CURRENT SCIENCE AND TECHNOLOGY
e-ISSN: 2785-8804
VOLUME 5, ISSUE 2, 2025, 42 - 47
DOI: https://doi.org/10.15282/cst.v5i2.12803

RESEARCH ARTICLE

Physicochemical properties, rheological properties and sensory evaluation of bread prepared from different flour formulations

P.K. Hong[1,2]*, S.Y. Chong[1], M.Y. Tey[1]

[1]Faculty of Industrial Sciences and Technology, Universiti Malaysia Pahang Al-Sultan Abdullah, Lebuh Persiaran Tun Khalil Yaakob, 26300 Kuantan, Pahang, Malaysia
[2]Centre for Bioaromatic Research, Universiti Malaysia Pahang Al-Sultan Abdullah, Lebuh Persiaran Tun Khalil Yaakob, 26300, Kuantan, Pahang, Malaysia

Abstract - The rise in the price of wheat flour has caused an increase in manufacturing costs. Partial wheat flour substitution in bread formulations with local ingredients like rice flour and glutinous rice flour is one of the methods to cope with wheat shortage, reduce wheat dependency and wheat price increment problems. The objectives of this study are to investigate the physicochemical, rheological properties of dough and consumer acceptance by using different bread formulations. The relationship between the physicochemical properties of breads, rheological properties of bread and consumer acceptances were studied. The bread was from different flour formulations which were F1 (wheat flour), F2 (20% wheat flour substitution with rice flour) and F3 (20% wheat flour substitution with glutinous rice flour). Physicochemical properties involving pH and TTA were done on both dough and bread while colour and baking loss measurement was done on bread only. Proximate analysis was done by using the bread. In addition, rheological properties were also tested by using dough. The breads for all formulations did not show significant difference in the parameter tested such as the dough pH ($p=0.952$) and bread pH ($p=0.859$) respectively ($p>0.05$). For sensory evaluation, consumer acceptance towards all three bread samples were similar for the attributes including colour, aroma, taste, texture and overall acceptance ($p>0.05$). The physicochemical, rheological properties and consumer acceptances were similar within these breads. Therefore, this research can further study by substituting higher portions of wheat flour with locally produced flours such as rice flour and glutinous rice flour.

Article History
Received : 16 July 2025
Revised : 8 September 2025
Accepted : 17 October 2025
Published : 29 December 2025

Keywords
Wheat flour substitution
Glutinous rice flour
Rice flour
Bread

1. Introduction

The main ingredients required for bread making are yeast, flour, salt, and water. The price of bread in Malaysia has risen recently. This is because the prices of materials for bread-making, such as flour, sugar, and eggs, have been increasing [1]. Factors such as geopolitical tensions between Russia and Ukraine, rising input costs, and inclement weather all contribute to higher wheat prices. Global warming, driven by climate change, reduces crop productivity, leading to global hunger, higher food costs, and making food unaffordable for people in poverty [2]. The global food insecurity problem was worsened by the COVID-19 pandemic [3]. The Ukrainian-Russian war is causing further disruption to the supply chain, leading to supply shortages and significant price increases, which were already exacerbated by the COVID-19 outbreak [4]. Following the COVID-19 outbreak, the Russia-Ukraine conflict, and climate change, obtaining cheap and healthy food is becoming harder globally [5]. This further worsens food insecurity in low-food-productivity countries like Malaysia, which depends heavily on imported food and raw materials. Therefore, local ingredients such as glutinous rice flour and rice flour were used to partially replace wheat flour in the bread formulation to reduce the cost of bread making and lessen dependency on imported raw materials. In this study, a new bread quality is developed by partially replacing the flour with glutinous flour and rice flour to reduce our country's reliance on imported wheat flour. It was carried out to investigate the physicochemical and rheological properties of dough and consumer acceptance by using different bread formulations. The relationships among the physicochemical properties of breads, the rheological properties of bread, and consumer acceptance were studied.

2. Materials and Methods

2.1 Bread Preparation

In the bread-making process, the ingredients used were wheat flour, rice flour, glutinous flour, yeast, water, and salt, all purchased from the local market. 3 bread formulations were used for sample preparation (Table 1), and each was prepared in triplicate. The first formula, bread made only with wheat flour (F1), served as the control for this experiment. The second and third formulations of bread were partially replaced with 20 %w/w of wheat flour by using rice flour (F2) and glutinous rice flour (F3). For each formulation, the bread was prepared by mixing all the dried ingredients by hand until homogeneous, then adding water. The dough was kneaded and left to rise at room temperature for 1 hour. Then the dough was deaired, shaped into 50 g portions, and incubated at room temperature for another 1 hour. The dough was baked at 200°C for 20 minutes. Once baking was complete, the bread was left to cool, then packed and sealed in polypropylene plastic bags and kept frozen until use.

