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# *Gamet (Porphyra lanceolata)*-Infused Cupcake

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***Abstract***

**Aim:** This study aimed to evaluate cupcakes infused with Porphyra lanceolata as an active ingredient.
**Methodology:** An experimental design was used in the study, and participants were selected using a purposive sampling method. The participants of the study were TLE instructors and teachers, as well as bakers and bakery owners. Data was collected and analyzed statistically using a weighted mean and Analysis of Variance (ANOVA). The municipalities of Sta. Maria, Narvacan, Burgos, and San Esteban were the locales of the study.
**Results:** The findings revealed that the participants preferred cupcakes that were rich in aroma and good in texture. It is also shown that Alga Porphyra lanceolata enhances the flavor of the cupcake since Alga Porphyra lanceolata is rich in nutrients needed by the body. Also, the alga Porphyra lanceolata has antibacterial and antifungal properties.
**Conclusion:** Subjects preferred cupcakes that were rich in aroma and good in texture.

***Keywords:*** Porphyra lanceolata, alga, cupcake, additive, infusion

## INTRODUCTION

Algae are easily obtained on moist land or aquatic surfaces, in freshwater or saltwater media, and are an important source of essential compounds for human nutrition. Despite the apparent simplicity of these organisms, some algae have internal systems that are only found in superior vegetables (Rocha, et al., 2007). Interestingly, although these algae showed a low lipid content, they possessed a high level of polyunsaturated fatty acids. Thus, these algae seem to be an interesting source of some polyunsaturated fatty acids and have demonstrated their effect on the reduction of coronary diseases (Plaza, Cifuentes & Ibáez, 2006).

Moreover, one of the least studied aspects, which is one of the research lines of their group, is the development of more appropriate, fast, cost-effective, and environmentally-friendly extraction procedures able to isolate the compound or compounds of interest from these natural sources. The supplementation of bread with protein using fish pulp is a viable alternative for providing all the essential amino acids, making this product easily acceptable and capable of reaching the low-income public (Centenaro, et al., 2007).

The economic, cultural, and scientific development of our society has given rise to important changes in our food habits and lifestyle. For example, diets in developed countries are highly caloric and rich in saturated fats and sugars, while the consumption of complex carbohydrates and dietary fiber is low. This fact, together with a decrease in physical activity, has given rise to an increase in obesity problems and, along with them, a rise in the incidence of heart diseases, diabetes, and hypertension in the population (Geslain-Lanéelle, 2006).

Porphyra lanceolata is an alga that belongs to the group of red algae. This type of algae is a rich source of proteins, exogenous amino acids, and vitamins necessary for the proper functioning of the human body. Compounds derived from this algae are also used for medical purposes. Among the many useful products derived from algae are agar, alginate, biofuels, and biosorbents, which are used in wastewater treatment. Nowadays, these macroalgae are very interesting to consumers and the food industry due to their low content of calories and high content of vitamins, minerals, and dietetic fiber.

The algae were utilized as the main additive in the study, and it is said to be red and/or green when fresh and shiny black when dried. This special type of algae grows seasonally during November and December only. In the Ilocos Region, this algae can only be found in Burgos, and Ilocos Norte and the other locality where these algae can be found is in Monterey Peninsula, California. Besides its natural character, other important aspects related to algae are their easy cultivation, their rapid growth (for many of the species), and the possibility of controlling the production of some bioactive compounds by manipulating the cultivation conditions. In this way, these algae can be considered genuine natural reactors, being, in some cases, a good alternative to chemical synthesis for certain compounds.

The fusion of the alga *Porphyra lanceolata* into the formulation of cookies, tarts, and cakes contributes to the more nutritious value of these cupcakes. Bread is one of the most consumed foods and is a major source of calories

in diets in many countries. Therefore, it has been the subject of this study involving the addition of *Porphyra lanceolata* as a new ingredient or additive in producing cupcakes, cookies, tarts, and cakes.

It is at this juncture that this experimental study was conducted. It is hoped that this study will shed light on the production of algae-infused products not only on cupcakes but also on other meals.

**Objective**

This study aimed to evaluate cupcakes infused with Porphyra lanceolata as an active ingredient.

Specifically, the following questions were investigated:

1. What are the sensory characteristics of the cupcakes infused with *Porphyra lanceolata* that was appealing to the participants along:
    a. appearance;
    b. color;
    c. aroma;
    d. texture; and
    e. taste?
2. What are the nutrient contents of the algae Porphyra lanceolata?
3. What is the result of the microbial analysis of the cupcakes infused with *Porphyra lanceolata*?
4. How long is the shelf life of the cupcakes infused with the alga *Porphyra lanceolata* in terms of appearance, color, aroma, texture and taste?
5. Is there a significant difference between the sensory characteristics along appearance, color, aroma, texture and taste of cupcakes infused with the alga *Porphyra lanceolata*?
6. What is the best formulation of cupcakes infused with *Porphyra lanceolata* to be used in making cupcake?

**METHODS**

**Research Design**

The experimental research design is considered to be the most accurate type of experimental research since it makes use of control groups and experimental groups. This study was composed of one control group and three experimental groups. It is for this reason that the true experimental research design was chosen for this study. An experimental method emphasizes the employment of a procedure in the achievement of the desired output. It also focused on the gathering of numerical data and responses from respondents with the samples of products produced from the experiment.

**Population and Sampling**

The participants of the study were TLE instructors and teachers, as well as bakers and bakery owners. Data was collected and analyzed statistically using a weighted mean and Analysis of Variance (ANOVA). The municipalities of Sta. Maria, Narvacan, Burgos, and San Esteban were the locales of the study.

