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Physicochemical Properties and Sensory Evaluation of Rice Paper Incorporated with Jackfruit Seed Flour

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Abstract

Rice papers made of non-glutinous rice are a common food item in Vietnam and Thailand. Known as Banh Da Nem in Vietnam, these rice papers are frequently used in preparing the traditional dish called Vietnamese spring rolls. Jackfruit seeds are rich in starch, which has the ability to absorb moisture and reduce stickiness in rice paper by absorbing excess water. This study employed a simplex lattice mixture design method to determine the optimal formulation, featuring various mixture proportion of ingredients jackfruit seeds flour (JSF), rice flour (RF), and tapioca flour (TF) to formulate rice paper incorporating jackfruit seeds. Among the seven formulations, three were successfully in production. Five samples, including a control and commercial rice paper, were studied. The physicochemical properties (moisture content, protein content, tensile strength, thickness, and colour) and sensory characteristics of rice paper incorporated with jackfruit seed flour samples were evaluated to identify the best formulation for comparison with control and commercial rice paper samples. The sensory evaluation revealed that panellists accepted rice paper incorporated with jackfruit seeds samples, with sensory scores ranging from 6 to 7. Formulation 2, comprising 33% rice flour, 33% tapioca flour, and 33% jackfruit seeds flour, was identified as the most acceptable formulation, displaying 9.10 ± 0.31% moisture content, 2.27 g/100g protein content, and 0.94 ± 0.0mm thickness. The incorporation of jackfruit seed flour in rice paper samples for Formulation 1, Formulation 2, and Formulation 3 resulted in higher values for L* (25.71-34.86), a* (0.45-3.19), and b* (-3.77-3.15). Jackfruit seed flour is naturally gluten-free. In recipes that traditionally use gluten-containing flours, the use of jackfruit seed flour can provide a non-sticky alternative. In this study, incorporating jackfruit seed flour into rice paper could indeed offer a potential solution for achieving a low-stickiness surface area while maintaining acceptable sensory and physicochemical properties.

1. Introduction

Rice paper is a thin, transparent paper-like material made from a mixture of rice flour, tapioca flour, water, and sometimes additional ingredients like salt. It is commonly used in Asian cuisines, particularly in Vietnam and Thailand, to create various dishes such as spring rolls and summer rolls [1]. Recognized for its gluten-free composition and low-calorie profile, rice paper has witnessed increased popularity among teenagers, prompting

an exploration into its enhancement through the incorporation of jackfruit seed flour to address the issue of excessive stickiness.

Fruit by-products, a contemporary focus in rice paper development, introduce jackfruit seeds as a potential candidate. Jackfruit seeds, noted for their superior nutrient content compared to other tropical fruits [2], are commonly processed into jackfruit seed flour (JSF). Prior research has highlighted jackfruit seed flour capability to augment specific food products, particularly in texture improvement [3].

Consumer acceptance is paramount in the food industry, and commercial rice paper often falls short in terms of the desired texture, particularly excessive stickiness. Consumers anticipate that new rice paper incorporated with jackfruit seed flour should be both flavourful and exhibit reduced stickiness. This study aims to evaluate the sensory acceptance of modified rice paper incorporating jackfruit seeds.

Significantly, a dearth of existing research exists on the incorporation of jackfruit seed flour into rice paper. This project is undertaken to ascertain the optimal formulation for rice paper incorporating jackfruit seed flour, employing a rigorous sensory evaluation methodology. The identified the best formulation will undergo comparative analysis against both a control and commercially available rice paper. Subsequently, a comprehensive investigation into the physicochemical properties and sensory attributes of rice paper incorporation with jackfruit seed flour will be conducted.

2. Materials and Methods

2.1 Materials and Instruments

The materials used in this study were rice flour, tapioca flour, jackfruit seed flour, water. The instruments used in this research study include a moisture analyzer (MX-50 A&D, Japan), electronic weighing balance (Shimadzu AUW220D), kjeldahl method (Velp Scientifica), colorimeter (Colour Flex, Hunter Lab Inc), food dehydrator (Hendi, UK), digital caliper measuring tool, and tensile strength (TA-XT2i, Stable Micro System, Surrey, England).

