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Sweet Brine: Innovative Procedure to Convert Hard-Rinded Fruit Wastes to Bonbon Desserts

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ABSTRACT

In 2015, the Department of Environment and Natural Resources in its October Waste Manual revealed that over 40% of the wastes in local communities are biodegradable leftovers from vegetables and fruits. The study aimed to produce a viable concoction upon which vegetable peelings and other biodegradable leftovers could be recycled and be made edible. Using the trial and error method system, the study employed three mixture solutions: vinegar and salt, wine and beer, and water and baking soda which were tested with rinds of papaya, watermelon, and lemon. The research yielded two-pronged outputs: 1) a scientifically sound solution to recycle hard-rinded fruit wastes, and 2) an innovative procedure on how to use the solution in converting fruit rinds to sweet bonbon desserts. The procedure involved peeling the rinds until the hardcore remains, immersing the core to the solution for 10 days and then drying the rinds, cooking them under low heat with caramelized sugar and serving as tarts or bonbon. The study was carried out following the main postulates of science when

it comes to boiling, drying, dehydrating, preserving, powdering and processing of fruit rinds into candied versions. Chemicals used for the study were as follows: water and baking soda with the ratio of 4:2; wine and beer in equal part and vinegar and salt solution in equal parts in 50ml of water. Upon evaluation, it was found out that the drying time significantly affected the moisture content of the dehydrated watermelon rind candies. These results showed that longer drying time would result in a significant decrease in the moisture content of the dehydrated candies. Furthermore, the study has proven that the drying time, amount of moisture allowed to remain in the rinds, as well as how fine the rinds would be powdered all affect the overall condition of the candied rinds and how strong the finished products are when it comes to resisting spoilage and the formation of molds without compromising the taste and overall consumption condition of the rinds.

Keywords — Food innovation, fruit candy, solution, recycle, biodegradable, experimental method, Philippines

INTRODUCTION

The watermelon is an edible fruit. Botanically, it is a berry produced by several kinds of large herbaceous flowering plants in the *genus Citrullus*. In some countries, watermelons used for cooking may be called plantains, in contrast to dessert watermelons. The fruit is variable in size, colour and toughness of the flesh, often characterized by its long and sometimes curved shape, and the flesh is soft and subtle to touch and is a valuable source of starch and comes in usual colors of green, yellow, red, purple or brown when ripe already. Watermelons come from two wild species –*Citrullus lanatus* and *Citrullus balbisiana*. Citrullus species are native to tropical Indomalaya, Philippines, and Australia, and are likely to have been first propagated in Papua New Guinea. They are developed in 135 countries, mainly for their crop, and to a minor degree to create fiber, watermelon wine, and watermelon beer and as ornamental plants (AOAC, 2015).

Worldwide, there is no sharp distinction between "watermelons" and "plantains." Especially in the Americas and Europe, "watermelon" usually refers to soft, sweet, dessert watermelons, especially those of the Cavendish sector, which serve as the main crop for export in most watermelon-growing countries. By contrast, another archetype of watermelon is the *Citrullus Cultivars* which has

a sturdier and fiber-rich enzymes called "plantains." In Southeast Asian territories where watermelon is considered to be a staple food, the distinction between the two types of watermelon is not so much highlighted and the fruit is considered to be a regular fruit.

FRAMEWORK

The research employed the Input-Process-Output method wherein the information used to generate the output are processed according to the trial and error method and the process flow that generated the most commendable output is recommended as the main method for producing watermelon bonbons from watermelon rinds.

