Food Research 8 (Suppl. 8) : 83 - 87 (2025)
Journal homepage: https://www.myfoodresearch.com

FOOD RESEARCH

RESEARCH PAPER

Development and acceptability of white oyster mushroom (*Pleurotus florida*)-moringa pili tart

*Lingao, B.E.R. and Diokno, M.C.

College of Industrial Technology, Central Bicol State University of Agriculture-Sipocot, Philippines 4408

Article history:
Received: 24 April 2024
Received in revised form: 11 January 2025
Accepted: 16 February 2025
Available Online: 13 March 2025

Keywords:
White oyster mushroom,
Moringa,
Pili tart,
Organoleptic evaluation

DOI:
https://doi.org/10.26656/fr.2017.8(S8).13

Abstract

This study was developed to innovate and enhance the nutritional value of pili tart by supplementing the tart shell with white oyster mushroom and moringa powder. Pili tart shell was prepared from a control recipe and three (3) treatments with varying proportions of flour, 25%, 20%, 15% White Oyster Mushroom Powder (WOMP), and 3%, 2%, and 1% Moringa Powder (MP). The physicochemical analysis and proximate analysis were determined through laboratory analysis. While, the organoleptic characteristics (color, texture, taste, and aroma), were evaluated by the group of respondents. In this study, moisture, ash, water activity, and pH content were 6.80%, 1.81%, 0.970, and 5.65 respectively. Likewise, 7.67% crude protein, 37.78% crude fat, 45.96% total carbohydrates, and 21410.5 J/g calorie content were found in the product which represents the basic nutrients in the innovative pili tart. While the organoleptic evaluation concluded that the supplementation of 20% white oyster mushroom powder and 2% moringa powder was favorable by the respondents in all attributes. Moreover, supplementation of 15-25% mushroom and 1-3% moringa powder in the pili tart shell was significantly acceptable by the consumers. Based on the direct method of shelf-life analysis, pili tart with white oyster mushroom-moringa can be stored at room temperature for up to 14 days.

1. Introduction

Oyster mushrooms are commercially important in the world mushroom market, and several species are grown commercially on a large and small scale in many countries (Adebayo *et al*., 2012). It is one of the most popular and valuable foods of the century because they have great nutritional value since they are quite rich in protein, with an important content of essential amino acids and fiber, and low fat but with excellent important fatty acids content (Valverde *et al*., 2015). Besides, mushrooms are well-known containing bioactive compounds, such as ergosterol, β-glucans, lentinan, and peroxidase, which possess health functionalities. This shows that the incorporation of mushrooms into food products enhances the nutritional values, as well as the physical properties of the food product (Ho *et al.*, 2020).

Moringa (*Malunggay*) is one of the most popular and abundant food plants in the Philippines that is available in nature. All plant parts have a remarkable range of functional and nutraceutical properties (Singh *et al*., 2012). Moreover, the leaves of this plant being rich in protein may serve in combating protein-energy malnutrition for the undernourished population of the world. It is used as a potential antioxidant, anticancer, anti-inflammatory, antidiabetic, and antimicrobial agent (Gopalakrishnan *et al*., 2016). Also, it is excellent source of many vitamins and minerals such, as Vitamin B6, Vitamin C, Iron, Riboflavin (B2), Vitamin A (from beta-carotene), and Vitamin A (USDA Food Composition Data Base, 2019).

The process of drying and powdering has been used in a different fresh food to prevent early spoilage and can easily incorporate significant ingredients in the food products. Particularly, Fresh mushrooms being perishable start deterioration instantly within a day after harvest. Because of the extremely delicate nature of fresh mushrooms, they have to be preserved (Majeed *et al*., 2017). Because of this, the incorporation of mushrooms and moringa has already been introduced in different baked products. In terms of the product characteristics, the addition of 15% of mushroom powder level significantly improved the colour, flavor, and texture (Sheikh *et al*., 2013). Furthermore, the supplementation of mushroom powder has remarkably high moisture, protein, and total ash contents. The mineral composition increased with increasing mushroom supplementation except for magnesium, manganese, and calcium contents. The contents of all amino acids and B-vitamins