2.2 Methods

2.2.1 Preparation of jackfruit seed flour

Jackfruit seeds were cut manually with a sharp knife, and the seeds were collected from the bulbs. The jackfruit seeds were selected for processing. The collected seeds were washed with tap water to remove their impurities. The white aril (seed coats) was peeled off manually. The thin brown spermoderm was removed by cracking or peeling. Jackfruit seeds were dried for 24 hours at 70 ºC using a food dehydrator. Seeds were ground in a grinder to get flour. After grinding, the jackfruit seed flour was sieved to remove any coarse particles or larger particles that did not grind completely [4]. Then, the flour had to be packed into zip lock bags for further use.

2.2.2 Preparation of rice paper incorporated with jackfruit seed flour

The rice paper incorporated with jackfruit seeds was prepared by mixing other ingredients with different proportions of rice flour, tapioca flour, jackfruit seed flour and water. The variations between ingredients were calculated by using Simplex Lattice Design in Design Expert (Stat-Ease, Inc., Trial Version 13). All the ingredients were mixed together and stirring to make sure the flour mix well. The water mainly constant which is 62 ml. The batter was spread thinly on a cloth mold, covered, and steamed for 2 to 3 min. The rice paper sheets were allowed to cool, and then air dried for 24 hours [5]. The control rice paper was prepared using a mixture of 50% rice flour and 50% tapioca flour [6]. The percentage of flour in rice paper incorporated with jackfruit seed flour is presented in table 1 below.

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Table 1 *Ingredients Percentage of Rice Paper Incorporated with Jackfruit Seed Flour*

Formulation	Rice flour (%)	Tapioca flour (%)	Jackfruit seed flour (%)
1	0	0	100
2	33	33	33
3	67	16	16
4	0	50	50
5	16	67	16
6	16	16	67
7	50	0	50

As per the data presented in Table 2, three distinct formulations of rice paper incorporating jackfruit seed flour were implemented among the selected seven formulations, showcasing successful production outcomes. The remaining formulations cannot be used due to the inability to achieve the desired texture after production. Subsequently, a comparative analysis was conducted, comparing these three formulations against both the control and commercially available rice paper, encompassing the study of five samples.

Table 2 *The formulation was selected after proving successful in production*

Formulation	Rice flour (%)	Tapioca flour (%)	Jackfruit seed flour (%)
1	67	16	16
2	33	33	33
3	0	50	50

2.3 Physicochemical properties

This study employed a moisture analyser, a colorimeter, a tensile strength, and a digital caliper measuring tool to evaluate the moisture content, colour [7], stretchability and thickness respectively. Each analysis was performed in triplicate.

2.4 Nutritional analysis

Protein content in the sample was determined by using Kjedahl method according to Association of Official Analytical Chemists (AOAC) Official Method 988.05. For the preparation of reagents, a 40% sodium hydroxide solution was created by dissolving 200g of sodium hydroxide in distilled water in a volumetric flask, with the volume adjusted to 500 mL. Additionally, a 4.0% boric acid solution was prepared by dissolving 20g of boric acid in 500 mL of distilled water in a volumetric flask. The methyl red/bromocresol green indicator was prepared by dissolving 100 mg of methyl red and bromocresol green separately in 95% ethanol and combining them in a ratio of five parts bromocresol green solution to one part methyl red solution. Blank batches, used to subtract reagent effects from sample nitrogen, contained all chemicals used, excluding the sample.

For digestion, approximately 1g of the dried sample was weighed into a Kjeldahl flask. To this, 30 mL of concentrated sulfuric acid (95-97%), 0.4g of copper sulphate, and 3.5g of potassium sulphate were added. The mixture was gradually heated in a fume cupboard to prevent excessive frothing. Digestion proceeded at 400°C for 2.5 to 3 hours until the mixture exhibited an iridescent blue colour. After cooling, the solution was diluted with 100 mL of distilled water [8].

