ISSN: 2572-5971

Research Article

Advances in Nutrition & Food Science

Evaluation of Jute (Corchorus Olitorius) Leaves as a Sushi Wrap

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Submitted: 30 Sep 2018; **Accepted**: 06 Oct 2018; **Published**: 29 Oct 2018

Abstract

Nori is edible dried seaweed used in Japanese Sushi dishes. It is made from red algae (Porphyra) and is processed and imported mainly from Japan, Korea, and China. The technology and environmental conditions necessary for the sustained mass production of Nori limits the Philippines despite its abundant supply of Porphyra. This situation contributes to higher retail prices of Sushi. Hence, an experiment was undertaken whereby Jute (Corchorus olitorius), highly prized for its fiber and nutritious content, was used to make a Sushi wrap similar to Nori. Thirty (30) respondents from a local university gave a higher rating to the Jute Sushi for appearance, aroma, taste, and texture compared to the standard Nori Sushi. T-test results showed no significant difference between the two samples, which confirms Jute to be a viable substitute for Nori. Recommendations to improve product taste, shelf life and base studies on commerciality are proposed. Mass production would mean a cheaper alternative source for Nori and offer additional revenue for Jute farmers, processed food manufacturers and retailers.

Keywords: Food and nutrition, Product improvement, Ingredient change, Substitution, Jute, Nori, Sushi, and Asia

Introduction

Known for its nutritive value, Nori is the Japanese name for the dried edible seaweed made from *Porphyra*, red papery sea algae. The most common Nori, called *Yakinori*, is available at supermarkets worldwide. The crisp, toasted sheets are used for everything from making sushi rolls to flavoring pasta. It contains a high percentage of protein, iodine and vitamins A, B, and C and is commonly used in Japanese kitchens. Popular as well in other Asian countries for its unique *umami* (mouth-watering) taste, Nori is used to flavour soups, or as a wrap for rice-balls, or plainly eaten as an accompaniment to sake [1].

Porphyria is the most promising seaweed species for culture with great revenue potential in local and international markets. It is locally known as *gamet* in the Philippines, Kim in Korea, Zicai in China, and Laver in the West. With at least 133 reported species worldwide, there have been three (3) species identified as thriving in the Ilocos Norte and Cagayan province coastal regions. *Porphyra* are produced in unprecedented quantities in Japan due to its successful artificial cultivation. However, the industry in the Philippines remains underdeveloped. The seaweed is mainly gathered from rocky crevices by fisher folk who are exposed to hazards of the waves and the weather. The seasonality and the difficulty of collecting and processing using the traditional sun-drying method have made *Porphyra* a relatively high-priced food item [2].

Jute (*Corchorus olitorius*), on the other hand, locally known as *Saluyot* or *tugabang*, is a green leafy vegetable that is found in tropical and subtropical from Asia to Africa. It is popularly known as Lalo in Haiti, *Molokheya/ Mulukhiyah* in Egypt and Lebanon, and Bush Okra or *Ewedu* in West Africa [3]. It is valued for its strong fiber content and is rich in calcium, phosphorus, iron and potassium. It has Beta Carotene that is good for the eyesight and Vitamin C that is best for smooth skin and for strong immunity [4]. Other studies show that Jute could help control diabetes and can be a treatment for jaundice and liver disorders [5,6]. Likewise, it has been determined that 100 grams of Jute contains an ample amount of Vitamin A, thiamine, riboflavin, and ascorbic acid [7]. Given these facts, people appreciate the benefits that can be derived from eating and incorporating Jute in their diet [8] and have used Jute leaves in stews, soups, tisanes or teas [3].

Here in the Philippines where there is an inexpensive and abundant supply of the crop, the Department of Agriculture has been promoting Jute as a tea remedy and as a noodle additive good for reducing high blood pressure, headaches, gastrointestinal problems and cholesterol [9,10]. Hence, determining the viability of Jute leaves as a Sushi wrapper would not only give a cheaper alternative to Nori but would also provide a new application for this nutrition-laden crop. If mass produced, this product can further boost the income of Jute growers and spark interest from the processed food and restaurant industries and the general consumer market.

