.80	LVM	7.60	LVM	6.70	LVM	7.37	LM
Adult	8.50	LVM	8.40	LVM	8.00	LVM	8.30	LVM
Food Experts	7.90	LVM	7.20	LVM	6.70	LM	7.27	LM
Senior Citizen	8.50	LVM	8.40	LVM	8.10	LVM	8.33	LVM
Overall Mean	7.97	LVM	7.78	LVM	7.30	LM	7.68	LVM

Legend:

Range of Mean	Descriptive Interpretation (DI)
8.51 – 9.00	Like Extremely (LE)
7.51 – 8.50	Like Very Much (LVM)
6.51 – 7.50	Like Moderately (LM)
5.51 – 6.50	Like Slightly (LS)

Range of Mean	Descriptive Interpretation (DI)
4.51 – 5.50	Neither Like nor Dislike (NLD)
3.51 – 4.50	Dislike Slightly (DS)
2.51 – 3.50	Dislike Moderately (DM)
1.51 – 2.50	Dislike Very Much (DVM)
1.00 – 1.50	Dislike Extremely (DE)

Level of Acceptability of Squash Ice Cream in terms of Texture

The respondents rated ***Like Moderately (LM***) the texture of Squash Ice Cream with an overall mean of 7.32. Treatments 1 and 2 with weighted mean of 7.58 and 7.53, respectively were very much acceptable by the evaluators. However, for treatment 3 with 6.85 weighted mean, it was moderately acceptable by the evaluators.

The highest rating was given by the grade school pupils with an overall mean of 7.97 with a descriptive

interpretation of ***Like Very Much (LVM)***. However, the High School students rated the product with the lowest rating of 6.63 or ***Like Moderately (LM).*** This signifies that high school students are particular with the texture of food items in addition to taste and appearance. This is also supported by Dahl (2021) in his article that texture is important in determining the eating quality of foods and can have a strong influence on food intake and nutrition. Furthermore, Lewis (2020) explained that texture of food products is important to the enjoyment and acceptability of foods.

Table 5. Respondents' Acceptability of the Squash Ice Cream in terms of Texture (n=60)

Respondents	Treatment 1		Treatment 2		Treatment 3		Overall Mean	
	Mean	DI	Mean	DI	Mean	DI	WM	DI
Grade School	8.30	LVM	8.30	LVM	7.30	LM	7.97	LVM
High School	6.70	LM	7.10	LM	6.10	LS	6.63	LM
College	6.60	LM	7.90	LVM	6.70	LM	7.07	LM
Adult	8.20	LVM	7.80	LVM	7.30	LM	7.77	LVM
Food Experts	7.80	LVM	6.50	LS	6.30	LS	6.87	LM
Senior Citizen	7.90	LVM	7.60	LVM	7.40	LM	7.63	LVM
Overall Mean	7.58	LVM	7.53	LVM	6.85	LM	7.32	LM

Legend:

Range of Mean	Descriptive Interpretation (DI)	Range of Mean	Descriptive Interpretation (DI)
8.51 – 9.00	Like Extremely (LE)	4.51 – 5.50	Neither Like nor Dislike (NLD)
7.51 – 8.50	Like Very Much (LVM)	3.51 – 4.50	Dislike Slightly (DS)
6.51 – 7.50	Like Moderately (LM)	2.51 – 3.50	Dislike Moderately (DM)
5.51 – 6.50	Like Slightly (LS)	1.51 – 2.50	Dislike Very Much (DVM)
		1.00 – 1.50	Dislike Extremely (DE)

Overall Acceptability of Squash Ice Cream

Table 6 shows the evaluators' sensory results on the Overall Acceptability of the Squash Ice Cream in terms of appearance, aroma, taste and texture.

Based on the results, squash ice cream is very much acceptable. The most acceptable treatment was Treatment 1 with an overall mean of 7.78 with descriptive interpretation of ***Like Very Much (LVM).*** Further, Treatment 2 was the second most acceptable treatment with an overall mean of 7.63 ***(Like Very Much)*** and Treatment 3 was rated as ***Like Moderately (LM***) or 7.18. This signifies that lesser quantity of mashed squash in the Ice Cream mixture is very much acceptable along the sensory characteristic of the product.

In Treatment 1, the highest rating was given by the adults with a mean of 8.35 (***Like Very Much).*** This implies that the Squash Ice Cream is suitable for adults in terms of their food preference. As a result, they can be considered as one of the main target markets of this product. However, the high school students gave the lowest rating of 7.03 or ***Like Moderately (LM)*** which signifies that this category of evaluators are very meticulous and careful in terms of choosing and purchasing food items.