*Corresponding author.
Email: *babyeloisa.lingao@cbsua.edu.ph*

eISSN: 2550-2166
Published by Rynnye Lyan Resources

analyzed were also increased (Ndungu *et al*., 2015). Meanwhile, the supplementation of moringa powder significantly increased the fibre, ash, protein, and ether extract while decreasing moisture content (Sengev *et al*., 2013). Additionally, the addition of Moringa oleifera leaf powder improves the nutritional quality and substantial changes in the functional properties. Furthermore, the use of Moringa oleifera leaf powder, therefore, has the potential to combat protein-energy malnutrition and micronutrient deficiencies in developing countries (Karim *et al*., 2015).

This study aimed to improve and innovate the pili tart by supplementing the tart shell with white oyster mushroom and moringa powder. This study also involves the processing of the mushroom and moringa into powder, evaluation of the physicochemical properties and nutrient contents (ash, crude protein, crude fat, total carbohydrates, and calories), and evaluation of organoleptic characteristics of each formulation. It was also done to find the best formulation that can be used in improving the nutritional value and quality of carbohydrate-based food products.

2. Materials and methods

This study applied the descriptive-experimental method. The Research and Development (R&D) method was also used to meet the objectives of the study. Weighted mean and ranking technique were used as the Statistical Tool of the study. Weighted mean and ranking techniques were used to determine the level of acceptability of the white oyster mushroom pili tart in terms of color, texture, taste, and aroma.

2.1 Collection and selection of oyster mushroom and matured moringa

Harvesting of good quality white oyster mushroom from CBSUA-Sipocot cultured mushroom was facilitated to ensure high-quality Mushroom powder was produced. The supply of Moringa was collected from selected Barangays of the Municipality of Sipocot, where the abundant source of Moringa plant can be found. Harvesting of matured Moringa in the morning was facilitated ensuring the freshness of the leaves.

2.2 Preparation of oyster mushroom powder

The mushroom was washed in clean running water to remove dirt, sand, and other undesirable materials before being used for the security of sanitation. The clean and fresh mushrooms were sliced into small pieces with a knife and blanched in hot water at 100°C for three minutes. Then drained and mushrooms were spread in drying trays and dried in the sun for 3 days, 9 hrs/day. After cooling to room temperature, the dried mushrooms were ground into powder in a grinder then they were sieved and packaged in polythene bags and stored at room temperature for further use in the preparation of pili tart.

2.3 Preparation of moringa powder

The harvested leaves were thoroughly washed in running tap water twice to remove the presence of dirt or surface impurities if any and placed in a tray for drying. At last, dried leaves were milled and packed into a tight plastic container until further use.

2.4 Pili tart making procedure

The experimentation of the Pili Tart was conducted by following the existing recipe. With the guide of the different studies related to the modification of baked products using white oyster mushroom and moringa powder, the tart shell was prepared from a control recipe and three (3) treatments with varying proportions of flour, white oyster mushroom powder, and moringa powder, other than the three manipulated ingredients, all of the remaining ingredients were constant. 100% All-Purpose Flour was used as the control recipe and replaced with 25%, 20%, and 15% levels of white oyster mushroom powder, and 3%, 2%, and 1% level of moringa powder, respectively. However, all trials have a constant amount of salt, sugar, butter, and water. Chopped pili nuts were used for the filling of the tart.

2.5 Organoleptic evaluation

Test questionnaires were facilitated to the respondents individually to gather data relevant to the study. Each respondent was given questionnaires together with the different trials to be evaluated based on the benchmarks for evaluation. The pili tart products were evaluated in terms of organoleptic evaluation (color, texture, taste, and aroma) with the use of a five-point Likert scale.

2.6 Physicochemical properties and nutritional content analysis of white oyster mushroom moringa pili tart

To assess the physicochemical properties and nutritional content of the developed white oyster mushroom pili tart, samples were submitted to the Food Testing Laboratory, Shared Service Facility (SSF) of the Central Bicol State University of Agriculture – Pili Campus for food analysis. The sample was analyzed by using AOAC methods, IKA Bomb Calorimeter, and computation.