Background

Gatchalian and De Leon stated that a new food product can be improved either by involving a change of the ingredients or a change in the process of production. Ingredients can be substituted, removed, added or the totally new product can be sensory evaluated [11]. Product improvement may further take on the form of process changes. This involves development of shortcut procedures in product manufactured without accompanying reduction in quality.

Adopting the Gatchalian and De Leon's concept of ingredient change, Jute leaves were substituted for the *Porphyra* seaweed that is the primary component of Nori wrapper in making Sushi. The objective is to determine if Jute leaves are a viable alternative to Nori.

Specifically, the following questions were put forth

1. What are the respondents' assessment of the characteristics of the Nori-wrapped Sushi and Jute-wrapped Sushi in terms of Appearance, Aroma, Taste, and Texture?
2. How do the respondents' assessment the characteristics of the Nori-wrapped Sushi and Jute-wrapped Sushi compare in terms of Appearance, Aroma, Taste, and Texture?

The null hypothesis tested was that there is no significant difference between the Nori-wrapped Sushi and Jute-wrapped Sushi in terms of appearance, aroma, taste, and texture.

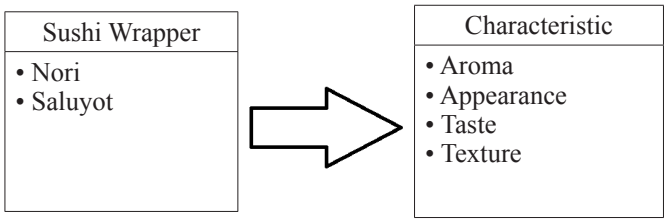

Figure: Hypothesized relationship between Sushi with selected wraps and their characteristics

Methodology

The study is an experimental research, one where at least one or more independent variables are deliberately manipulated to produce an effect. This is considered the most sophisticated method for testing hypothesis involving cause-effect relationship as seen in the research simulacrum (shown above) [12].

Descriptive analysis, which is one analytical tool for Sensory Science was applied to the data gathered. This is an objective method where the assessments are strictly controlled. Unlike consumer tests, the appearance, odour, flavour, texture and mouth feel can be accurately described and measured. Once the researchers and their culinary advisers have agreed and defined the qualifiers for each characteristic, the two products are profiled; giving each attribute quantitative scores [13]. Quantitative data was gathered by means of a survey questionnaire, and the resulting data were analysed using statistical computational techniques.

Experimental Procedure

In making the Jute wrapper, the standard recipe, the ingredient and corresponding measures, the procedure and drying period used by Ramirez et. al, to test the viability of paco fern as a substitute to Nori, was adopted [14]. The researchers were also guided by the video uploaded by Drennan, F entitled "Making Nori the paper-making way [15]."

The following steps were taken in creating the dried Jute wrapper:

1. Prepare materials needed for drying Nori seaweed (silk screen, nylon cloth, square frame, rectangular pan/s and newspaper)
2. Wash 480 grams Jute leaves in running water, and then soak Jute leaves in two (2) liters of water.
3. Place the pans on a flat surface; put the silk screen inside the pan and place the nylon cloth on top of it; then put on the frame.
4. Pour the 2 liters of water on the nylon cloth and silk screen; then pour the soaked Jute leaves on the nylon cloth, and then wait for it to dry.
5. After some time, take the formed Jute out of the silk screen and put it on the newspapers for it to absorb excess water.
6. Put another nylon cloth above the Jute and another set of newspaper then press it with a wood, to dry and flatten completely.
7. Set aside to dry.

The researchers adopted a simplified version of the California Roll recipe by Brown to make the standard and experimental Sushi samples [16].