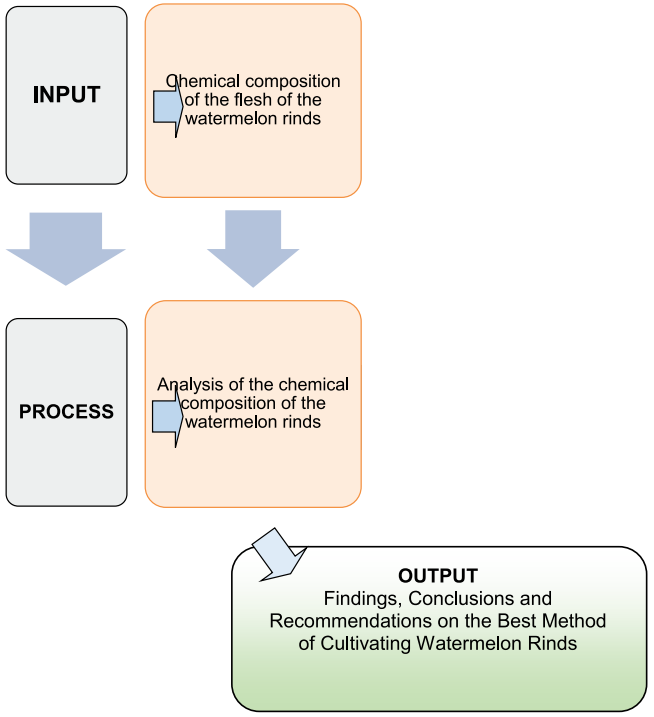

Figure 1. Research Paradigm

OBJECTIVES OF THE STUDY

The general objective of the study is to come up with a viable concoction upon which vegetable peelings and other biodegradable leftovers could be recycled and be made edible in an environment-friendly manner. Specifically, it determined the veracity of the following criteria. (1) Rinds, especially that of fruits like watermelons, possess physical characteristics that make them ample for being converted to candied states so that their antioxidant properties may be preserved and consumed by the people; (2) the amount of these organic wastes generated from households is negligible, that generated from food-processing industries, could be effectively reduced by converting disposable fruit rinds to consumable candied rinds; (3) watermelon rinds, when applied with the right amount of heat in the right amount of time for drying process, can be converted into quality fruit rinds that can be consumed by the people without losing their nutrients and antioxidant properties; (4) wastes can be potentially converted to Hard-Rinded Fruit Wastes to Bonbon Desserts. The study opted to answer the following objectives, (1) to describe the processes that can be done with the watermelon rinds so that they may be converted to candied rinds without losing their nutrient and antioxidant values; (2) to describe the methods for the preparation of the watermelon rinds to convert to watermelon bonbon, and (3) to determine the drying and moisturizing preparation for the chosen mixture in item 2.

METHODOLOGY

Research Design

The research design employed in this study is the scientific experiment method wherein several tests were done via trial and error assumption to see and inspect which experiment that has varying independent and dependent variables will yield the best possible quality of candied watermelon rinds.

Research Site

The research was carried out in the experiment rooms of Batangas State University, the main institution where the proponents of the study are currently working as university professors.

Participants

The participants of the study were the two proponents, assisted by several college students under their tutelage, and guided by food technologists of the university to monitor results accurately and carry out the experiments effectively and properly.

Instrumentation

The study was carried out following the main postulates of science when it comes to boiling, drying, dehydrating, preserving, powdering and processing of fruit rinds into candied versions. No method that is unconventional in terms of candying fruit rinds were employed in the study. And since all methods are conventionally used in preserving fruit rinds in their candied states, then all the steps carried out and used in this study produced utmost reliability and validity.

Methods for Preparation of Fruit Rinds to Bonbons

Chemicals

Chemicals used for the study were as follows: water and baking soda with the ratio of 4:2; wine and beer in equal part and vinegar and salt solution in equal parts in 50ml of water. For water purposes, distilled or mineral water was utilized for the processing. Corollary to this, the methodologies were run in three trials and the results were statistically treated through the process of averaging. (Chen, Rubenthaler, & Schanus, 1988).

Sample Preparation

Watermelon was purchased from a local market and processed. Rinds of watermelon after processing were selected. The rinds were subjected to running distilled water to be cleaned and then were subjected to the heat of 50 ± 1°C to be cooked. Afterwards, they were powdered with the use of lab grinder and then were put in containers with controlled temperatures at 4°C. A record of the yield of rind from fruit and after converting to powder was maintained (Lee et al., 2013).

Color

The first healthy indicator of the success of this process is the color of the powdered rinds. Healthy and fresh rinds and when powdered was determined by visual observation using the methods described by Muhamad, Zainon, Kormin, and Ali, (2015). As a result, a 3.0gram of the powdered rind, when placed in a

graduated cylinder could be packed properly without sacrificing the color of the rinds. (Leong and Shui, 2012).

Preparation of Sample Extracts in Solvents

Samples were extracted with water. 1.0 g of sample was suspended with 100 ml solvent, allowed to extract for 10-hour soaking and filtered. All analysis was carried out in freshly collected extracts.

Research Ethics Protocol

No ethnic or vulnerable sector of the society was offended or injured with the conduct of this study and therefore no informed communal consent was secured prior to the making of the study. Nevertheless, the authorization of the University, through its research and study development department was secured to make sure that all experiments carried out under this study are sanctioned by the university.

Statistical Techniques

Since the study involved an empirical mode of experimentation purely to produce the best possible quality candy version of watermelon rinds, then the study did not employ any necessary statistical technique.