2.7 Shelf-life analysis of white oyster mushroom-moringa tart shell at room temperature

https://doi.org/10.26656/fr.2017.8(S8).13

To determine the shelf-life of the White Oyster Mushroom-Moringa Pili Tart, the Direct Method of Shelf -life analysis guided by the book by the New Zealand Food Safety Authority (2005) was used. Five (5) replicates were prepared in the sterilized Petri plates and placed inside a chamber that was subjected to observations.

2.8 Tabulation, statistical analysis, and interpretation of data

With the use of weighted mean, ranking technique, and ANOVA, the results of this study were tabulated, analyzed, and interpreted.

3. Results and discussion

3.1 Physicochemical properties of white oyster mushroom moringa pili tart

3.1.1 Moisture content

The moisture content of white oyster mushroom-moringa pili tart was found 6.80%, which is considerably within the range of the required amount of moisture in baked products with the use of mushroom powder with the ranges of 1.16 – 32.60% (Salehi, 2019). The result indicates that the lower moisture content is due to the incorporation of white oyster mushroom and moringa powder in the preparation of pili tart. Besides, the findings of Farzana *et al*. (2016), validated the finding that adding mushroom and moringa powder decreases the moisture content. The moisture content of the food has a significant impact on the product's taste, texture, appearance, shape, and weight. More moisture encourages bacteria to proliferate quickly, it plays a crucial role in preserving good food quality and extending shelf life.

3.1.2 Ash content

The ash content of white oyster mushroom-moringa pili tart was found at 1.81%, this also in close agreements in the study of Salehi (2019), were found in the range of 0.84 – 3.47% of ash contents in different baked products containing 20% of oyster mushroom powder. This indicates that pili tart supplemented with mushroom-moringa powder can be a good source of minerals.

3.1.3 Water activity

Water activity refers to water in food that is not observed in food molecules and can facilitate the growth of bacteria, yeast, and molds (Ng *et al*., 2016). It can be controlled through drying and the addition of sugar, which becomes significant in the present study. The white oyster mushroom-moringa pili tart contains 0.970 aw. The result found that it is higher than the typical water activity of 0.95 for some foodstuffs stated by U.S. Food and Drug Administration (2014). This indicates that the water activity of the present study may compromise the other components of the white oyster mushroom-moringa pili tart and affect the longevity of the shelf life.

3.1.4 pH level

The analysis found that the pH level of white oyster mushroom-moringa pili tart is 5.65. The value of pH can be a major factor affecting the appearance, texture, flavor, nutritional content, and even the safety of the food. pH values were greater than 5.6, which makes the food susceptible to bacterial spoilage and the possible growth of pathogens. The interaction of water activity and pH on toxin production by Clostridium botulinum was found in the study of Rahman and Rahman (2020) which stated that the toxin in food can be detected at day 14 with 0.973 aw and with a pH value of 5.50. A pH value of 4.0 to 5.8 is recommended for baked bread to prolong its shelf life (Sper Scientific Direct, 2021). This implies that the present study is within range of the recommended pH for baked products.

3.2 Organoleptic evaluation of white oyster mushroom-moringa pili tart

In the present study, the supplementation of 20% WOM powder and 2% Moringa powder was favorable to the respondents. In terms of color, the respondents were favored the brown color as compared to the darker and lighter color of the pili tart. It is obvious that the interactions of treatments showed a significant effect on the color of the crust from light brown to dark brown. This is consistent with Majeed *et al*. (2017), who reported that the color value varied significantly due to changes in mushroom powder supplementation amount, with crust color of light brown darkening progressively with increasing levels of mushroom powder. In terms of texture, the crumbly texture of the pili tart was favored by the respondents. The result proved that the 20% of mushroom powder supplementation was favorable texture for the respondents as the rates decreased when the supplementation of mushroom powder was more or less than 20%. The score for texture gradually decreases as the supplementation level of mushroom powder increases in flour (Majeed *et al*., 2017). Furthermore, in terms of aroma, respondent prefers the strong aroma of mushroom powder complemented with the sugary aroma of the filling. However, in terms of taste, it is been revealed that the increased supplementation of white oyster mushroom powder with the addition of the bitter taste of moringa powder will result in the strong woody-bitter taste of the pili tart.

https://doi.org/10.26656/fr.2017.8(S8).13

Moreover, supplementation of 15-25% mushroom and 1-3% moringa powder in the pili tart shell was significantly acceptable by the consumers.

