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Utilization of Watermelon Rind Puree As An Enhancer of Chips

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Abstract

This study was conducted to improve or develop food products and processing technologies specifically that will help in value-adding, creating new marketable forms that out from the watermelon rind that is usually thrown away or discarded. The study used experimental research using a completely randomized design with four treatments replicated thrice. Different measurements of watermelon rind puree were used to represent the treatments of the study. The products were evaluated by 50 respondents composed of ten (10) trained faculty on sensory evaluation of products; 35 student evaluators who know food preparation and evaluation of products and five (5) selected bakery owners from the Municipality of Sta. Maria Ilocos Sur. Results showed that T3 (400ml of watermelon rind puree) was best in all sensory evaluations and had the highest return on investment. Analysis of variance manifests that there is a significant difference between treatments. Based on the study, the watermelon cookies are considered healthy, acceptable, and nutritious. It contained ash of 1.12g, moisture content 12.96g, crude fat 11.0g, and 10.37g per 100 g of crude protein per 100 grams of the product. The technology should be subjected to further testing on shelf-life tests and physio-chemical tests. This study also recommends the use of watermelon rind as an enhancer in making pastry products like chips, marmalade, jams/jellies and other products.

Keywords: watermelon chips, puree, watermelon rind

Introduction

Man is always in search of food to supplement whatever existing resources he already has discovered. Through the ages, he is aided by science and technology to augment his means of sustenance. As society becomes more complex and competition for food gets much tougher than before, he explores his surroundings in search of food. Since he knows that plants around him can supply him with the necessary subsistence, he only has to prove deeper and discover more that can utilized for food.

The Philippines is endowed with futile soil and rich coastal waters is a veritable source of agriculture and marine resources. Millions of hectares of land are planted to various crops such as sugarcane, rice, corn, banana, pineapple, mangoes, watermelon, and others.

Many foods are being wasted if not consumed or utilized after the harvest season. To avoid situations like this, they must be utilized in their natural form or other forms.

In this era where there is a shortage of food supply, new products, and recipes are produced from indigenous resources where available within the local community and the seemingly nuisance litters.

Like watermelon, it is abundant in many times of the year. As such, not all the watermelons that are harvested can be sold. Not all parts of the watermelon are eaten by the consumer. They usually throw away or discard the seed, the rind of the fruit.

Some people are not aware that the whole thing of a watermelon is edible and could be a potential source of healthy food and a viable source of nutrients. Since the rind is edible, the community folks seem not interested to venture on processing it as food. Thus, the utilization of the pile-up waste of watermelon fruit into different recipes helps minimize the market glut and may eventually lead to the commercialization of the products, here and abroad.

People nowadays are very fond of having snacks and the trends of snacking have changed over the years. However, unlike in past years, consumers are very conscious about their health, their perception of food has progressed from being affected mainly by taste and appearance to considering the concept of optimal nutrition by avoiding foods that are associated with nutritional inadequacy (Maota, 2019).

There is a huge demand for a nutritious snack in the market. This is where watermelon rind and skin can be utilized as added in the preparation of snacks to help eradicate malnutrition.

Thus, the researchers aim to seek innovations that would help address the nutrition and livelihood concerns of the Ilokano community, particularly the watermelon growers. The end goal was to come up with products that is acceptable and highly nutritious to supplement the nutritional needs and livelihood of the community and the nation at large.

Objective of the Study

1. To determine the level of acceptability of the products formulated in terms of appearance, aroma, taste.
2. To determine the significant difference in the level of acceptability of the formulated watermelon twisted cookies in terms of the above mentioned variables
3. To identify the nutrient composition of the best formulation
4. To compute the economic value of the product formulated

1.2. Significance of the Study

This study would certainly benefit kids and students, teachers of home economics, homemakers, entrepreneurs, and farmers.

Besides the medicinal uses of watermelon, the rind also gives many health benefits and provides some nutrients needed by the body like vitamins A, C, B6, amino acid, citrulline, and the antioxidant lycopene both excellent for heart health. When the rinds are processed into food products like chips, it would be a very nutritive and healthy watermelon twisted cookies which could be a healthy snack for kids and students.

Among the homemakers, the utilization of locally available materials to substitute the expensive commercially prepared ones could be an answer to their economic constraints. Further, knowing how to process the rinds of watermelon may enable them to venture into a greater production scale that could augment the family's source of income. In so doing, they not only do not contribute significantly to the improvement

of the quality of life of their families but at the same time, help in the conservation of natural resources without sacrificing the quality of the environment.