***CORRESPONDING AUTHOR | P.K. Hong** | ✉ hongp@umpsa.edu.my

Table 1. Ingredients used for bread sample preparation

Ingredient	Weight (g)		
	F1	F2	F3
Wheat flour	500.0	400.0	400.0
Rice flour	-	100.0	-
Glutinous rice flour	-	-	100.0
Water	325.0	325.0	325.0
Yeast	15.0	15.0	15.0
Salt	7.5	7.5	7.5

2.2 Physicochemical Analysis

For the physicochemical analyses, the pH of the dough and breads was measured with a pH meter, and 0.1 M sodium hydroxide was used to determine total titratable acidity (TTA). For colour measurement, a colourimeter was used to measure the bread crust colour in terms of L*, a*, b*, C* and h*. All the readings were analysed three times to determine the average values.

2.3 Rheological Analysis

For rheological properties, elasticity, extensibility, resistance to deformation, and viscosity of the dough were tested using a MCR 102 rheometer. The amplitude test was run, followed by a frequency sweep, to determine the shear strain. The shear strain obtained from the amplitude sweep was used in the frequency sweep by increasing the frequency from 0.1 to 10 Hz.

2.4 Sensory Evaluation

In the sensory evaluation, panellists were recruited from the staff and students of Universiti Malaysia Pahang Al-Sultan Abdullah. To prevent any bias in the presentation order, random three-digit codes were assigned to each bread sample [6]. Clear instructions were given to the panellists verbally before they entered the booth area and in writing in the provided questionnaire. For the questionnaire, a nine-point scale ranging from 1 (‘dislike extremely’) to 9 (‘like extremely’) was provided for the evaluation of bread samples [7].

3. Results and Discussion

3.1 Physicochemical Analysis

The pH values of dough and bread across the three flour formulations were not significantly different (p>0.05). A slightly acidic condition, with a pH range of 4.5 to 6, was favoured by yeast for optimal performance [8]. F2 had the lowest value, 4.66 ± 0.51 for dough and 5.18 ± 0.31 for bread (Table 2). This agrees with a previous study showing that the bread dough's gas-forming capability is boosted by incorporating rice flour, which promotes fermentation and the production of sugar [9]. The pH value of dough is lower than that of bread because the formation of acid during dough fermentation results in a drop in pH value. The low pH values obtained indicate that the dough and bread samples across all formulations were slightly acidic. The TTA measurements of dough and bread were similar across formulations (p>0.05). F2, with the lowest pH value, obtained the highest TTA value of 10.80 ± 5.15 for dough and 6.67 ± 2.02 for bread. The TTA value is inversely proportional to the pH value [10]. Opposite to that of pH, the TTA of bread was lower than the TTA of dough for all three flour formulations. This is due to the loss of acetic acid during baking, which results in a slight increase in pH and a decrease in TTA [11].

Table 2. pH measurement and total titratable acid for all formulations of bread and dough samples

Formulation	pH		Total Titratable Acid	
	Dough	Bread	Dough	Bread
F1	4.78 ± 0.45	5.28 ± 0.26	7.57 ± 3.21	6.07 ± 2.21
F2	4.67 ± 0.51	5.18 ±0.31	10.80 ± 5.15	6.67 ± 2.02
F3	4.73 ± 0.49	5.27 ± 0.12	9.83 ± 6.71	5.70 ± 2.69

Table 3 presents the colour measurements for all bread formulations. The colour differences among the 3 types of bread prepared from different formulations were not significant, and their colours were almost the same (p>0.05). The L* with a p-value of 0.066 showed the most tendency to become significant. The L* value, which indicates lightness, was the highest for F3 (64.63 ± 6.82), followed by F1 (58.99 ± 9.02) and F2 (55.31 ± 8.23). This means that F3 is the whitest bread. According to Ronie et al. [12], low Maillard reaction levels result in gluten-free bread crusts that are lighter than those of pure wheat bread. Similar observations were obtained for F3. Wheat flour has higher free amino acid and protein content, which enhances the rate of the Maillard reaction and produces a darker crust colour [13]. All the a* values for the 3 bread types are positive, indicating redness. No significant difference was detected for the a* value of breads with a p-value of p=0.305 (p>0.05). F1 had the highest a* value of 10.51 ± 3.66, F2 had the second highest value of 9.94 ± 4.38, while F3 had the lowest value of 7.86 ± 4.47. The b* value relates to the blue or yellow colour of bread, with positive values indicating yellow, while negative values indicate blue. Chroma was represented by the C* value, a measure of colour strength that corresponds to colour saturation [14]. For h*, which indicates hue is related to the origin of colours like primary and secondary colours, but not mixed colours like tertiary colours. The bread samples in this experiment were commonly brown in colour. Brown can be formed by mixing the primary colours red, yellow, and blue. In general, all 3 types of formulation give rise to bread with the lowest redness (a*) value, low yellowness (b*), low chroma (C*), higher lightness (L*), and higher hue (h*).