Ingredients for Sushi Rice

2 cups sushi or short grain rice
2 cups water, plus extra for rinsing rice
2 tablespoons rice vinegar
2 tablespoons sugar
1 tablespoon kosher or table salt

Procedures for Sushi Rice

1. Place the rice into a mixing bowl and cover with cool water. Swirl the rice in the water, pour off and repeat 2 to 3 times or until the water is clear.
2. Place the rice and 2 cups of water into a medium saucepan and place over high heat. Bring to a boil, uncovered. Once it begins to boil, reduce the heat to the lowest setting and cover. Cook for 15 minutes. Remove from the heat and let stand, covered, for 10 minutes.
3. Combine the rice vinegar, sugar and salt in a small bowl and heat in the microwave on high for 30 to 45 seconds. Transfer the rice into a large wooden or glass mixing bowl and add the vinegar mixture. Fold thoroughly to combine and coat each grain of rice with the mixture. Allow to cool to room temperature before using to make sushi or sashimi.

Ingredients for Sushi

4 sheets Nori
1/2 batch sushi rice, recipe follows
1 small cucumber, peeled, seeded, and cut into matchstick-size pieces
1 ripe mango, peeled, seeded, and cut into strips
4 crabsticks, torn into pieces
Wasabi, for serving
Soy sauce, for serving

Procedures for Sushi

1. Cover a bamboo rolling mat with plastic wrap.
2. Cut Nori sheets in half crosswise. Lay 1 sheet of Nori, shiny side down, on the plastic covered mat.
3. Wet fingers with water and spread about 1/2 cup of the rice

evenly onto the Nori.
4. Turn the sheet of Nori over so that the rice side is down.
5. Place 1/8 of the cucumber, mango and crab sticks in the center of the sheet.
6. Grab the edge of the mat closest to you, keeping the fillings in place with the fingers, and roll it into a tight cylinder, using the mat to shape the cylinder.
7. Pull away the mat and set aside. Cover with a damp cloth. Repeat until all of the rice has been used.
8. Cut each roll into 6 pieces. Serve with wasabi and soy sauce.

It should be noted that, due to the unavailability of fresh Porphyra seaweed, only the Jute leaves were processed and dried into square sheets. Commercial Nori sheets were used for the sensory evaluation of the Sushi samples.

Locale and Sample

A purposive sample of thirty (30) respondents from a college offering Hotel and Restaurant Management at local university in Quezon City were invited to evaluate the Sushi samples. They were mostly female (80%), majority (93%) of whom was students in their 3rd year of HRM study and a few (7%) culinary professors. They were randomly chosen to be the sample as both groups had the knowledge and skills in cookery and Asian cuisine. Those who had allergies to seafood and who had no preference for Sushi and Jute were excluded from the sample.

Research Instrument

The survey questionnaire, made up of two parts, was given to the respondents after they have been brief about the study and have signed a consent form to indicate that they are willing to participate in evaluating the Sushi samples. The first part of the survey tool had questions that gathered data on respondents' profile as to age, gender and academic rank while the second part, had questions that gathered data on their assessment of the Nori-wrapped Sushi and Jute-wrapped Sushi in terms of in terms of appearance, aroma, taste and texture. The sensory evaluation section of the tool utilized a 7-point semantic differential scale to rate characteristics from polar opposites, the left side being the least ideal characteristic of the test sample given a rating of 1 and the right side being the most ideal characteristic of the test sample given a rating of 7.

Data Collection

Before the survey, the researchers obtained permission from the Dean of the College of Hospitality (1) to use the kitchen laboratory of the university to make both the standard Nori-wrapped Sushi and experimental Jute-wrapped Sushi, and (2) to conduct their survey among the students and faculty. They oriented and explained the contents and procedure in making the Sushi samples to the participants whom they requested to sign the Consent Form, signifying their willingness to be part of the study. The filled-up survey forms were collected after the sensory evaluation of the samples by each respondent. Data from each form was subsequently tallied in a Microsoft Excel spread sheet for easy computation and summary of results.