Table 6. Respondents' Overall Acceptability of the Squash Ice Cream (n=60)

Respondents	Treatment 1		Treatment 2		Treatment 3	
	Mean	Descriptive Interpretation	Mean	Descriptive Interpretation	Mean	Descriptive Interpretation
Grade School	8.00	LVM	8.15	LVM	7.63	LM
High School	7.03	LM	7.13	LM	6.55	LS
College	7.28	LM	7.45	LM	6.65	LM
Adult	8.35	LVM	7.98	LVM	7.70	LM
Food Experts	7.78	LVM	6.88	LM	6.58	LS
Senior Citizen	8.28	LVM	8.18	LVM	8.00	LM
Overall Mean	7.78	LVM	7.63	LVM	7.18	LM

Legend:

Range of Mean	Descriptive Interpretation (DI)
8.51 – 9.00	Like Extremely (LE)
7.51 – 8.50	Like Very Much (LVM)
6.51 – 7.50	Like Moderately (LM)
5.51 – 6.50	Like Slightly (LS)

Range of Mean	Descriptive Interpretation (DI)
4.51 – 5.50	Neither Like nor Dislike (NLD)
3.51 – 4.50	Dislike Slightly (DS)
2.51 – 3.50	Dislike Moderately (DM)
1.51 – 2.50	Dislike Very Much (DVM)
1.00 – 1.50	Dislike Extremely (DE)

Overall Ranking of the Sensory Qualities

Table 7 presents the overall ranking on the sensory qualities on the acceptability of the Squash Ice Cream in terms of appearance, aroma, taste and texture.

One objective of the study is to determine the sensory quality that is accepted the most by the respondents on the Squash Ice Cream. The result shows that the **taste** was the best characteristic sensory quality of the product, which was followed by its aroma, then appearance. The taste of Squash Ice Cream provides new flavor because of the squash added and it is not too sweet. This means that the taste is the distinguishing characteristic of the product that was most appealing to the respondents.

The sensory quality that was liked the least among the respondents was the texture because it is not yet too smooth compared to other commercialized ice cream in the market. The result implies that the weakest sensory quality of the product, which is the texture needs to be developed and improved for a higher level of customer satisfaction.

Table 7. Overall Rating of the Sensory Qualities

Sensory Evaluators	Sensory Qualities			
	Appearance	Aroma	Taste	Texture
Grade School Pupils	4	3	1	2
High School Students	3	1	2	4
College Students	4	2.5	1	2.5
Adults	2	3	1	4
Food Experts	3	2	1	4
Senior Citizen	1	3	2	4
Overall Rank	**3**	**2**	**1**	**4**

Respondents' Level of Satisfaction of the Squash Ice Cream

Half of the respondents were ***satisfied*** (30 out of 60). This shows that the product was satisfying to the evaluators. While 38.33% (23) evaluators were highly satisfied in terms of its appearance, aroma, taste and texture, there were 11.67% (7) evaluators that were slightly satisfied.

Table 8. Respondents' Level of satisfaction of the Squash Ice Cream

LEVEL OF SATISFACTION	FREQUENCY (F)	PERCENTAGE (%)
Satisfied	30	50.00
Highly Satisfied	23	38.33
Slightly Satisfied	7	11.67
Total	60	100.00

Shelf Life of Squash Ice Cream

The shelf life of Squash Ice Cream was determined using one environment which is refrigerated. Sealed ***Ice cream*** will stay fresh for two to four months in a zero-degree Fahrenheit freezer. On the other hand, ***once opened***, ice cream stays fresh for about six weeks when stored at zero degrees Fahrenheit. To maintain optimal quality as well as safety, always ensure the container is tightly closed when returning ice cream to the freezer. This will keep out moisture, air, and any other contaminants that may be neighboring in the freezer (Eclipse Foods, 2020).

Conclusion

This study determined the level of acceptability of the Squash Ice Cream along appearance, aroma, taste and texture. It also determined the sensory quality of the product that evaluators liked most, customer's overall satisfaction of the product, and the shelf-life of Squash Ice Cream**.**

This study followed the descriptive type of research wherein the Squash Ice Cream was evaluated by sixty (60) respondents from different groups (e.g. grade school pupils, high school students, college students, adults, food experts and senior citizens). The main gathering tool was a structured evaluation form. Weighted mean, frequency and percentage were used to analyze and interpret the data on the respondents' evaluation. Ranking was used to determine the most liked sensory characteristic of the product by the evaluators.