**Instrumentation**

A purposive sampling of the participants was employed in the selection of the subjects. The population consisted of 80 respondents, including TLE instructors and teachers, bakers, and bakery owners.
The research site covered the municipalities of Sta. Maria, Narvacan, Burgos, and San Esteban-Bakersies. It involved the bakers and bakery owners.

The study made use of the following techniques.

**Testing.** This study necessitates that it undergoes testing. Three trials were conducted on the subjects to evaluate the sensory characteristics of the cupcakes.

Moreover, three laboratory tests were conducted: qualitative phytochemical analysis to determine the nutrient content; microbial analysis to determine the specific anti-bacterial and anti-fungal properties, and Microbial Load Analysis to determine the shelf life of the cupcakes and to detect the presence or absence of the test microbes.

**Rubrics.** A rubric-type scale, personally designed by the researcher was presented to the Review Committee who at the same time validated the instrument. The rubric was used in the study to measure the responses of the subjects to the product (cupcake) with the following parameters: appearance, color, aroma, texture, and taste. The data were categorized as follows:

**Data Categorization**

Appearance

| Point Scores | Range Interval | Descriptive Rating |
|---|---|---|
| 5 | 4.21-5.00 | The is very attractive. |
| 4 | 3.41-4.20 | The cupcake is attractive. |
| 3 | 2.61-3.40 | The cupcake is slightly attractive. |
| 2 | 1.81-2.60 | The cupcake is slightly not attractive. |
| 1 | 1.00-1.80 | The cupcake is not attractive at all. |

Color

| Point Scores | Range Interval | Descriptive Rating |
|---|---|---|
| 5 | 4.21-5.00 | The cupcake has a very vibrant color. |
| 4 | 3.41-4.20` | The cupcake has a vibrant color. |
| 3 | 2.61-3.40 | The cupcake has a slightly vibrant color. |
| 2 | 1.81-2.60 | The cupcake is slightly not vibrant in color. |
| 1 | 1.00-1.80 | The cupcake is not vibrant in color at all. |

Aroma

| Point Scores | Range Interval | Descriptive Rating |
|---|---|---|
| 5 | 4.21-5.00 | The cupcake smells very savory. |
| 4 | 3.41-4.20 | The cupcake smells savory. |
| 3 | 2.61-3.40 | The cupcake smells slightly savory. |
| 2 | 1.81-2.60 | The cupcake smells slightly not savory. |
| 1 | 1.00-1.80 | The cupcake smells not savory at all. |

Texture

| Point Scores | Range Interval | Descriptive Rating |
|---|---|---|
| 5 | 4.21-5.00 | The cupcake is very chewy and smooth. |
| 4 | 3.41-4.20 | The cupcake is chewy and smooth. |
| 3 | 2.61-3.40 | The cupcake is slightly chewy and smooth. |
| 2 | 1.81-2.60 | The cupcake is slightly not chewy and smooth. |
| 1 | 1.00-1.80 | The cupcake is not chewy and smooth at all. |

Taste

| Point Scores | Range Interval | Descriptive Rating |
|---|---|---|
| 5 | 4.21-5.00 | The cupcake is Very delicious/tasty. |
| 4 | 3.41-4.20 | The cupcake is delicious/tasty. |
| 3 | 2.61-3.40 | The cupcake is slightly delicious/tasty. |
| 2 | 1.81-2.60 | The cupcake is slightly not delicious/tasty. |
| 1 | 1.00-1.80 | The cupcake is not tasty/ not delicious at all. |

**Observation.** The researcher personally conducted daily observations on the product (cupcakes). There was documentation made daily.

**Data Collection**

The finished products, the algae-infused cupcake, were given to 80 respondents, which were broken down into the following: 30 TLE instructors and teachers; 50 bakery owners and bakers; and A letter asking permission to conduct the study was given to the District Supervisor of Sta. Maria. The study was administered to different public institutions within Sta. Maria, Ilocos Sur. Furthermore, the researcher also roamed around the neighboring

municipalities such as Narvacan, Burgos, and San Esteban for bakery owners, bakers, and their personnel to evaluate the pastry products.

The nutrient content, microbial analysis, and shelf life of the cupcakes infused with Porphyra lanceolata were determined using laboratory tests at the Mariano Marcos State University-Molecular Microbiology and Biotechnology Laboratory in Batac City, Ilocos Norte, which is government-accredited.

Furthermore, the microbial analysis of the cupcakes infused with Porphyra lanceolata is subdivided into two: antibacterial and antifungal analyses. The antibacterial analysis made use of penicillin as the positive control and Itraconazole for the antifungal analysis.

Cupcakes infused with the alga Porphyra lanceolata were baked personally by the researcher. It had undergone 3 trials at 80 subjects per trial. The first trial was given and comments were gathered. The second session of baking was done to integrate the comments gathered in the first trial. After the second trial, there were still comments so the researcher made another baking session for the incorporation of the comments, the third and final trial made.

Data collected were treated with confidentiality. No names were identified with the scores.

**Data Analysis**

Responses on the food tasting are the responses that were treated with statistical analysis. The instruments determined the sensory characteristics of the cupcakes infused with the alga Porphyra lanceolata along with appearance, color, aroma, texture, and taste were analyzed collectively and individually.