One of the challenges of home economics education is the development of creativity and innovativeness among students. Product development from indigenous resources available in the locality could be one of the potential areas for innovations. Thus, the teachers of home economics may introduce the result of this investigation as a take-off point for greater exploratory work among the students.

This study is also perceived to provide an opportunity for other research, especially on the food production aspect. Its results could be a show window for possible exploration of other economic plants in various localities. In so doing, the Filipinos would be assured of self-reliance, self-sufficiency.

Scope and Delimitation of the Study

This study was limited to the production of watermelon chips from watermelon rinds at three different formulations.

The sensory evaluation and acceptability tests were limited to the evaluators' personal assessment of the products along pre-determined set of criteria thus, it is subject to whatever frailties their personal evaluation may contain.

Further, the processing of the products was done under at culinary arts laboratory of the institution to which the researcher works.

Review of Literature and Studies

Characteristics of Watermelon Rind

Watermelon (Citrullus lanatus), from the family of cucumber (Cucurbitacea), is a large, oval, round, or oblong tropical fruit and is considered the star fruit of summer because the pulp is composed mostly of almost 92 percent water. It is largely consumed med as a refreshing summer fruit. Consumers much appreciate it because of its refreshing capability, attractive color, delicate taste, and high water content to quench the summer thirst. Besides the medicinal uses of watermelon rind, and peel is composed of the various minerals determined, the mineral composition (mg/100 g) in the peel, Iron 1.29, manganese 1.42, phosphorous 135.24, calcium 29.15, sodium 12.65, copper 0.45, zinc 1.29, magnesium 1.48, potassium 1.37 (Hafiza et al., 2002). It also contains a vitamin composition in mg/100 g, retinol (vitamin A) -52.13, Thiamine (vitamin B1)1.23, Riboflavin (vitamin B2) 2.71, Niacin (vitamin B3) - 4.25, Pyridoxine (vitamin B6)- 5.34, (Int.J. Curr.Microbiol.App.Sci (2017).

The watermelon peel is a good source of natural polyphenols, antioxidants, and minerals.

The watermelon rind is the firm white part of the fruit that's left behind after the bright pink, red, white and yellow flesh has been eaten or scooped away. It has a crisp texture similar to a cucumber and is versatile.

Nutritive Value of Watermelon Rind

The watermelon rinds had higher moisture, ash, fat, protein and carbohydrates 10.61%, 13.09%, 2.44%, 11.17% and 56.00%. Watermelon rinds showed significantly greater free radical scavenging activity and β-carotene (39.7% and 96.44%). The citrulline in watermelon rinds gives it antioxidant effects that protect you from free-radical damage. Citrulline converts to arginine, an amino acid vital to the heart, circulatory system and immune system. The rind is edible and can be used as a vegetables.

According to Al-Sayed, Hanan M. A, (2013) cited that watermelon rind is a good source of nutritional food ingredients such as antioxidants, amino acids, and pectin, especially citrulline. In processed foods, rind has been tested in pickled form and in jam. The watermelon rind can be processed into powder and can apply in carbohydrate-based goods like cakes, cookies, noodles, beef patties, and pork patties.

El-Behairy, Usam A., etc. (2022) claimed that watermelon rind is a good source of the dietary fiber (16%), nutrition minerals (especially potassium which was more than 4%) and antioxidants compounds (phenols was 1415 ppm & flavonoids was 732 ppm). It is also valuable by-products due to their content of many nutrients and antioxidants and can be used in the manufacture of products as nutritional supplements.

Furthermore, Perz, Jose etc., (2022) claimed that watermelon rind can be used as pectin extraction with citric acid as the extractant solvent, in which it was found that pH of 2.0, extraction time of 62.31 min, and liquid-solid ratio of 35.07 mL/g. Under this optimal condition, the pectin yield, degree of esterification, methoxyl content, and anhydrouronic acid content were 24.30%, 73.30%, 10.45%, and 81.33%, respectively. Based from its chemical characterization and physicochemical properties, they concluded that the watermelon rind waste, can be an inexpensive source to obtain good pectin quality and high purity and have a high potential to be used in food industry.

According to a study of Yadla, A K, et.al (2013), 100% of watermelon rind can be incorporated in producing nutritious and acceptable fruit butter.

Thirty percent (30 %) of watermelon rind flour can partially altered a refined wheat flour in producing a nutritious cookies (Ashoka S, Shamshad Begum S and Vijayalaxmi KG. 2021).

According to Shruti Dubey, Hradesh Rajput , Kajol Batta,(2021) the most underutilized portion of watermelon, which is the rind possess good efficiency and which can be utilized in producing nutritious food products.