3.3 Nutritional content of white oyster mushroom moringa pili tart

The analysis presents the amount of ash, crude protein, crude fat, total carbohydrates, and calorie content.

The result reveals that crude fat (37.78) and total carbohydrates (45.96) are the major components of white oyster mushroom-moringa pili tart. While ash and crude protein were found 1.81 (Protein factor = 5.70) and 7.67 respectively. These results corroborate with the study of Salehi (2019) who summarized the effect of dried mushroom powder on the chemical properties of bakery products and found them to range from 0.53 – 3.58 of ash, and 6.50 – 15.55 of protein, whereas the present study is within the results range. The fat content was found to range from 1.68 – 23.08 which is lower than the result of the present study. And carbohydrates found ranging from 46.47 – 68.59 which is higher than the result of the present study. This implies that the addition of white oyster mushroom and moringa powder into carbohydrate-based food products improved the nutrients ingredients and quality of the product. The analysis also revealed that white oyster mushroom-moringa pili tart contains 21410.5 J/g of calories (5.11381 kcal). This implies that the use of white oyster mushroom and moringa powder in a baked product can be a good source of energy.

3.4 Shelf life of white oyster mushroom-moringa pili tart at room temperature for storing

Using the Direct Method of Shelf-life Analysis guided by the New Zealand Food Safety Authority (2005), the shelf-life of the White Oyster Mushroom-Moringa Pili Tart was analyzed at 25℃ room temperature with an average total relative humidity of 51.33%. A total of five (5) replicates underwent sterilization and were placed in Petri plates and then placed in the chamber to ensure sanitation during the process of observation. All five replicates were observed in the chamber with 24-hour intervals for 20 data points (20 days). The observation stopped when the physical changes occurred.

Based on the ocular observation and data gathered the White Oyster Mushroom-Moringa Pili Tart has been observed will only last at least 14 days (2 weeks) at room temperature. On the 16th day of the observation period, the development of molds was seen on the surface of the tart of each sample.

The result was supported by the study of Rahman and Rahman (2020), which found that the toxin production by Clostridium botulinum can be found at day 14 in food having 0.973 aw and with a pH value of 5.50. This indicates that the growth of the bacteria can be seen in a minimum of 14 days. This implies that the amount of water activity (0.970), and pH (5.65) found in white oyster mushroom-moringa pili tart with the addition of the amount of moisture (6.80) compromise the longevity of the shelf life of the product.

4. Conclusion

Supplementation of 15 - 25% white oyster mushroom and up to 3% moringa powder in pili tart creates a significant impact on the physicochemical properties of the product. Moreover, the mixture of the powders contributes to improving the nutrients and the quality of the product. The study concluded that the level of supplementation of the two powders is highly acceptable by the consumers in terms of organoleptic characteristics. Further, 20% mushroom powder and 2% moringa powder in the ideal formulation of the product.

Acknowledgements

The researchers would like to acknowledge the support of Central Bicol State University of Agriculture who provided financial contributions that helped the realization of this study.

References

Adebayo, E.A., Oloke, J.K., Ayandele, A.A. and Adegunlola, C.O. (2012). Phytochemical, antioxidant and antimicrobial assay of mushroom metabolite from *Pleurotus pulmonarius* –LAU 09 (JF736658). *Journal of Microbiology and Biotechnology Research*, 2(2), 366-374.

Farzana, T., Mohajan, S., Saha, T. and Hossain, M.D. (2016). Development of a healthy soup powder using phytonutrient enriched mushroom-moringa leaf. *Daffodil International University Journal of Allied Health Sciences*, 3(1-2), 33-40.

Gopalakrishnan, L., Doriya, K. and Kumar, D.S. (2016). *Moringa oleifera*: A review on nutritive importance and its medicinal application. *Food Science and Human Wellness*, 5(2), 49–56.