The Kjeldahl technique involves distillation. For this step, 10 mL of the digested solution was added to 10 mL of NaOH (40%) and fixed to the distillation device. Following the completion of distillation, 10 mL of boric acid (4%) was added, along with a mixture of three drops of methyl red and bromocresol green dye, to the ammonia receiving flask. Approximately 25 to 30 mL of the distillate was then collected in a receiving conical flask. The collected solution in the receiving conical flask was then titrated with 0.1M HCl in the last step, and the titre was then recorded. The calculation of nitrogen percentage and protein percentage in the sample was determined by using the following equations.

$$\%Nitrogen = [\frac{mL\ (titre - B \times M\ HCl \times dilution\ factor \times 14.007)}{mg\ sample \times 10}] \times 100$$

Where, $MHCl$ = molarity of hydrochloric acid
B = blank

$$\%P = \%N \times C?$$

Where, P = protein
N = nitrogen
CF = conversion factor

2.5 Sensory evaluation

The sensory analysis of rice paper incorporated with jackfruit seeds was done by 9-point hedonic rating scale and involved 60 panellists [9]. The rice paper incorporated with jackfruit seeds was evaluated for different sensory attributes, including colour, aroma, texture, taste and overall acceptability.

2.6 Statistical analysis

The average value obtained for each sensory attribute of each formulation of rice paper incorporated with jackfruit seed was calculated and used to determine the formulation with highest acceptability and degree of liking. At the same time, ANOVA will be used to determine significant differences between sensory data for all formulations of rice paper incorporated with jackfruit seeds. All physicochemical properties of rice paper incorporated with jackfruit seeds were conducted in triplicate and expressed in means of three replicates and standard deviation which was calculated by using IBM SPSS Statistics 22[10].

3. Results and Discussion

3.1 Physicochemical properties

The physicochemical properties of all 5 formulations of rice paper incorporated with jackfruit seeds were analysed including moisture content, protein content, tensile strength, thickness and colour. With this, the results for these physicochemical properties were tabulated in Table 3 below respectively.

Table 3 *Experimental results of physicochemical properties of rice paper incorporated with jackfruit seeds*

Samples	Moisture Content (%)	Protein Content (g/100g)	Tensile Strength		Thickness (mm)	Colour		
			Force	Distance		L*	a*	b*
Control	8.60 ± 0.33^{d}	2.91	0.20 ±0.00^{a}	-4.10±1.90^{a}	0.52 ±0.08^{c}	27.97 ± 0.94^{c}	0.17 ± 0.28^{c}	-3.44 ± 0.65^{b}
Commercial	13.00 ± 0.39^{a}	0.6	0.13 ±0.05^{ab}	-13.23 ±7.20^{a}	0.19± 0.01^{d}	31.76 ± 0.51^{b}	-0.71± 0.01^{d}	-3.92 ± 0.05^{b}
Formulation 1	9.58 ± 0.16^{bc}	1.76	0.13± 0.05^{ab}	-3.20 ±1.51^{a}	0.78 ±0.04^{b}	25.71 ± 0.32^{d}	0.45 ± 0.20^{c}	-3.77 ± 0.22^{b}
Formulation 2	9.10 ± 0.31^{cd}	2.27	0.10 ±0.00^{b}	-6.06 ±2.07^{a}	0.94± 0.00^{ab}	27.28 ±0.02^{cd}	0.96 ±0.01^{b}	-3.14 ± 0.03^{b}
Formulation 3	10.26 ± 0.31^{b}	1.86	0.10± 0.00^{b}	-10.43 ±4.68^{a}	1.04± 0.10^{a}	34.86 ± 1.15^{a}	3.19 ± 0.23^{a}	3.15 ± 0.71^{a}

Value was expressed in mean ± standard deviation. The means with different lower case letters (a,b,c,d) in the same column are significantly different at(p<0.05). Formulation 1(67% RF+16% TF+16% JSF), Formulation 2(33% RF+ 33%TF +33% JSF), Formulation 3(50% TF+ 50% JSF)