According to the United Nations Food and Agriculture Organization (FAO), fruits and vegetable processing industry estimated that losses and waste is the highest among all types of foods, and may reach up to 60%. About 25% - 30% of by-products wastes among whole commodity group produces by the processing of fruits and vegetables industry. Out of the total annual production, one third of it is simply discarded in the form of rind and peel.

Nutritive Value of Watermelon Peel

The peel of the watermelon contains minerals, antioxidant activity, total phenolic content, crude protein, fat, fiber, and ash. The watermelon peels also contain protein (6.77 g/100g), fat (0.92 g/100g), ash (13.2 g/100g), fiber (24 g/100g), sodium (53.59 mg/100g), potassium (2074 mg/100g), calcium (468 mg/100g), copper (0.59 mg/100g), iron (12.08 mg/100g), magnesium (164.48 mg/100g), zinc (0.91 mg/100g) and phosphorus (107 mg/100g). It also indicates a significant free radical scavenging activity (IC50 of 147.30 mg/kg) and total phenolic content (2.47 g/100g).

Sensory Evaluation of the Product

Product acceptability (as gleaned from the conceptual meaning given by Edradan (1995) generally means the degree to which a certain thing is accepted, approved or considered pleasant by the individual or group. Furthermore, this can be indicated by one's liking of a particular thing or idea which can be manifested in many forms.

As implied by Roger and Shoemaker (1971) adopting or accepting a particular thing depends upon some factors or variable that deemed important to the individuals or group. This means that the individual would adopt or accept a thing if he perceived that some benefits can be derived from it. Another factor according to Roger and Shoemaker is compatibility. The thing is being accepted or adopted must be consistent with the existing values, experience, needs and resources of the consumers.

Sensory evaluation is used for product evaluation, for data analysis and for product control. According to Prell (1976) sensory evaluation is an instrument to measure objectivity with considerable degree of reliability and validity of the product. It is also used for decision making.

Sensory evaluation has five functions (Gatchalian 1981): First, is to determine the consumer preferences; second, is to determine the difference among samples as effect of raw materials, processing procedure added chemicals and ingredients, color and storage procedure, third, is to determine different preferences among the samples, fourth, is to select the best sample of processes and lastly, is to determine the grade of quality level of food samples.

The sensory qualities of foods should be systematized or classified in accordance with the sense by which the various attributes of quality perceived by the consumer. Appearance is sensed by eye.

Aroma is a fragrance or odor as perceived by the nose. Odor stimuli affect only a small area of yellow-brown receptor cells located in the ceiling of the inner nose.

Taste is the perception of the stimuli through the taste buds which are primary located at the tongue. The tongue is the most responsive to taste particularly its tip, sides and upper rear surface.

Data Gathering Procedure and Instrument

Microbial Analysis

The Microbial Analyses of the watermelon chips using the three formulations were determined through laboratory tests at Mariano Marcos State University- Molecular Microbiology and Biotechnology Laboratory Batac City, Ilocos Norte. All treatments underwent microbial analysis to detect the presence or absence of the test microbes to determine and verify if the product is safe for human consumption. The results revealed all treatments were negative.

Sensory Evaluation of the Products

The study used one set of the appended evaluation questionnaires for the panel of evaluators. They were informed through a letter of invitation on the date, place, and time of evaluation.

The sensory evaluation of the products was done at the Foods Laboratories at the Ilocos Sur Polytechnic State College – College of Teacher Education (CTE).

The evaluator of the study consists of 50 respondents composed of ten (10) trained faculty on sensory evaluation of products; 35 student evaluators who have knowledge in food preparation and in evaluation a product and five (5) selected bakery owners from the Municipality of Sta. Maria Ilocos Sur.

In gathering the data, a score sheets used for sensory test. It utilized the 5-point Likert scale to measure the level of acceptability of watermelon chips in terms of appearance, taste, and aroma.

The 5-point Likert scale is interpreted as follows:

Range of Mean Rating	Descriptive Interpretation
4.51 – 5.00	Like very much

3.51 – 4.50	Like much
2.51 – 3.50	Like moderately
1.51 – 2.50	Dislike moderately
1.00 – 1.50	Dislike very much

Proximate Analysis

Micronutrient analysis determined the nutrient content of the watermelon chips cookies using AOAC Method. Proximate analysis for samples was done according to the standard AOAC (AOAC, 2016). Moisture content, crude fat and ash were analyzed and calculated. This was conducted in DOST San Fernando City, La Union. Moreover, the crude protein of the watermelon twisted cookies were analyzed and calculated in SGS Philippines, Inc. Manila. All formulations weighed approximately 300 g. The results were expressed as g/100 g of dry matter.