The nutrient content, microbial analysis, and shelf life analysis of the cupcakes infused with Porphyra lanceolata were determined through a laboratory test at Mariano Marcos State University- Molecular Microbiology and Biotechnology Laboratory Batac City, Ilocos Norte is duly accredited by the government.

| **Treatment** | **Cakes** | **D.R.** |
|---|---|---|
| T0 | 2.85 | VC |
| T1 (25g) | 3.95 | SVC |
| T2 (50 g) | 4.11 | SVC |
| T3 (75 g) | 4.04 | SVC |
| **Overall Acceptable** | 3.74 | A |

| Legend: | D.R. – Descriptive Rating | VVC- Very Color |
|---|---|---|
| | SVC- Slightly Vibrant Color | VC – Vibrant in Color |
| | SNV- Slightly Not Vibrant in Color | NVA- Not Vibrant at All |

Furthermore, the microbial analysis of the cupcakes infused with Porphyra lanceolata was subdivided into two: antibacterial and antifungal analyses. The antibacterial analysis made use of penicillin as the positive control and Itraconazole for the antifungal analysis.

## RESULTS and DISCUSSION

### Sensory characteristics of the cupcakes infused with *Porphyra lanceolata* alga

Table 1. Sensory Characteristics of the Cupcakes along with the Appearance

| **Treatment** | **Cakes** | **D.R.** |
|---|---|---|
| T0 | 3.05 | SA |
| T1 (25g) | 4.20 | VA |
| T2 (50 g) | 3.97 | A |
| T3 (75 g) | 3.47 | SA |
| **Overall Acceptable** | **3.67** | **A** |

| Legend: | D.R. – Descriptive Rating | VA- Very Attractive |
|---|---|---|
| | SA- Slightly Attractive | A – Attractive |
| | SNA- Slightly Not Attractive | NAA- Not Attractive at All |

**Appearance.** Otherwise termed the "look", a product seems to attract the attention of consumers when buying a particular commodity. In like manner, baked products apply the same principle. The more pleasant the look

of a pastry, the greater the chance that it will be saleable. As a result, Table 1 shows the sensory characteristics of the algae-infused cupcakes as well as their appearance. It can be seen from the figure that it registered an overall all-acceptable mean rating of a cupcake (3.67) with a description of acceptable, which means that the appearance of the cupcake with infused algae is pleasing in the eyes of the food experts.

Specifically, the highest mean ratings were registered in the cupcakes with treatment 1 (4.20) with a description of very attractive. The study of Bond (2004) when she tested the formulation of the different flours in butter cake formulation reveals that treatment 2 got the highest mean rating in appearance.

On the contrary, the lowest mean ratings were registered on T0 for cupcakes (3.05), which had a description of being slightly attractive, where the plain ingredients were mixed. It would be safe to say that when other treatments were seen, their judgment had changed, changing their rating thereafter. Hence, this supports the theory of Oliveira (2001) that photoreception (sight) is the ability of the brain and eye to detect electromagnetic waves within the visible range (light) and then interpret images as to how they are perceived.

Table 2. Sensory Characteristics of the Cupcakes along Color

**Color**. "Color refers to the shade of the cooked food. Colors in food are sometimes affected by the ingredients or some food coloring that are added to it. It also adds zest to the food, making it more enticing to look at. Thus, the sensory characteristics of the pastry products along with color are shown in Table 2. It can be seen from the table that the overall acceptability of the cupcake is (3.74) with a description of acceptable. This means that the products infused with the algae were acceptable among the respondents.

Specifically, the highest mean ratings were registered for treatment two (T2) cupcakes (4.11) with a description of a very attractive. This means that the color of the cupcakes was pleasing in the eyes of the respondents. It further implies that they were enticed to look at it. The small black dots, as seen in the cupcakes, caused by the algae, added vibrant color to the products. Hence, the findings of Ishida and Steel (2014) support the result of the study that wheat bread samples were more attractive to consumers compared to plain white bread samples.

On the other hand, the lowest mean ratings were registered with treatment zero cupcake (2.85) and with a description of slightly vibrant in color. This means that the food expert subjects had seen cookies of the same color as those seen over the display window of the bakery in their places. Further, almost all cookies, whether produced locally by bakers in town or produced at a manufacturing plant, have the same look in terms of colors. The findings support the study of Liu (2005), et al., who concluded that color affects the decision of consumers when buying meat products. Moreover, Moraes (2010) also cited that color affects the consummation of people buying pan bread products.

Table 3. Sensory characteristics of the cupcakes along aroma

| **Treatment** | **Cakes** | **D.R.** |
|---|---|---|
| T0 | 3.08 | SA |
| T1 (25g) | 4.21 | VA |
| T2 (50 g) | 3.98 | A |
| T3 (75 g) | 3.64 | A |
| **Overall Acceptable** | 3.73 | Sa |
| Legend: | D.R. – Descriptive Rating | SVS- Smells Very Savory |
| | Sa- Savory | SS- Slightly Savory |
| | SNS- Slightly Not Savory | NSA- Not Savory at All |

**Aroma**. The aroma of food products involves the sense of smell or olfaction. This is otherwise known as the "chemical sense." And unlike taste, there are hundreds of olfactory receptors in our olfactory epithelium (where the receptors are located). Odor molecules have a variety of features and can combine with many or few receptors. It is known that there is not one receptor for a specific kind of smell. Our sense of smell is known as "pattern recognition" (Oliveira, 2001).

The aroma of the pastry products can be seen in Table 3. It registered an overall acceptable rating of cupcakes of 3.73 with a description of savory. This means that cupcakes infused with algae are acceptable along with this factor.