Based on the findings of the study, the appearance, aroma and taste of the product were ***Liked Very Much (LVM)*** by the evaluators. As to the texture of the product, the respondents rated **Like Moderately (LM)** the Squash Ice Cream.

Based on the results, the Squash Ice Cream is very much acceptable. The most acceptable treatment was Treatment 1. Further, Treatment 2 was the second most acceptable treatment and the least acceptable among the treatments was Treatment 3. Treatment 1 is the most acceptable because it used lesser quantity of Squash which better compliment the Ice cream mixture.

As to the best characteristic sensory quality of the product, the taste is the most liked by the evaluators which is followed by its aroma. This means that the taste is the distinguishing characteristic of the product that was most appealing to the respondents. The sensory quality that was liked the least among the respondents was the texture of the product.

As to the overall satisfaction of the evaluators, almost 40 percent were ***highly satisfied***, half of them were ***satisfied*** and the rest were ***slightly satisfied*** in terms of its appearance, aroma, taste and texture.

The study concluded that the Squash Ice Cream is very much acceptable in terms of its appearance, aroma, taste and texture. In addition, Treatment 1 which garnered the highest rating was the most acceptable among the three treatments.

Recommendations

Based on the conclusions, the following are to be recommended:

The squash ice cream has to be commercially produced for the following target markets:

- **Health Conscious individuals.** People are becoming more mindful of buying food that gives them health benefits and these are the health-conscious individuals who prefer to try products that have nutritional benefits to them.
- **Millennials (Youth).** Millennials represent a large segment of the population and are an important target market because of their interest and their number. One of their characteristics involves eagerness to try something new and they want to be updated of the trends which will drive them to buy the product**.**
- **Kids and Parents.** Kids have a special palate for sweet treats. They are very much fond of eating desserts and it is a perfect opportunity for parents to engage their kids to eat vegetables. In addition, kids have a huge influence to their parents' buying decision and as a future adult consumer.
- **Tourists.** Since squash is an abundant agricultural product of Ilocos Norte, and the place is one of the top tourist destinations in the Philippines, tourists also want to purchase local and innovative products like the squash ice cream.

Said squash ice cream can be displayed and sold in:

Souvenir Shops/Pasalubong Centers. It is where local or foreign tourists flock especially during summer time when the weather is conducive for travelling leisurely. The squash ice cream could add to the experience of these tourists.

School Cafeteria- Nowadays, school cafeterias are strict in selling snacks for the students. The squash ice cream is a nutritive snack, so this is a perfect place to distribute the product.

It is also recommended that the Squash Ice Cream should be subjected to Patenting or Utility Model and registered at the IPOPhil.

Further, extension activities or interventions may be considered to local and target communities where squash are massively grown.

Since there are other squash-based products that can be produced, these have to be formulated and undergo sensory evaluation and customers' acceptance. These products will undergo the said test to be able to see their level of acceptability and commerciality.

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Literature Cited

1. Agriculture and Fishery Statistics (2018). Agriculture Statistics 1st Semester 2018 Crop. Production of CAR. Retrieved from http://rssocar.psa.gov.ph/agriculture-releases/1st%20Semester%202018%20Crop%20Production%20of%20CAR. Retrieved date February 2021.
2. Amaya C. (2019). Benefits Of Squash For Skin, Hair, And Health. Retrieved from https://www.stylecraze.com/articles/benefits-of-squash-for-skin-hair-and-health/. Retrieved date February 2021.
3. Bédard, Roger and Fafard, Mélanie (2013). Squash . Retrieved from https://quatr.us/central-america/squash-food-history-central-america.htm. Retrieved date February 2021.
4. Bureau of Agricultural Research,(2012). Squash an Introduction. Retrieved from https://www.bar.gov.ph/index.php/agfishtech-home/crops/207-vegetables/1301-squash. Retrieved date February 2021.
5. Car (2017). Where does squash come from? Central America. Retrieved from https://quatr.us/central-america/squash-food-history-central-america.htm. Retrieved date February 2021.
6. Dahl, Wendy J. (2021). What is food texture? Retrieved from https://edis.ifas.ufl.edu/publication/FS156. Retrieved date February 2021.
7. Department of Agriculture (2020). Philippines: Department of Agriculture 7 to explore planting of high- value crops. Retrieved from https://www.freshplaza.com/article/9256554/philippines-department-of-agriculture-7-to-explore-planting-of-high-value-crops/. Retrieved date February 2021.
8. Department of Agriculture, Regional Field Office No. 02, High Value Crops Development Program (2017). Squash Production guide. Retrieved from https://cagayanvalley.da.gov.ph/wp-content/uploads/2018/02/Squash.pdf. Retrieved date February 2021.
9. Forde, Ciarán G. (2016). Flavor perception and satiation. Retrieved from https://www.sciencedirect.com/topics/food-science/food-odor. Retrieved date February 2021
10. Foreman (2017). History of Squash. Retrieved from https://www.wcia.com/ciliving-tv/cihobby/history- of-squash/. Retrieved date February 2021.
11. Fox (2015). The health benefits of eating squash. Retrieved from https://www.communityhealthmagazine.com/nutrition_and_fitness/healthy_eating/the-health-benefits-of-eating-squash/article_f8716118-865d-11e6-9aef-8be01d8d0bf0.html. Retrieved date February 2021
12. Goodfood (2021). How to prepare squash. Retrieved from https://www.bbcgoodfood.com/howto/guide/how-prepare-squash. Retrieved date February 2021
13. Juan Magsasaka (2012). Squash (Calabasa) Production. Retrieved from https://www.juanmagsasaka.com/2012/10/squash-production.html. Retrieved date February 2021