3.1.1 Moisture content

Based on Table 3, all samples achieved a moisture content of less than 14%, meeting conditions unfavourable for microbial growth [11]. Among the samples incorporating jackfruit seeds flour, Formulation 2 exhibited the lowest moisture content at 9.10%, outperforming Formulations 1 and 3. However, control rice paper without jackfruit

seeds flour recorded the lowest moisture content at 8.60%, proving to be the most effective in preventing microbial growth. In contrast, commercial rice paper had a higher moisture content at 13.00%. Commercial has the higher moisture content due to maintain flexibility and prevent the sheets from becoming too brittle (12). The effectiveness of sun drying, employed in the production of rice paper with jackfruit seeds flour, is highly dependent on weather conditions. The drying process on different days can affect the moisture content ofrice paper. Sunlight and warm temperatures are essential for successful drying, so the process may be slower or less effective during cloudy or rainy days.

3.1.2 Protein content

In the earlier research, the protein content was reported to fall within the range of 5% to 7%; nevertheless, none of the samples reached these protein levels [13]. The protein content ranged from 1.76 to 2.27 g/100g in samples incorporating jackfruit seeds flour, with Formulation 2 showing the highest protein content at 2.27 g/100g, surpassing Formulations 1 and 3. Unexpectedly, the control sample (presumed standard rice paper) recorded the highest protein content at 2.91 g/100g compared to other samples, while commercial rice paper had the lowest protein content at 0.6 g/100g.

The formulation 2 has higher protein content than the formulation 3 due to protein content of the ingredients which is rice flour contains about 5.95-9.4 grams of protein per cup. The combination of rice flour, tapioca flour and jackfruit seed flour may result more balanced amino acid profile, contributing to the overall higher protein in the Formulation 2. Commercial rice paper typically has low protein content as it is primarily made from rice flour and water, both low in protein [14].

3.1.3 Tensile strength

In testing the tensile strength of rice paper, the maximum force the rice paper can withstand before breaking or tearing apart was measured. The force applied during stretching and the subsequent recovery of the rice paper after force removal can indicate its elasticity. The control rice paper demonstrated the highest mean force at 0.20 ± 0.00, signifying its superior strength and resistance to tearing or breaking. However, Formulations 1,2 and 3 exhibit lower stretchability and were prone to tearing easily. No significant difference was observed among all samples at a significance level of ($p < 0.05$). The increase in the percentage of jackfruit seed flour led to a decrease in the force value. Consequently, the incorporation of jackfruit seed flour did not enhance the tensile strength and stretchability of rice paper.

The distance over which the material elongates provides information about its flexibility and ductility. A higher elongation at break suggests greater flexibility and the ability to deform before failure. Formulation 1 has the highest mean distance which is -3.20 ±1.513 whereas commercial has the lowest distance mean which is 13.23±7.20. The greater the distance that can be pulled by the rice paper, it indicates that the rice paper has stronger elasticity and is less prone to tearing. Conversely, if the rice paper breaks with minimal stretching, it may be considered more brittle, and the distance at which it breaks helps determine this characteristic.

3.1.4 Thickness

The thickness of rice paper plays a crucial role in determining its strength and resistance to tearing or breaking. Increased thickness generally enhances these properties. However, an elevated incorporation of jackfruit seed flour does not sustain this resistance and results in easier breakage of the rice paper.

According to Table 3, Formulation 3 exhibits the highest mean thickness at 1.04mm, while commercial rice paper has the lowest mean thickness at 0.19mm among the rice paper samples. A significant difference in thickness exists between commercial rice paper and the other samples at a significance level of ($p < 0.05$). The incorporation of jackfruit seed flour contributes to the enhanced thickness, as the percentage of jackfruit seed flour increases, leading to a thicker surface area of the rice paper.

3.1.5 Colour

The colour of a food product provides consumers with an almost immediate impression of its freshness, flavour, and overall quality, influencing their decision to purchase or select the item [15]. In the case of rice paper, colour plays a crucial role in determining its quality. Therefore, the colour of rice paper was analysed, and results were recorded, with L* representing the lightness of the rice paper sample, a* representing chromaticity from red to green, and b* representing chromaticity from yellow to blue.