The highest means were recorded for cupcakes (4.21) with a description of very savor. This means that the smell of the cupcakes infused with algae is pleasing to the subjects. Further, the added saltiness of the algae when blended with other ingredients has added a flavorful aroma to the baked products. The study's findings support

Masood's conclusion, as cited by Latif (2005), et al., who reported having a good aroma with the use of additives such as calcium propionate (0.15%), lactic acid (0.10%), and acetic acid (0.10%).

On the other hand, the lowest mean ratings were registered with treatment zero (T0) on cupcakes (3.08) with a description of slightly savory. This means that the subject respondents have already smelled the same products before, which bears no difference from the product that the researcher is letting them smell. The finding supports the study by Muresen (2012) that odor affects consumer preferences in patronizing a bakery product.

Table 4. Sensory characteristics of the cupcakes along texture

| **Treatment** | **Cakes** | **D.R.** |
|---|---|---|
| T0 | 2.88 | CS |
| T1 (25g) | 4.25 | VCS |
| T2 (50 g) | 4.15 | SCS |
| T3 (75 g) | 3.75 | SCS |
| **Overall Acceptable** | 3.76 | SCS |
| Legend: | D.R. – Descriptive Rating | VCS-Very chewy and smooth |
| | SCS- Slightly chewy and smooth | CS-chewy and smooth |
| | SNCS- Slightly Not chewy and smooth | NCSA-Not chewy and smooth at all |

**Texture.** Mechanoreceptors or the sense of touch or feeling, are a major factor in determining the texture of anything. It involves the ability of the brain and the sense of feeling to detect roughness, smoothness, and brittleness in a thing and then make an interpretation as to how it was perceived. As such, the sensory perception of the cupcakes along with texture is shown in Table 4. It can be gleaned from the table that it registers an overall acceptable mean on a cupcake (3.76) with a description of being slightly chewable and smooth. This means that subjects were convinced that the texture of the cupcakes had passed their standards.

Specifically, the highest mean ratings were registered on treatment one (T1) among the cupcakes (4.25), with a description of being very chewy and smooth. This means that the fewer algae in the concentration of the pastry products, the better texture they get. Furthermore, the softness of the cupcakes added the natural black color and the softness of the algae, as well, gave the baked products a lifelike texture. Hence, the study by Ishida and Steel (2014) confirmed the findings of the study when they concluded that it is known that the appearance of whole-grain bread may lead to rejection by some consumers who prefer a softer texture and white appearance, like that of conventional bread, which is made without the addition of ingredients to increase the fiber content. This further means that texture is a considerable factor in pastry consumption.

On the other hand, the lowest mean ratings were registered along with treatment zero (T0) among cupcakes which were rated chewy and smooth with 2.88. This means that although the texture of the treatment was still good, an additional ingredient that was added to the pastry had made it even better in texture compared to the traditional texture of plain ingredients. However, the findings of the study confirm the conclusion of Ishida and Steel (2014) stating that "regarding the attribute texture, On the other hand, the lowest mean ratings were registered at treatment zero (T0) among cupcakes, which were rated as chewy and smooth with a 2.88. This means that although the texture of the treatment was still good, an additional ingredient that was added to the pastry had made it even better in texture compared to the traditional texture of plain ingredients. However, the findings of the study confirm the conclusion of Ishida and Steel (2014) stating that "regarding the attribute texture, the white bread samples were more accepted than the whole grain bread samples since only sample WHO1 received similar scores to those of the white pieces of bread." This further means that traditional looks and textures are still preferred by most consumers.

Table 5. Sensory Characteristics of the Cupcakes along Taste

| **Treatment** | **Cakes** | **D.R.** |
|---|---|---|
| T0 | 3.14 | SA |
| T1 (25g) | 4.07 | A |
| T2 (50 g) | 4.16 | A |
| T3 (75 g) | 3.56 | A |
| **Overall Acceptable** | 3.73 | Ta |
| Legend: | D.R. – Descriptive Rating | VT- Very tasty |
| | Ta- Tasty | ST-Slightly Tasty |

| | | |
|---|---|---|
| | SNT- Slightly not tasty | NTA- Not tasty at all |

**Taste.** Chemoreception, otherwise known as the sense of taste and smell, involves the tongue for tasting or gestation. This is the "chemical" sense where there are four There are four main types of tastes that receptors (buds) in the tongue can distinguish: sweet, salty, sour, and bitter. Furthermore, most of what we perceive (or describe as tasting) is actually smelling. (Oliveira, 2011). As such, the sensory perception of the cupcakes along with their taste is shown in Table 5. It could be gleaned from the table that it registered the following mean ratings for cupcakes (3.73) were rated tasty in terms of taste. This means that the cupcakes had passed the standards of the food experts' subjects in terms of palatability.

Specifically, the highest mean ratings were registered in treatment two (T2), where it obtained a score of 4.16% with a description of tasty and very tasty." This means that the subjects discovered that having little and not too much algae infused in the pastry is more palatable. This is further enriched by the chewiness property of the algae, which like most of the properties of algae, This was further supported by Singh-Ackbarali (2014) stating that, "For food and beverage products, sensory analyses are the main concepts of integration with marketing where the priority is on people's perceptions of sensory quality rather than real taste evaluations." For a marketer, it is more important to know what consumers think they taste than what they really taste. Also, Kihlberg (2004) affirms that "the superior importance of taste for product acceptance is in line with self-reported priority of sensory attributes for product choice or purchase on the part of consumers." Not surprisingly, quality and freshness, price, and taste were perceived as the strongest factors in influencing food choice.