14. Learn.Eateasy.com (2021). Growing Squash: How to Plant, Grow, Harvest, and Store. Retrieved from https://learn.eartheasy.com/guides/growing-squash-how-to-plant-grow-harvest-and-store/ Retrieved date February 2021
15. Lewis, Addie (2022). What is Taste and Why is it Important in Food Products? Retrieved from https://www.highspeedtraining.co.uk/hub/what-is-taste-in-food-products/. Retrieved date February 2021
16. Lewis, David (2020). Structure and texture — their importance in food quality. Retrieved from https://www.researchgate.net/publication/229583991_Structure_and_texture_-_their_importance_in_food_quality. Retrieved date February 2021
17. Library of Congress (2019). How did the squash get its name? Retrieved from https://www.loc.gov/everyday-mysteries/agriculture/item/how-did-squash-get-its-name/. Retrieved date February 2021
18. Macdougall (2021). Sensory Evaluation/Appearance. Retrieved from https://www.sciencedirect.com/topics/food-science/food-appearance. Retrieved date February 2021.
19. Moreno, Reymund B. (2014). Sensory Acceptability of Squash *(Cucurbita Maxima)* in Making Ice Cream. West Visayas State University-Calinog Campus, Calinog, Iloilo, Philippines. *rrbmoreno@yahoo.com Date Received: November 14, 2014; Date Revised: January 14, 2015*. **Asia Pacific Journal of Multidisciplinary Research**
20. Ocean Robbins (2020). Top Health Benefits of Squash + How to Prepare and Eat It. Retrieved from https://foodrevolution.org/blog/health-benefits-of-squash/. Retrieved date February 2021
21. OrganicFacts (2021). Squash: Top 5 Benefits & How To Use. Retrieved from https://www.organicfacts.net/health-benefits/fruit/squash.html . Retrieved date February 2021.
22. Philippine Statistics Authority (2020). Squash Production. Retrieved from http://rsso01.psa.gov.ph/content/highlights-major-vegetables-and-rootcrops-production-ilocos-region-2021. Retrieved date February 2021.
23. Pinoyentre (2013). Squash Production. Retrieved from https://www.pinoy-entrepreneur.com/2009/12/05/squash-production/. Retrieved date February 2021.
24. Pinoynegosyo.blogspot.com (2019). Squash Farming Guide. Retrieved from https://pinoynegosyo.blogspot.com/2009/04/squash-farming-guide.html. Retrieved date February 2021.
25. Rolek, Barbara (2021). All About Squash. Retrieved from https://www.thespruceeats.com/all-about-squash-1137499. Retrieved date February 2021.
26. Schecter, Anita (2019). What Is Squash?. Retrieved from https://www.thespruceeats.com/what-is-squash-2356041. Retrieved date February 2021.
27. Staughton, John (2020). Squash: Top 5 Benefits & How To Use. Retrieved from https://www.organicfacts.net/health-benefits/fruit/squash.html. Retrieved date February 2021
28. Tepper, Lorna M. (2013). SQUASH PRODUCTION GUIDE. Retrieved from http://bpi.da.gov.ph/bpi/images/Production_guide/pdf/PRODUCTIONGUIDE-SQUASH.pdf. Retrieved date February 2021.
29. Webmd.com. Health Benefits of Squash. Retrieved from https://www.webmd.com/diet/health-benefits-squash#1. Retrieved date February 2021.