Referring to Table 3, among all five samples, Formulation 3 achieved the highest L* value, representing lightness, at 34.86, while the control had the lowest value at 27.97. However, despite having a higher L* value, Formulation 3 appears darker, possibly influenced by the colour of individual ingredients. Jackfruit seed flour, being darker than tapioca flour, contributes to a darker appearance, impacting the L* value. For a* and b*, Formulation 3 has higher values of 3.19 and 3.15, indicating a more reddish and yellowish hue. The higher

percentage of jackfruit seed flour in Formulation 3 contributes to a brown colour due to the presence of pigments like anthocyanins [16].

3.2 Sensory Evaluation

Table 2 below shows the results for the sensory evaluation test for all 3 formulations of rice paper incorporated with jackfruit seeds, including colour, texture, aroma, taste and overall acceptability. Overall, the results showed that there was a significant difference between all formulations in terms of colour, texture, aroma, taste and overall acceptability ($p<0.05$).

Table 4 *Result for sensory evaluation of rice paper incorporated with jackfruit seed flour*

Samples	Colour	Texture	Aroma	Taste	Overall Acceptability
Control	7.08 ± 1.25^{a}	7.17 ± 1.18^{a}	7.28 ± 1.23^{a}	7.00 ± 1.22^{b}	7.10 ± 1.24^{b}
Commercial	6.98 ± 1.94^{a}	5.93 ± 2.20^{b}	6.00 ± 2.09^{b}	6.58 ± 1.89^{b}	6.53 ± 1.89^{b}
Formulation 1	7.32 ± 1.82^{a}	6.68 ± 1.82^{a}	6.38 ± 1.984^{a}	6.62 ± 1.89^{ab}	6.82 ± 1.82^{ab}
Formulation 2	6.87 ± 1.64^{a}	6.82 ± 1.80^{a}	6.32 ± 1.873^{a}	6.97 ± 1.89^{a}	7.20 ± 1.76^{a}
Formulation 3	5.83 ± 2.21^{b}	6.08 ± 2.18^{a}	5.73 ± 2.033^{a}	5.93 ± 2.33^{b}	6.10 ± 2.08^{b}

Value was expressed in mean ± standard deviation. The means with different lower case letters (a,b) in the same column are significantly different at $p<0.05$.

Formulation 1(67% RF+16% TF+16% JSF), Formulation 2(33% RF+ 33%TF +33% JSF), Formulation 3(50% TF+ 50% JSF).

3.2.1 Colour

According to Table 4, Formulation 2 received the highest colour rating at 7.32, making it the most preferred option. In contrast, commercial rice paper received the lowest score at 5.83, indicating it is less preferred. Formulation 3 showed a significant difference from other samples at a significance level of ($p < 0.05$). The colour of rice paper can be differentiated based on the varying percentages of jackfruit seed flour in the sample. A higher percentage in rice paper incorporated with jackfruit seed flour results in a browner and more yellowish colour of the rice paper.

3.2.2 Texture

The control sample also exhibited the highest degree of liking for texture, with an average score of 7.17, while commercial rice paper had the lowest mean score of 5.93. There is a significant difference between commercial rice paper and all other samples at a significance level of ($p < 0.05$). The control rice paper is characterized by greater firmness, attributed to its thick surface area, while commercial rice paper, with a thinner surface area, displays lower firmness. Firmness in rice paper refers to the level of hardness experienced when biting into the rice paper [16]. The addition of jackfruit seed flour reduces stickiness on the surface area of rice paper

3.2.3 Aroma

In aroma assessment, the control achieved the highest mean score (7.28), while Formulation 3 had the lowest mean score (5.73). Significant differences were identified between commercial rice paper and both sample rice papers at a significance level of ($p < 0.05$). Formulation 3 is distinguished by its strong aroma, attributed to its higher percentage of jackfruit seed flour, which imparts a subtle nutty fragrance. The nutty aroma of jackfruit seeds is due to the presence of aromatic compounds, including flavonoids and sulfur derivatives [17]. This unique aroma profile contributes to the distinctive sensory experience of Formulation 3 compared to the other samples.