On the other hand, the lowest mean ratings were registered at treatment zero (T0), with 3.16 and a description of delicious in taste. It means that saturation of taste when it comes to traditional cupcakes has been manifested in the ratings of the subjects. This further means that additional ingredients in the cupcakes subjected to tasting are new and found to be flavorful. Moreover, the salty property of the algae, like most properties of algae, when blended with the ingredients (the sweetness and the saltiness) of the cupcakes, has rendered the cupcakes an additional palatability. Hence, "The sensory quality of bread ("taste") was the most important factor in liking." The most important factor for liking bread was taste, and the information provided with samples had an effect related to the type of information. A majority of organic consumers thought that organic food tasted better than conventional and that the consumption of organic bread should increase. (Kihlberg, 2004). Also, according to the consumers, the three most important factors influencing the purchase of pan bread were taste (19.6%), tenderness (16.8%), and expiration date (14.3%). Both groups indicated that appearance, price, health benefits, and fiber content were secondary factors. Both groups indicated the parameters of taste and tenderness as important factors when buying pan bread (Pohjanheimo et al., 2010).

## Nutrient Content Analysis of the *Porphyra lanceolata* alga

Table 6. Qualitative phytochemical analysis on the *Porphyra lanceolata* alga

| Phytochemical Tested | Test Done | Interpretation |
|---|---|---|
| Cardiac glycoside | Keller Kiliani | Present |
| Carbohydrates | Mollisch's | Present |
| Phytosterols | Liebermann Burchard's | Present |
| Proteins | Xanthoproteic | Present |
| Triterpenes | Salkowski's | Present |

All-natural foods contain vitamins and minerals that are good sources of nutrients needed by the body to strengthen the immune system to fight diseases that could be harmful. These vitamins and minerals are intact in each of the plants and vegetables that are edible for human consumption. Thus, some vitamins and minerals that are

present in the algae are shown in Table 6. The algae have undergone qualitative phytochemical analysis to determine the different nutrients that are contained in them.

It can be seen from the algae that 5 nutrients are present, namely: cardiac glycoside, carbohydrates, phytosterols, proteins, and triterpenes. Cardiac glycosides are organic compounds containing a glycoside (sugar) that act on the contractile force of the cardiac muscle. Therapeutic uses of cardiac glycosides primarily involve the treatment of cardiac failure, while carbohydrates provide the energy required for your daily activities because they are an energy-giving nutrient. Phytosterols, on the other hand, are compounds found in plants that resemble cholesterol, which helps lower bad cholesterol in the body. Proteins are used to build and repair tissues. Protein is used to make enzymes, hormones, and other body chemicals. Triterpene acids, as well as triterpene mono alcohols and diols, have antioxidant properties. The pharmacological potential of triterpenes of the lupine, oleanane, or ursane types for cancer treatment seems high, which could be used to treat cancer patients.

Other nutrients that are present in the algae are the following: 85 grams of water, 0.3 grams of fats and crude fiber, 0.10 mg of thiamine, 0.45 mg of riboflavin, and 1.5 mg of niacin, 39.0 mg of vitamin c, and 5.20 mg of vitamin a.

Table 7. Mean sizes (mm) Inhibition Zones of the *Porphyra lanceolata* Alga against the Test Fungi

| **Treatment** | **Test Fungi** | | |
|---|---|---|---|
| | ***Fusarium oxysprum*** | ***Trichopyton mentagrophytes*** | ***Candida Albicans*** |
| T1R1 | 0.0714 | 0.8571 | 0 |
| T1R2 | 0.0714 | 1.3929 | 0.7857 |
| T1R3 | 0.2857 | 1.3574 | 0.4286 |
| T2R1 | 0.1071 | 0.1786 | 1.9643 |
| T2R2 | 0.0357 | 0.0714 | 0.0357 |
| T2R3 | 0.1429 | 0.1429 | 0.0357 |
| T3R1 | 0.0714 | 0.0179 | 0 |
| T3R2 | 0.1964 | 0.0536 | 0.0179 |
| T3R3 | 0.1071 | 0.0179 | 0 |

Legend T1 – Ethanolic Extract T2 (+) control - Itraconozole T3 (-) control – distilled water

**Anti – microbial properties of the *Porphyra lanceolata* alga**

To further examine the algae, they underwent microbial analysis against fungi and bacteria. This test is to determine whether the algae can fight the microorganisms when they are taken into the body after they have been taken in. As such, Table 9 shows the mean size in terms of millimeters of the inhibition zones of the Porphyra lanceolata against the 3 test fungi, which are: Fusarium oxysprum, Trichophyton mentagrophytes, and Candida albicans.

It can be gleaned from the table that treatment with ethanol extract along with T1R2 (1.3929) and T1R3 (1.3574) exhibited the widest mean size inhibition of the fungus Trichophyton mentagrophytes and treatment 2 (+) control with itraconazole T2R2 (1.9643) of the fungus Candida albicans. This means that the treatments were the most effective in controlling the growth of the fungi in the body. The findings support the study of Barayuga (2008) that dragon fruit extracts along with their stems, pulp, and fruit peel are effective in controlling fungi in the body when taken in.