Return of Investment

The calculation of watermelon chips total expenses were estimated to determine the income of the products.

Ethical Consideration

In line with the purpose of this study, the researchers were responsible in protecting the legal and moral rights of the respondents. The following ethical principles were considered during the study.

Conflict of Interest. The researchers have no conflict of interest to declare.

Voluntary Participation and Consent. The researchers asked permission from the administrator of the school where she gathered data through a request letter and asked consent from the evaluators without persuasion. The evaluators did not feel any point of coercion to participate in the study.

Privacy and Confidentiality. Confidentiality and anonymity of respondents was ensured to prevent the vulnerability of the data gathered be disclosed. The identity of the evaluators was not revealed and all the data in the research study be kept.

Compensation. There was no monetary compensation for the evaluators' participation in this study.

Risk of Harm. In gathering the data, taste test of the sample product was done by the evaluators. However, the sample product underwent microbial analysis verifying that the product was safe for human consumption.

Statistical Treatment of Data

All the data gathered were statistically treated using the following statistical tools.

1. Mean is used to describe the sensory acceptability characteristics of the watermelon twisted cookies terms of color, taste, flavor, palatability, and aroma.
2. Analysis of Variance (ANOVA) is used to determine the significant difference between and among the different formulations
3. Tukey Kramer Multiple Comparison Test is used to determine which of the different formulations show significant differences in the quality of watermelon twisted cookies

RESULTS AND DISCUSSIONS

Sensory Characteristics in Level of Acceptability of Watermelon Chips

The sample products in each set were subjected to sensory appraisal by a panel of evaluators. Sensory evaluation or appraisal is a scientific discipline used to evoke, measure, analyze, and interpret reactions to those characteristics of food and materials as they are perceived by the senses of touch, sight, smell, and taste. Thus, the sample products were evaluated by the panel of evaluators using the sensory test to determine the level of acceptability of watermelon chips. The product was evaluated by the panel of evaluators in terms of appearance, aroma, taste and their mean ratings are displayed in Table 2.

Table 2. Acceptability of watermelon (Citrullus lanatus) twisted cookies in terms of appearance

Treatments	Mean	Descriptive Rating
T_0 - control	3.71b	Like Much
T_1 -200 ml watermelon rind pureed + basic ingredients	4.07ab	Like Much
T_2 - 300 ml watermelon rind pureed + basic ingredients	4.05abc	Like Much
T_3 = 400 ml watermelon rind pureed + basic ingredients	4.33a	Like Very Much

The table shows that T_3 (400 ml watermelon rind pureed) obtained the highest mean of 4.33 described as "like very much" as compared to the other treatments with descriptive rating of "like much". One-way analysis of variance shows significant differences which means that the evaluators perceived differences in the color of the product. When subjected to Tukey-Kramer Multiple Range Test results indicate that T_0 is significantly different with T_3.

According to Callejo (2011) Crumb color is highly related with ingredients (recipe). Most important attributes are described as is their relationship with the processes or characteristics of the ingredients used. The watermelon chips formulation in this research provided such colors from brown to mellow yellow and the evaluators perceived that the yellow of T_3 has an appealing or soothing effect to the eyes.

Table 3. Acceptability of watermelon (Citrullus lanatus) pilipit in terms of taste

Treatments	Mean	Descriptive Rating
T_0 - control	3.97abc	Like Much
T_1 -200 ml watermelon rind pureed + basic ingredients	3.87b	Like Much
T_2 - 300 ml watermelon rind pureed + basic ingredients	4.10ab	Like Much
T_3 = 400 ml watermelon rind pureed + basic ingredients	4.24a	Like Very Much

Among the treatment formulations, results shows that T_3 has the highest mean of 4.24 described as "like very much" as compared to the other treatments with descriptive rating of "like much". One-way Analysis of Variance showed significant difference, when further subjected to analysis using Tukey-Kramer Multiple Range Test, it indicates that T_3 is significantly different with T_1. The results means that T_3 is the best treatment compared to other treatments and most particularly to T_0 in terms of taste. This is supported by the study of Liem (2019) which stated that taste plays an important role in food choice. Individuals within similar food environments respond in different ways, resulting in taste, and subsequently, food, likes and dislikes that are unique to individuals.

According to Melis (2017), taste perception varies greatly among individuals, strongly influencing food preferences and selection, and therefore nutritional status and health.