3.2.4 Taste

Control obtained the highest taste score (7.00), indicating a preferable taste. In contrast, Formulation 3 received the lowest score (5.93), representing a less preferable taste profile. According to the previous study, jackfruit seeds have a nutty flavour [18], which contributes to the bitter aftertaste in Formulation 3. Therefore, Formulation 3 is rated as having the least preferable taste among the samples. The higher percentage of jackfruit seed flour in rice paper is attributed to the distinct taste profile observed in Formulation 3.

3.2.5 Overall

Overall acceptability is a crucial aspect in consumer preferences for food products, influencing new product development and innovation. It provides insights into the preferences of panellists regarding the samples.

Formulation 2 had the highest mean value of 7.20, while Formulation 3 had the lowest mean value of 6.10. Recognized as the optimal choice within the sample set, Formulation 2 was selected as the final formulation for comparison with the control and commercial rice paper. The sensory evaluation results highlight that Formulation 2, comprising 33% Rice Flour + 33% Tapioca Flour + 33% Jackfruit Seeds Flour, can effectively substitute rice paper without compromising various attributes, indicating its favourable reception among consumers. This suggests that Formulation 2 possesses a well-balanced sensory profile, making it a promising alternative in the development of rice paper products.

4. Conclusion

Rice paper incorporated with jackfruit seeds samples was successfully formulated and selected by using simplex lattice mixture design. The sensory evaluation results showed that the panellist accepted all 5 rice paper samples with sensory scores between 6 and . Rice paper formulation 2 had the highest sensory scores for texture, taste and overall acceptability among the other samples. Therefore, the formulation 2 was selected as the best formulation and was compared with control and commercial rice paper. In the study, the physicochemical properties of all five rice paper samples were examined, including moisture content, protein content, colour, and texture. All samples successfully achieved a moisture content within the expected range of 8% to 13%. However, the protein content in samples with jackfruit seed incorporation did not reach the highest expected value. The texture of commercial rice paper differed significantly from the new formulations, suggesting that the new formulation could reduce stickiness in rice paper. The colour measurements (L*, a*, b*) in jackfruit seed-incorporated rice paper were inversely proportional to the quantity of jackfruit seeds. The incorporation of jackfruit seed flour in rice paper samples resulted in higher values for L* (25.71-34.86), a* (0.45-3.19), and b* (-3.77-3.15). In conclusion, substituting jackfruit seeds in rice paper with a combination of rice flour and tapioca flour effectively replaced ingredients in commercial rice paper, with acceptable changes in texture and sensory attributes for consumers. For further studies, some recommendations are suggested. Firstly, study on effect of varying the percentage of jackfruit seed flour in the formulation influences the texture, colour, aroma, taste and overall acceptability of rice paper. Lastly, optimize the formula involves investigating different ratios and combinations of jackfruit seed flour, rice flour and tapioca flour to enhance the formulation for improved physicochemical properties and sensory attributes.

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Conflict of Interest

Authors declare that there is no conflict of interests regarding the publication of the paper.

Author Contribution

The authors confirm contribution to the paper as follows: ***study conception and design:*** *Wan Nur Izzah, Hatijah Basri;* ***data collection:*** *Wan Nur Izzah;* ***analysis and interpretation of results:*** *Wan Nur Izzah;* ***draft manuscript preparation:*** *Wan Nur Izzah, Hatijah Basri. All authors reviewed the results and approved the final version of the manuscript.*

References

[1] Akmal Nizam Mohammed & Farzad Ismail (2013) Study of an entropy-consistent Navier-Stokes flux, International Journal of Computational Fluid Dynamics, 27(1), 1-14, https://doi.org/10.1080/10618562.2012.752573
[2] Corazza, I., Pennucci, F., & Sabina De Rosis. (2021). Promoting healthy eating habits among youth according to their preferences: Indications from a discrete choice experiment in Tuscany. Health Policy, 125(7), 947 https://doi.org/10.1016/j.healthpol.2021.03.014
[3] Ranasinghe, R. A. S. N., Maduwanthi, S. D. T., & Marapana, R. A. U. J. (2019). Nutritional and Health Benefits of Jackfruit (Artocarpus heterophyllus Lam.): A Review. International Journal of Food Science, 2019, 1–12
[4] Tulyathan, V., Tananuwong, K., Songjinda, P., and Jaiboon, N. 2002. Some physicochemical properties of jackfruit (Artocarpus heterophyllus Lam) seed flour and starch. Science Asia, 28: 37-41.
[5] Cameron, S. J., & Hosseinian, F. (2013). Potential of flaxseed in the development of omega-3 rice paper with antioxidant activity. 53(1), 170–175. https://doi.org/10.1016/j.lwt.2012.12.004
[6] Chamchan, R., Chupeerach, C., & On-Nom, N. (2017). Development of rice paper by using geminated Homnin brown rice flour. Progress in Applied Science and Technology, 7(2), 263-270
[7] AOAC (2000). Approved methods of analysis. St Paul, MN: The Association of Official Analytical Chemists.