Ho, L.-H., Zulkifli, N.A. and Tan, T.-C. (2020). Edible mushroom: nutritional properties, potential nutraceutical values, and its utilisation in food product development. In Passari, A.K. and Sánchez, S. (Ed.) An Introduction to Mushroom. IntechOpen eBooks.

Karim, O.R., Kayode, R.M.O., Oyeyinka, S.A. and

Oyeyinka, A.T. (2015). Physicochemical properties of stiff dough 'amala' prepared from plantain (Musa Paradisca) flour and Moringa (*Moringa oleifera*) leaf powder. *Hrana U Zdravlju I Bolesti : Znanstveno-stručni Časopis Za Nutricionizam I Dijetetiku*, 4(1), 48–58.

Majeed, M., Khan, M.U., Owaid, M.N., Khan, M.R., Shariati, M.A., Igor, P. and Ntsefong, G.N. (2017). Development of Oyster Mushroom Powder and its Effects On Physicochemical and Rheological Properties of Bakery Products. *The Journal of Microbiology, Biotechnology and Food Sciences*, 6 (5), 1221–1227. https://doi.org/10.15414/jmbfs.2017.6.5.1221-1227

Ndungu, S.W., Otieno, C.A., Onyango, C. and Musieba, F. (2015). Nutritional Composition, Physical Qualities and Sensory Evaluation of Wheat Bread Supplemented with Oyster Mushroom. *American Journal of Food Technology*, 10(6), 279-288.

New Zealand Food Safety Authority (2005). A Guide to Calculating the Shelf life of Foods. Information Booklet for the Food Industry. Wellington, New Zealand: New Zealand Food Safety Authority.

Ng, S.H., Wan Ahmad, W.A.N. and Wan Ishak, W.R. (2016). Quality Characteristics of *Pleurotus sajor-caju* Powder: Study on Nutritional Compositions, Functional Properties and Storage Stability. *Sains Malaysiana*, 45(11), 1617–1623.

Rahman, M.S. and Rahman, M.R.T. (2020). pH in Food Preservation. In Handbook of Food Preservation. 3rd ed. USA: CRC Press.

Salehi, F. (2019). Characterization of different mushrooms powder and its application in bakery products: A review. *International Journal of Food Properties*, 22(1), 1375–385. https://doi.org/10.1080/10942912.2019.1650765

Sengev, A.I., Abu, J.O. and Gernah, D.I. (2013). Effect of Moringa oleifera Leaf Powder Supplementation on Some Quality Characteristics of Wheat Bread. *Food and Nutrition Sciences*, 4(3), 270–275. https://doi.org/10.4236/fns.2013.43036

Sheikh, M., Kumar, A., Islam, M.M. and Mahomud, M.S. (2013). The effects of mushroom powder on the quality of cake. *Progressive Agriculture*, 21(1–2), 205–214. https://doi.org/10.3329/pa.v21i1-2.16769

Singh, Y., Jale, R,. Prasad, K.K., Sharma, R. and Prasad K. (2012). *Moringa oleifera*: A Miracle Tree, presented at the Proceedings, International Seminar on Renewable Energy for Institutions and Communities in Urban and Rural Settings, p. 73-81. Jevra, India: Manav Institute.

Sper Scientific Direct (2021). The Importance of pH in Food Quality and Production. Retrieved on December 6, 2021 from Sper Scientific Direct website: https://sperdirect.com/blogs/news/the-importance-of-ph-in-food-quality-and-production

U.S. Food and Drug Administration (2014). Retrieved on December 6, 2021, from USFDA website: https://www.fda.gov/inspections-compliance-enforcement-and-criminal-investigations/inspection-technical-guides/water-activity-aw-foods

Valverde, M.E., Hernández-Pérez, T. and Paredes-López, O. (2015). Edible mushrooms: improving human health and promoting quality life. *International Journal of Microbiology*, 2015(1), 376387. https://doi.org/10.1155/2015/376387

https://doi.org/10.26656/fr.2017.8(S8).13