Data Analysis

Demographic profile of the respondents, though not indicated in a table, were tallied by using a frequency distribution and relative frequencies were multiplied by 100% to get the percentages. Weighted mean was applied on the data on the sensory evaluation as the mean is the only measure of central tendency wherein all values in the data set are fairly represented [17]. The following verbal interpretation matrix was used in the assessment of the mean scores:

1.00 – 1.85 Extremely (variable to the left)
1.86 – 2.71 Moderately (variable to the left)
2.72 – 3.57 Slightly (variable to the left)
3.58 – 4.43 Neither variable to the left nor variable to the right
4.44 – 5.29 Slightly (variable to the right)
5.30 – 6.15 Moderately (variable to the right)
6.16 – 7.00 Extremely (variable to the right)

The null hypothesis was tested using the paired t-test which is applicable to a two-group randomized experimental design with not more than 30 respondents [17].

Findings

For appearance, both the Nori-wrapped Sushi (4.80) and Jute-wrapped Sushi (5.27) were assessed as slightly appealing and neither thick nor thin (4.17 and 4.37 respectively). Shimizu said in an article, after a visit to a local producer of Nori, that the best Nori are dark green colour, attributed to the drying process and proper storage [1]. Splotchy, reddish, and pale sheets indicate lesser quality. On the other hand, raw Jute leaves are normally light-green in color but tend to become dark green once it undergoes a heating process such as roasting or drying under the sun [18]. The appeal of the Jute wrapper is supported by a study by Olano where Jute was used in jellies and "Liked Extremely" in terms of color [19]. Moreover, the slimy characteristic of Jute holds it together like a paste and the slimy mucus secreted by during processing gives the dried wrapper sheen not unlike that of Nori.

For aroma, both the Nori-wrapped Sushi (4.63) and Jute-wrapped Sushi (4.63) were slightly pleasant and had neither no earthy scent nor earthy scent (4.00 and 4.23 respectively). Nori has an ocean-like aroma that enhance the fish-rice pairing of Sushi which is why sushi chefs have gone to great lengths to develop alternatives such as the inside-out-sushi-roll, or soy-paper-sushi-rolls [20].

For taste, both the Nori-wrapped Sushi (3.70) and Jute-wrapped Sushi (3.70) were assessed as neither not salty nor salty and had neither no earthy taste nor earthy taste (3.63 and 3.77 respectively). The taste of unprocessed seaweed is salty, a little bit fishy and chewy [21]. The process of washing, drying and toasting reduces the taste of Nori to a lightly smoky and briny flavour [1]. Still, the incredibly high concentration of inosinate and glutamic acid in the Nori accounts for its *umami* flavour.

When collected young, jute leaves are tasty and tender and are a bit bitter like chilli leaves [18]. Most leafy vegetables have a pleasantly light aroma when processed or cooked since high temperatures tend to reduce flavonoids and natural chemicals in the leaves due to evaporation.

For texture, the Nori-wrapped Sushi (4.40) was assessed as neither rough nor smooth and slightly soft (4.47). The best Nori is that with smooth texture and has retained its crispiness. In order to retain this crispy quality, Nori should be kept in airtight containers or re-toasted for a few seconds over an open flame before its use [1]. Contrarily, the Jute-wrapped Sushi was assessed as slightly

smooth (4.53) and extremely soft (6.00). This may be attributed to the mucous-like enzyme that it excretes when crushed, processed or cooked [22]. This was validated by the study of Olano on vegetable jellies where it was found that jelly made from Jute was high in moisture content compared to the other jellies made from Alugbati and Malunggay [19].

Overall, compared to Nori-wrapped Sushi the respondents gave a higher assessment to Jute-wrapped Sushi in terms of Appearance (4.82), Texture (4.57), Aroma (4.43), and Taste (3.73).

Table 1: Assessment of the characteristics of Nori-wrapped Sushi and Jute-wrapped Sushi n= 30