Table 8. Mean sizes (mm) Inhibition Zones of the *Porphyra lanceolata* Alga against the Test Bacteria

| Treatment | Test Bacteria | | |
|---|---|---|---|
| | ***Pseudomonas aeruginosa*** | ***Escherichia Coli*** | ***Staphylococcus aureus*** |
| T1R1 | 0.1426 | 0.0357 | 0.8214 |
| T1R2 | 0.0357 | 0.0357 | 0.0714 |
| T1R3 | 0.0714 | 0.0536 | 0.1786 |
| T2R1 | 2.8214 | 1.8571 | 0.3214 |
| T2R2 | 2.5714 | 1.0357 | 0.3214 |
| T2R3 | 2.1071 | 0.8214 | 0.2857 |
| T3R1 | 0 | 0.1071 | 0.0536 |
| T3R2 | 0.0536 | 0.1429 | 0.0357 |
| T3R3 | 0.0357 | 0.0714 | 0.2143 |

Legend: T1 – Ethanolic Extract T2 (+) control - Penicillin T3 (-) control – distilled water

In millimeters, Table 8 shows the inhibition zones of the Porphyra lanceolata algae against the test bacterium, Pseudomonas aeruginosa, Escherichia coli, and Staphylococcus aureus. It can be gleaned from the table that treatment 2 (+) control penicillin along T2R1 (2.8214), T2R2 (2.5714), and T2R3 (2.1071) exhibited the widest mean size inhibition of the bacteria Pseudomonas aeruginosa, while the same treatment along T2R1 (1.8571) and T2R2 (1.0357) also exhibited the widest mean size inhibition of the bacteria Escherichia coli. This means these are the treatments that are effective in controlling the growth of the bacteria in the body. The results of the study further prove the anti-microbial properties of the different extracts. Accordingly, tannins, as cited by Barayuga (2008), nearly all higher plants contain anti-microbial substances. These substances that accumulate in the plant tissues make the plants resistant to pathogenic microorganisms.

The algae Porphyra lanceolata has antibacterial and antifungal properties. The said algae can inhibit the fungi Trichophyton mentagrophytes and Candida albicans, while the bacteria Pseudomonas aeruginosa and Escherichia coli also exhibited the widest mean size of inhibition.

| Food Product | Microbial Load (Total Plate Count x$10^{12}$) | Detection of Pathogens | | | | | |
|---|---|---|---|---|---|---|---|
| | | ***E Coli*** | ***Salmonella sp*** | ***Listeria monocytegenes*** | ***Staphylococcus aureus*** | ***Pseudomonas aeruginosa*** | ***Molds*** |
| 1st Observation | | | | | | | |
| Cupcakes | 14.7 | Neg (-) | Neg (-) | Neg (-) | Pos (+) | Neg (-) | Pos (+) |
| 2nd Observation | | | | | | | |
| Cupcakes | 28.3 | Neg (-) | Neg (-) | Pos (+) | Pos (+) | Neg (-) | Pos (+) |

Legend : Neg (-) Negative Pos (+) Positive

**Shelf life of the cupcakes infused with *Porphyra lanceolata* alga**

The stated shelf life of food is the period during which it remains safe and suitable for consumption, provided the food has been stored following any stated storage conditions. This means that the food must remain safe to consume and has not deteriorated in quality or spoiled in any way that the consumer would find unacceptable and has not lost significant amounts of any nutrients listed on the label (Ministry for Primary Industries, 2014).

Table 9 shows the microbial load analysis and detection of pathogens of Porphyra lanceolata infused cupcakes in determining their shelf life. Pastry samples were given for laboratory testing and observation. The cupcakes underwent 2 observations, each lasting 7 days, respectively. It can be gleaned from the table that the cupcakes were negative for Escherichia coli, Salmonella sp., and Pseudomonas aeruginosa for the first and second observations. This is further proven by table 10 on the inhibition zones of the bacteria in the algae. 3 treatments along Pseudomonas aeruginosa and 2 treatments along Escherichia coli inhibited the widest range in terms of millimeters while it was positive for Listeria monocytogenes, Staphylococcus, and molds on the first and second observations, respectively. This means that cupcakes infused with algae can only last for 5–6 days. The findings support Saddozai and Khalil's (2009) claim that chemical profiles such as pH, water activity, and moisture content are the most important factors influencing the microbiological quality of these products. High moisture products, those with high water activity, are most likely to present food safety concerns as they support the growth of a wide range of bacteria, yeasts, and molds.

Some high moisture, low acid components of bakery products provide an environment that is highly conducive to the growth of pathogenic bacteria. Intermediate moisture products generally only support the growth of spoilage organisms such as osmophilic yeasts and molds. Further, unacceptable levels of bacteria might result from temperature abuse, poor hygienic practices, and the use of equipment (Food Standards Australia New Zealand, 2012).

It can be concluded from that appendix that one of the major environmental factors resulting in increased loss of quality and nutrition for most foods is exposure to increased temperature. The higher the temperature, the greater the loss of food quality. Thus, to predict the extent of high-quality shelf life to be able to put a shelf life date on a product, knowledge of the rate of deterioration as a function of environmental conditions is necessary. Coupled with this would be the need for knowledge of the actual environmental conditions to which the various classes of foodstuffs are exposed. (Food Standards Australia and New Zealand, 2012).

The shelf life of pastries infused with the Porphyra lanceolata algae is only a little less than a week, 6 days to be specific. The laboratory observations revealed that the pastries were negative for Escherichia coli, salmonella sp., and Pseudomonas aeruginosa for the first and second observations, while they were positive for Listeria monocytogenes, Staphylococcus aureus, and molds for the first and second observations. It was also found that several external factors can affect the shelf life of the pastries: the cooking process, the packaging, and the expiry date of the ingredients. Thus, within 6 days, the produced pastries are still edible but cannot be eaten the next day due to the presence of the said positive microbes that can cause diseases.