RESULTS AND DISCUSSION

The medical implications of converting fruit rinds to bonbon desserts

The health benefits of rinds embrace its capability to make available fast and instant energy, control and improve bowel movements, steady blood sugar levels, and sluggish down the aging progression, while also providing a crucial source of vitamin B1 to the human body. Other benefits include its ability to increase skin health, augment the metabolism, help in digestion, decrease high blood pressure, assist weight loss efforts, get better the immune system and give protection against dysentery, cancer, and heart disease.

The various benefits can be found in more than forty thousand varieties of this cereal that are available throughout the world. The two main categories are whole grain rinds and white rinds. Whole grain rinds are not processed very much, so it is high in nutritional value, whereas white rinds are processed so that the bran or outer covering is removed, leaving it with less nutritional value. People choose different styles of rinds for particular flavors, depending on their culinary needs, availability, and the potential for health benefits as well.

The Philippines or Chinese cuisines specialize in long grained rinds, whereas western countries prefer short or medium length grains. Since rinds are rich in carbohydrates, it acts as petroleum for the body and aids in the standard performance of the human brain. Carbohydrates which are considered to be one of the main sources of energy in the body aside from glucose and fats are considered important to be processed by the human body and be converted into substances that can be used by the human body as a stable, reliable source of energy. The vitamins, minerals, and various organic workings increase the functioning and metabolic activity of all your organ systems, which additionally increases energy levels (Agricultural Statistics, 2009).

Eating rinds is extremely beneficial for one's health, just because it does not hold damaging fats, cholesterol or sodium. It forms an essential part of the impartial diet. Any food that can give nutrients without having any harmful blow on health is a plus.

Rinds are low in sodium, so it is measured as one of the top foods for those suffering from intolerable amounts of high blood pressure and hypertension. This fact is also linked to growing concerns of heart failures and other complications like sudden attacks, rupture of necessary and vital veins and atherosclerosis of the blocking of the arteries which lead to non-passage of blood that supplies necessary hydration and oxidation to the human body. Watermelon consumption is necessary for this vein because it lowers the sodium content of the human body which then lowers the risk of heart-related risks.

Whole grain rinds like brown rinds are rich in inexplicable fiber that can defend against many types of cancer. Many scientists 'scholars share the belief that such impenetrable fiber is fundamental for protecting the body against the growth and metastasis of cancerous cells. Free radicals are by goods of cellular metabolism that can do grave harm to the organ systems and cause the transformation of strong cells into cancerous ones.

Medical experts say that powdered rinds can be applied topically to cure certain skin ailments. On the Philippine subcontinent, rinds water is willingly agreed by ayurvedic practitioners as an efficient balm to cool off reddened skin surfaces. The phenolic compounds that are set up in it, particularly in brown or wild rinds, have anti-inflammatory belongings and the rinds tend to reduce risks of multiple dermatological complications. The antioxidants in watermelon rinds also have the potential to minimize aging symptoms in humans like the appearance of wrinkles and other pre-aging indications. Medical experts say that powdered rinds can be applied topically to cure certain skin ailments.

Brown rinds are discovered to be a good source of nutrients that support the functioning of neurotransmitters in the body, therefore allowing the body to fight against Alzheimer's disease and other degenerative diseases. Various species of wild rinds have been shown to stimulate neuroprotective enzymes in the human brain, therefore helping the bodyguard against mostly intrusive and destructive degenerative diseases like Alzheimer's and Parkinson's. he corollary to this, even the oil extracted from the rinds themselves are found to contain considerable amounts of antioxidants that support healthy heart functioning and at the same time lowering the risks of fat-related complications in the body due to the rising content of fat and carbohydrates in the human body. Wild and brown (Bennion, 2015) rinds varieties are far better than white rinds in this category since the rinds of the grain are where much of the nutrients are; the rinds is removed in white rinds preparation.

Total antioxidant analysis

The vinegar and salt solution had the least effect on the loss of antioxidant present in the watermelon rinds. After the samples had cooled to room temperature, the absorbance was commendable. A typical solution of 1.0 ml is the appropriate volume for the sample and was incubated under the same conditions as the rest of the samples while samples of other solutions lost antioxidants of the rinds.

Drying and Moisture Preparation for the Chosen Moisture

Regulating the moisture content of the watermelon rinds especially when powdered and then converted into their candied forms is of utmost importance because moist candies are more prone to expiring very soon and serve as a habitat for molds and other organisms to live in. Through the experimentation, it was proven that the moisture content in the fresh and boiled rinds as summarized in the table below has no considerable differences. Nonetheless, the moisture in the boiled rinds is less than the average content in the fresh rinds particularly due to the osmotic dehydration that occurs in the plant cells in the rinds when subjected with heat like through the process of boiling. Since the better condition for the powdered and candied watermelon rinds is to contain the least amount of moisture as possible, it was deemed that the process that hosted the most amount of osmotic dehydration in the rinds was the best. Therefore, between the fresh and boiled rinds, the boiled rinds were deemed to be better samples (Lewinsohn et al., 2005).