Characteristics	Sushi	
	Nori-wrapped Weighted Mean	Jute-wrapped Weighted Mean
Appearance	4.48	4.82
Not Appealing - Appealing	4.80	5.27
	Slightly Appealing	Slightly Appealing
Thick - Thin	4.17	4.37
	Neither Thick nor Thin	Neither Thick nor Thin
Aroma	4.32	4.43
Unpleasant - Pleasant	4.63	4.63
	Slightly Pleasant	Slightly Pleasant
No Earthy Scent - Earthy Scent	4.00	4.23
	Neither No Earthy Scent nor	Neither No Earthy Scent nor Earthy Scent
Taste	3.68	3.73
Not Salty - Salty	3.70	3.70
	Neither not Salty nor Salty	Neither not Salty nor Salty
No Earthy Taste - Earthy Taste	3.63	3.77
	Neither No Earthy Taste nor Earthy Taste	Neither No Earthy Taste nor Earthy Taste
Texture	4.47	4.57
Rough - Smooth	4.40	4.47
	Neither Rough nor Smooth	Slightly Smooth
Hard - Soft	4.53	6.00
	Slightly Soft	Extremely Soft

Table 2 shows that the computed t-values for appearance (1.069), aroma (-0.382), taste (-0.199) and texture (-0.403) were all lower than the critical t-value of ±2.045 at a 29 degree of freedom and 5% level of significance. This validates the null hypothesis that there is no significant difference in the characteristics of the Nori-wrapped Sushi and the Jute-wrapped Sushi.

Table 2: T-test of significant difference between Nori-wrapped Sushi and Jute-wrapped Sushi n=30

Sushi							
	Nori	Jute					
Characteristics	Wrap	Wrap	df	t-critical	t-value	Decision	Conclusion
Appearance	4.48	4.82	29	± 2.045	-1.069	Accept H_o	Insignificantly different
Aroma	4.32	4.43	29	± 2.045	-1.382	Accept H_o	Insignificantly different
Taste	3.68	3.73	29	± 2.045	-1.199	Accept H_o	Insignificantly different
Texture	4.47	4.57	29	± 2.045	-1.403	Accept H_o	Insignificantly different

Conclusion and Recommendations

In summary, the findings show that Jute-wrapped Sushi rated higher than the Nori-wrapped Sushi in appearance, aroma, taste, and texture. T-test results validate the hypothesis that there is no significant difference between the two Sushi wrap samples. Hence, Jute is a viable alternative to Nori for Sushi.

It can be noted, however, that among the four characteristics evaluated, the Jute-wrapped Sushi rated low in terms of taste. To improve this, it is recommended that *Dashi* powder, a Japanese seasoning made from seaweed and dried fish shavings, be sprinkled before drying the blended Jute leaves into sheets to give it a mild and lightly salty sea flavour and aroma. The leaves can also be soaked in *Shirodashi* (white *Dashi*), a common type of soup base made from kelp and fish shavings, prior to processing to give the dried Jute wrapper the unique *umami* taste.

While the study was focused on the application of the dried Jute wrapper in a Nori dish, further tests should be made to attain the qualities of the standard Nori wrapper prior to its use. The fiber in the Jute leaves contribute to its soft and malleable characteristics, but the experimental product has yet to attain the crispy quality of the Nori wrapper. Thus, prior to processing into a fine flaky pulp, the Jute leaves can be steamed and then freeze-dried to make it crispy. Compared to the sun-drying method, freeze-drying can help retain its nutritional value was found to have the best quality in terms of color, ascorbic acid content, and reconstitution characteristics for vegetables that have undergone the process [23-26].

Consequently, results can be validated further by using dried Jute sheets on other Nori-based dishes. The effects of different packaging materials on the shelf-life of the product should also be tested prior to the conduct of a pilot-scale production and eventual technology-transfer to and commercialization by Jute farmers and processed food manufacturers.

Acknowledgment

The researchers would like to acknowledge the authors and publishers of the references and literary works cited herein and appreciate the participation of the survey respondents who were the primary source of data. Likewise, extreme gratitude is extended to: 1) selected HRM faculty of the College of Hospitality and Institutional Management for their guidance, meticulous scrutiny, expert advice, and insightful suggestions; 2) the Research Development and Innovation Center for their timely ethical review and assistance; 3) the program coordinator and campus administrator at Our Lady of Fatima University for the approval of the project; and 4) the research team's relatives and peers for their unceasing support. Above all, thanks and praise is to the Lord Almighty, Who was the team's source of courage, inspiration, perseverance, patience, tolerance and strength.

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