**Significant differences on the perception of the sensory characteristics of the cupcakes infused with algae**.

Table 11. Summary of Overall Acceptable Mean of the Sensory Characteristics of the Cupcakes

| **Treatment** | **Cakes** | **D.R.** |
|---|---|---|
| T0 | 3.67 | A |
| T1 (25g) | 3.74 | A |
| T2 (50 g) | 3.73 | A |
| T3 (75 g) | 3.76 | A |
| **Overall Acceptable** | 3.73 | A |

| Legend: | D.R. – Descriptive Rating | |
|---|---|---|
| | SA – Slightly Attractive | A – Attractive |
| | SNA – Slightly Not Attractive | NAA – Not Attractive at All |

The summary of the overall acceptable mean ratings of the sensory characteristics of the cupcakes infused with algae is shown in Table 11. It registers a grand mean of 3.73 for cupcakes with a description of acceptable. This signifies that the overall perception of the respondents towards the sensory characteristics of the cupcakes is acceptable. This further implies that the cupcakes infused with algae are far superior compared to the cupcakes with plain ingredients. A new ingredient blended with traditional ingredients has added a taste and zest to pastry products.

Specifically, the highest mean ratings among the indicators used were registered along with the cakes' texture (3.76), all with a description of acceptable. This implies that the texture of the cupcakes is palatable to the taste. Furthermore, it is safe to say that a new hue in the cupcakes' texture matters to the respondents before the tasting is done. While it has been noted that the most important aspect of every commodity is taste, as seen in the figure, it was the second-highest in terms of the mean. This affirms the statement "consumers scored taste, tenderness, and expiration date as the three most important factors when purchasing pan bread." Taste and tenderness were the most important factors chosen by both men and women. Therefore, these factors should be taken into account to increase the acceptance of products containing fibers. (Ishida and Steel, 2014). Also, the acceptance of course (dark) bread has increased, and the good taste of such bread and beliefs in its health-promoting attributes are pointed out by consumers. On the other hand, consumers are used to making food choices based on a product's physical attributes, where priority is given to appearance and taste. Consumers stated the importance of bread taste in their choice between organic and conventional products (Kihlberg, 2004).

On the contrary, the lowest mean ratings were registered along with the following: cakes (3.67) with a description of tasty. This means that cupcakes infused with algae are acceptable. However, subjects had given the emphasis on color, texture, and taste as the most important things to consider in the evaluation of the cupcakes. This affirms the statement of Lesser, as mentioned by Singh-Ackbarali (2014), that for food and beverage products, sensory analyses are the main concepts of integration with marketing where the priority is on people's perceptions of sensory quality rather than real taste evaluations. For a marketer, it is more important to know what consumers think they taste than what they taste.

**Conclusion**

Based on the results of the study, the following conclusions were drawn:

The sensory characteristics which registered the highest mean among the cupcakes were: aroma for the cookies and texture for the cakes and tarts. And for this reason, subjects preferred cupcakes that were rich in aroma and good in texture.

Several nutrients are found in the algae, namely: cardiac glycoside, phytosterols, proteins, triterpenes, carbohydrates, water, fats, crude fiber, thiamine, niacin, vitamin c, and vitamin a. This means that the algae Porphyra lanceolata is rich in nutrients needed by the body.

Treatments with ethanol extracts and itraconazole had the widest mean size inhibition of the fungus Trichophyton mentagrophytes and Candida albicans, while treatment with ethanol extracts and penicillin exhibited the widest mean size inhibition of Pseudomonas aeruginosa and Escherichia coli. Hence, the alga Porphyra lanceolata has antibacterial and antifungal properties.

The cupcakes were negative for Escherichia coli, salmonella sp., and Pseudomonas aeruginosa for the first and second observations, while they were positive for Listeria monocytogenes, Staphylococcus aureus, and molds on the first and second observations. Thus, the shelf life of cupcakes infused with the Porphyra lanceolata algae is only a little less than a week, 6 days to be exact.

The other indicators of the sensory characteristics, specifically aroma, texture, and taste, show no significant differences among other indicators, which implies that they are held constant. The sensory characteristics, appearance, and color of the cupcakes infused with the alga Porphyra lanceolata are significantly different from each other.

Treatment 2 consisted of the 50 g alga as an additive. It was concluded that the best formulation used in the cupcake infused with the alga Porphyra lanceolata is the T2.

**Recommendations**

A further study should be conducted to further improve the other sensory characteristics of the cupcakes that are infused with the same algae, Porphyra lanceolata. Further, the preferred sensory characteristics should be maintained and also improved.

Since the algae were found to possess several nutrients, then it could be tested on other products aside from pastries, say cuisines, for it to be enjoyed by others who do not want pastries.

The algae were found to have antifungal and antibacterial properties. Hence, a deeper study should be conducted to determine other antimicrobial properties.

On the other hand, since the algae possess antifungal and antibacterial properties, it is also recommended to formulate medicines or any kind of drugs that can prevent the inhibition and growth of the test bacteria and test fungi.

The same study can be conducted by infusing the algae with other pastries, employing other methods and techniques, and other combinations of ingredients, to determine other factors that contribute to the longer shelf life of the products.

The sensory characteristics of aroma, texture, and taste showed no significant differences among other indicators which implies that they are held constant. The color and appearance are significantly different from each other. Furthermore, there should be more sensory characteristics to be measured, aside from what was used in this study, to determine the significant differences.