Findings revealed that, T_3 has a balance taste of watermelon and the all-purpose flour used as perceived by the evaluators.

Table 4. Acceptability of watermelon twisted cookies in terms of aroma

Treatments	Mean	Descriptive Rating
T_0 - control	3.96	Like Much
T_1 -200 ml watermelon rind pureed + basic ingredients	3.96	Like Much
T_2 - 300 ml watermelon rind pureed + basic ingredients	4.06	Like Much
T_3 = 400 ml watermelon rind pureed + basic ingredients	4.41	Like Very Much

As to the aroma of the products, T_3 again showed the highest mean described as "like very much", whereas the other treatments were all described "like much". Significant difference was noted using the One-way Analysis of Variance. Further analysis using the Tukey-Kramer Multiple Range test showed that T_3 significantly differ with T_0 and T_1. The result could be attributed to the aromatic exogenous effect of watermelon which radiates a savory smell as mentioned by the evaluators.

Proximate Analysis of the Best Product Formulated

The best product formulated has undergone three nutrient testing in terms of ash, moisture content, and crude fat. Based on the analysis, it was found that chips made of watermelon rind puree with the addition of black pepper and garlic powder obtained an ash content of 2.67 g/100g, moisture content of 3.54 g/100g, and crude fat of 38.26 g/100g.

Sample Number	Sample Description	Test Parameter	Result
CHE-00527	Watermelon chips (300 grams in plastic packaging, 3 packs @ 100 grams each)	Ash	1.12 g/100g
CHE-00527	Watermelon chips	Moisture Content	12.96 g/100g

	(300 grams in plastic packaging, 3 packs @ 100 grams each)		
CHE-00527	Watermelon chips (300 grams in plastic packaging, 3 packs @ 100 grams each)	Crude Fat	11.0 g/100g
Phil23-04350-01.008	Watermelon chips (300 grams in plastic packaging, 3 packs @ 100 grams each)	Crude Protein (N x 6.25)	10.37g/100g

Table 5. Cost and return analysis of all treatments

Particulars	**T_0**	**T_1**	**T3**	**T4**
Price (Php)	15	15	15	15
Total Expenses(Php)	469.37	479.37	484.37	489.37
Total Sales	600.00	675.00	825.00	975.00
Total Yields	40	45	55	65
Net Income (Php)	130.63	195.63	340.63	485.63
ROI(%)	27.83%	40.80%	70.32%	99.235%

Watermelon chips with 400 ml watermelon rind pureed + basic ingredients obtained the highest ROI of 99.235% followed by the formulation of watermelon chips with 300 ml watermelon rind + basic ingredients and the lowest treatment with no addition of watermelon rind. This explains the addition of watermelon rind in the formulation increases the number of pack produced thus, the production or sales obtained is higher.

CONCLUSION

This study concludes that addition of watermelon rind in making chips is acceptable as food. It is highly available at low cost. It can also help promote better nutrition among school children. The ingredients needed are low-cost. The procedures are simple and replicable by parents, home economics teachers and entrepreneurs. Watermelon chips production can be a profitable home industry to boost family income.

RECOMMENDATIONS

It is then recommended that the technology of watermelon chips enhanced with 400 ml watermelon skin and rind puree, is better than the other formulation. This technology should be disseminated and encouraged among food industries to make economic use of local raw materials to incorporate into chips and provide with more functional components. It can also be further developed by conducting packaging studies. Further study will also be conducted on the effects of temperature, ph, and shelf life of the best formulation.

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CHAPTER II
MATERIALS AND METHODS
Materials/Equipment Used

The ingredients of watermelon chips are watermelon skin and rind puree, all-purpose flour, oil, and salt.

The tools and materials used in making watermelon chips are rolling pin, paring knife, wire whisk, chopping board, food tong, mixing bowl, measuring cup, measuring spoon, cling wrap, frying pan and polyethylene plastic for packaging.

The materials and tools were properly washed and sanitized before the actual preparation. These were air dried and properly arranged according to use in preparation table to make accessible to the researchers.

The equipment used are blender and sealing machine.

Research Design and Treatment

This study used the experimental research design which employed a complete randomized design, emphasized the procedure in the attainment of the desired output. It also focused on the gathering of numerical data from the responses obtained from the respondents using the sample products from the experiment.

The watermelon chips are composed of the following formulation treatments. Three trials were conducted to represent the replication:

T0 = Control

T1 = 200 ml watermelon skin and rind pureed + basic ingredients.

T2 = 300 ml watermelon skin and rind pureed + basic ingredients; and

T3= 400 ml watermelon skin and rind pureed + basic ingredients.