[8] Jamal, S., Jamil, D., & Khidhir, Z. (2020). Protein Determination in some Animal Products from Sulaymaniyah Markets Using Kjeldahl Procedure. Journal of Food and Dairy Sciences, 11(12), pp. 343–346. https://doi.org/10.21608/jfds.2020.160394
[9] Suphatta Phothiset, & Sanguansri Charoenrein. (2007). Morphology and physicochemical changes in rice flour during rice paper production. Food Research International, 40(2), 266–272. https://doi.org/10.1016/j.foodres.2006.06.002
[10] Phothiset, S., & Charoenrein, S. (2007). Morphology and physicochemical changes in rice flour during rice paper production. Food Research International, 40(2), 266-272.
[11] Nagano H., Shoji Z., Tamura A., Kato M., Omori M. and To K., Dang T. and Le N. (2000). Some characteristics of rice paper of Vietnamese traditional food (Vietnamese spring rolls)- a note. Food Sci. Tech. Res., 6(2): 102-105
[12] Ranalli, R. P., Howell, T. A., & Siebenmorgen, T. J. (2003, January 15). Effects of Controlled Ambient Aeration on Rice Quality During OnFarm Storage. Research Gate;Wiley. https://www.researchgate.net/publication/228483083_Effects_of_Controlled_Ambient_Aeration_on_Rice_Quality_During_On-Farm_Storage
[13] Pang, J., Guan, E., Yang, Y., Li, M., & Bian, K. (2021). Effects of wheat flour particle size on flour physicochemical properties and steamed bread quality. Food Science and Nutrition, 9(9), 4691–4700. https://doi.org/10.1002/fsn3.2008
[14] Jeong, G.-J., Khan, F., Min Jae Kang, Cho, K., Park, G.-W., Jo, D.-M., Park, S., & Kim, Y. (2022). Preparation of rice paper enriched with laver (Pyropia sp.) and tapioca starch with process optimization using response surface methodology. LWT, 160, 113312–113312. https://doi.org/10.1016/j.lwt.2022.113312
[15] Spence, C. (2019). On the changing colour of food & drink. International Journal of Gastronomy and Food Science, 17, 100161.
[16] Benjamat Nopa, Amonwan Phithiphrom, Orapan Sangsee, Phatthamon Srichan, Wanalee Seangpimpa, Renaldi, G., & Rajnibhas Sukeaw Samakradhamrongthai. (2023). Utilization of Plant Flour as an Alternative Ingredient to Develop Gluten-Free Fettuccine Analogue. https://doi.org/10.2139/ssrn.4574205
[17] Roji Waghmare, Memon, N., Gat, Y., Gandhi, S., Kumar, V., & Anil Panghal. (2019). Jackfruit seed: an accompaniment to functional foods. Brazilian Journal of Food Technology, 22. https://doi.org/10.1590/1981-6723.20718
[18] Saleh, M., & Jean-François Meullenet. (2013). Cooked rice texture and rice flour pasting properties; impacted by rice temperature during milling. Journal of Food Science and Technology, 52(3), 1602–1609. https://doi.org/10.1007/s13197-013-1180-y17)Abdel-Haleem, A. M. (2016). Production Of Gluten-Free Rolled Papers From Broken Rice By Using Different Hydrothermal Treatments. Egyptian Journal of Agricultural Sciences, 67(2), 167-179