Treatment 2 consisted of the 50 g alga as an additive and had a registered highest mean rating in terms of overall acceptability. It is therefore recommended to modify the volume of the alga using different pastry products aside from the cupcakes being observed.

**REFERENCES**

Asghar, A., Anjum, F. M., Allen, J. C., Daubert, C. R., & Rasool, G. (2009). Effect of modified whey protein concentrates on empirical and fundamental dynamic mechanical properties of frozen dough. *Food Hydrocolloids*, *23*(7), 1687-1692.

Azizi, M. H., & Rao, G. V. (2005). Food Chem, 89, 133-138

Bond, F. G. (2003). Engineering a mevalonate pathway in Escherichia coli for production of terpenoids, 21, 796–802.

Centenaro, G.S., Feddern, V., Bonow, E.T., & Mellado, M.S. (2007). Bread enrichment with fish protein. Ciência e Tecnologia de Alimentos 27(3): 663-668.

Enzing, C. M., Nooijen, A., Eggink, G., Springer, J., & Wijffels, R. (2012) Algae and genetic modification. Research, Production and Risks

Flack, E. (1987). Food Sci. Technology. Today l: 240-243

Food Standards Australia New Zealand (2014). Food Standards Code Standard 1.2.5 – Date Marking of Food

Geslain-Lanéelle, C. (2006). Conference on nutrition and health claims. Bologna, Noviembre.

Hemmingson, J.A., Falshaw, R., Furneaux, R.H., & Thompson, K. (2006). Structure and antiviral activity of the galactofucan sulfates extracted from Undaria pinnatifida (Phaeophyta). J Appl Phycol 18:185-193.

Ishida, & Steel. (2014). Effect of the addition of different fibres on wheat dough performance and bread quality. Food Chemistry, 79(2), 221-226. http://dx.doi.org/10.1016/S0308- 8146(02)00135-8.

Kakinuma, M., Park, C. S., & Amano, H. (2001) Distribution of free L-cysteine and glutathione in seaweeds. Fisheries Sci;67:194–196.

Kihlberg, I., Johansson, L., Kohler, A., & Risvik E. (2004). Sensory quality of whole 416 wheat pan bread – influence of farming system, milling and baking technique. Journal of Cereal Science, 39, 67 – 84.

Kwon, M. J., & Nam, T.J., (2007). A polysaccharide of the marine alga Capsosiphon fulvescens induces apoptosis in AGS gastric cancer cells via an IGF-IR-mediated P13K/Akt pathway. Cell Biol. Int., v.31, n.8, p.765-775.

Ministry for primary industries (2014). How to Determine the Shelf Life of Food A Guidance Document

Miyamoto, Y., Sakamoto, M., Maeda, T., & Morita, N. (2002). Nippon Shokuhin Kagaku Kogaku Kaishi 49: 534-539

Moraes, E. D. (1957) A simple method for the isolation and purification of total lipids from animal tissues. Journal of Biological and Chemistry", v. 226, p. 497-509

Mulbry, W., et al., (2008). Treatment of dairy effluents usingfreshwater algae: fatty acid content and composition of algal biomass at different manure loading rates. Journal of Applied Phycology 20(6): 1079-1085.

Muresan, C., Stan, L., Man, S., Scrob, S., & Muste, S. (2012). University of Agricultural Sciences Book of Veterinary Medicine Cluj-Napoca, Faculty of Agriculture, 400372, 3-5 Manastur Street, Romania

Oliveira, A.S., Sudatti, D.B., Fujii, M.T., Rodrigues, S.V., & Pereira, R.C., (2013). Inter- and intrapopulation variation In the defensive chemistry of the red seaweed Laurencia dendroidea" (Ceramiales, Rhodophyta). Phycologia, 52, 130–136.

Plaza, M., Cifuentes, A., & Ibáñez, E. (2008). In the search of new functional food ingredients from algae. Trends in Food Science & Technology, 19(1), 31-39.

Pohjanheimo, T., Luomala, H., & Tahvonen, R., (2010). Finish adolescents' attitudes towards wholegrain bread and

healthiness. Journal of the Science of Food and Agriculture, 90(9), 1538-1544.
Ribotta, P. D., Perez, G. T., Leon, A. E., & Anon, M. C. (2004). Effect of emulsifier and guar gum on micro structural, rheological and baking performance of frozen bread dough. Food Hydrocolloids, 18, 305-313.
Rocha, F.D., Pereira, R.C., Kaplan, M.A.C., & Teixeira, V.L. , (2007). Produtos naturais de algas marinhas e seu potencial antioxidante. Revista Brasileira Farmacognosia" 17(4): 631-907.
Rodriguez-Bernaldo de Quiros, A., Frecha-Ferreiro, S., Vidal-Perez, A. M., & Lopez-Hernandez, J., (2010). Antioxidant compounds in edible brown seaweeds. European Food Research and Technology, 231, 495-498.
Saddozai, & Khalil (2009). Effect of edible seaweeds (Undaria pinnatifida and Porphyra ternera) on the metabolic activities of intestinal microflora in rats. Nutrition Research, 22, 232-331.
Wills, T.A. (1991). Social support and interpersonal relationship. Prosocial Behavior, Review of Personality and Social Psychology.
Yao, S., Liu, R., Huang, X., & Kong, L. (2007). Preparative isolation and purification of chemical constituents from the root of Adenophora tetraphlla by high-speed counter-current chromatography with evaporative light scattering detection J. Chromatogr. A 1139, 254–262.