The results of the tests were also able to confirm that candied rind, when dried in a significantly lengthier amount of time, produced the least amount of moisture contents. Therefore, the amount of moisture in the candied rinds is proven to be inversely proportional to the length of time the candied rinds were dried because the moisture content of the rinds lowers as the length of the drying process gets longer (Gabriela, Pompeu, Paulo, & Carneiro, Hilary, 2004).

Table 1. The Moisture Content of Fresh, Blanched and Dehydrated Candy of Watermelon Rind

Sample	Moisture content (%)
Fresh	94.60 ± 0.07a
Blanched	96.18 ± 0.04a
50°C, 8 hours	22.82 ± 0.02b
50°C, 14 hours	16.68 ± 0.11c
50°C, 20 hours	15.07 ± 0.23d

As proven by literature, the ideal moisture content of the watermelon rinds when candied should range from 12- 21%. The reason behind this is that more water content than the one prescribed would lead to sappy and expiration-prone candies while any moisture content lower than that will lead to hard and not tasty candies. As also found in the experiments, the 14 and 20 hours as shown in the table above were proven to be sufficient to produce quality-oriented watermelon rinds candies. Fellows and Hampton (1992) noted that higher moisture content resulted in products that are highly vulnerable to damage since it would support the growth of mold and other intrusive organisms that will spoil the quality of the watermelon candies which will render them unfit for consumption. The law of foods influences the metabolic activity, multiplication, resistance and survival of the microorganisms present (Leistner, 2011). Table 2 below summarizes the dehydration proportions in the watermelon rinds when subjected to three varying drying times. The results were not shocking since they consisted to the findings of Jangam, Joshi, Mujumdar, & Thorat (2008) when they claimed that the threshold for strong, quality and reliable conversion of food from sappy to candied should have a moisture content that ranges between 0.4 and 0.6.

Table 2. Water Activity (aw) of Dehydrated Watermelon Rind Candies Dried at 50°C

Sample	Drying time (hours)	Water activity
A	8	0.656 ± 0.004ab
B	14	0.671 ± 0.009a
C	20	0.658 ± 0.005ab

Mean with the same letter are not significantly different at p <0.05

CONCLUSIONS

The best solution that yielded the bonbon characteristics with proper taste and smell is the vinegar and salt solution, with the ideal moisture content to produce strong, quality and reliable conversion of food from sappy to candied should range between 0.4 and 0.6 which can be converted to a total of 12-21% of water content that should remain in the rinds and this should be achieved through subjecting the watermelon rinds to a 14-20 hours of drying process as proven by the results.

The physical characteristics of the dehydrated watermelon rind candies as influenced by the drying time have been conducted. The drying time significantly affected the moisture content of the dehydrated watermelon rind candies. These results showed that longer drying time would result in a significant decrease in the moisture content of the dehydrated candies. For colour, the L* value of the dehydrated candies slightly decreased with lower drying time while the a* value slightly increased with longer drying time. Sample B (dried at 50 °C for 14 hours) was the most acceptable dehydrated watermelon rind candies as the sample received the highest score for overall acceptability compared to the other samples. This showed that drying time affects the sensorial characteristics of the dehydrated watermelon rind candies. Therefore, it can be concluded that the drying temperature of 50 °C and 14 hours of drying time is the most appropriate time to dry the candied watermelon rind.

TRANSLATIONAL RESEARCH

It is recommended that the testing of other fruit rinds according to the sample brines presented in this research should be done in order to convert more fruit wastes to palatable and edible products. To improve the transfer of the knowledge proven and found in this research to students, stakeholders, academicians,

scientists, to the community in general, and to all other interested parties, the summary of the processes, preparations, undertaking and results found in this research may be converted to two platforms: One, through videos and infographics where the step by step procedure alongside the results they produced will be shown in vivid graphics to foster easier understanding to the viewers; and Two, through manuals where fewer graphics and pictures will be shown but the full details of the experiments and steps undertaken shall be exhaustively discussed. During moments where this research may be demonstrated to the public like in experiment classes in food preparation classes or in students during science excursions, these videos/infographics may be shown or the manuals when printed may be distributed to improve appreciation and retention.

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