Table 3. Colour measurement for all formulations of breads

Colour space	F1	F2	F3
L*	58.99 ± 9.02	55.31 ± 8.23	64.63 ± 6.82
a*	10.51 ± 3.66	9.94 ± 4.38	7.86 ± 4.47
b*	21.57 ± 3.32	21.37 ± 3.10	22.19 ± 2.76
C*	24.25 ± 3.20	23.77 ± 4.20	23.79 ± 3.78
h*	64.15 ± 9.09	65.84 ± 8.17	71.69 ± 9.37

3.2 Rheological Analysis

The rheological characteristics of the dough were closely linked to the viscoelastic behaviour of the gluten network, which ultimately influences the dough's and product's attributes. Variations of storage modulus (G′) and loss modulus (G″) as a function of frequency for the dough samples (Figure 1). The value of G’ and G’’ for three of the formulations expands with an increase in the frequency. The loss modulus, G’’, for F2 and F3 was higher than that of F1. This increase might be attributed to differences in the interaction between starch and gluten in different flour combinations, where F1 was made from pure wheat flour. In contrast, F2 and F3 were made from partially substituted wheat flour with 25% glutinous rice flour and rice flour. The starch granules in the dough act as fillers, reinforcing the gluten and forming strong bonds [15]. The storage modules, G’ of the dough for three of the formulations, are always greater than the loss modulus G’’. This indicates that the dough exhibited elastic solid behaviour [18]. The value of G’ and G’’ of F3 were all greater than the corresponding G’ and G’’ values for dough of F2, then followed by dough of F1, which showed that F3 dough was the hardest dough, then followed by F2 and F3 [16]. Harder dough indicated a compact bread texture, leading to a less desirable taste compared with the other 2 formulations [17].

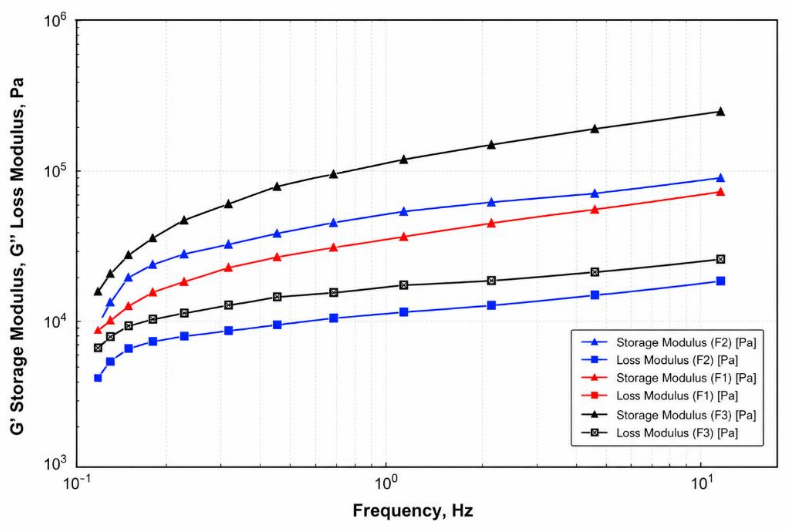

Figure 1. Frequency sweep for three formulations of dough

3.3 Sensory Evaluation

The differences in the flour composition of wheat flour, rice flour, and glutinous rice flour used might contribute to differences in colour, aroma, taste, texture, and overall acceptance of the bread. According to the ANOVA result, there was no significant difference among the colours for the 3 types of bread (p=0.368, p>0.05). In terms of colour, F1 obtained the highest score of 6.79 ± 1.56, F2 obtained the second highest score of 6.47 ± 1.98, while F3 obtained the lowest score of 6.30 ± 2.04. According to Anastopoulo [18], when bread comes out of the oven, it should be in a rich, deep golden-brown colour. This is mainly due to the browning process during baking, which is important for both nutritional and sensory aspects, including colour formation and flavour synthesis [19]. The panels prefer the colour of F1 bread because it is closest to the well-baked golden-brown colour of bread crust. On the other hand, F3 bread’s colour is the least preferred, maybe due to its pale crust colour.

In this study, both the taste and aroma of the bread were found to be similar despite differences in their formulations (p>0.05). During eating or drinking, the taste and aroma interact [20]. Both aroma and taste showed similar trends, with F1 achieving the highest score and F2 the lowest. Based on the research by Tamanna and Mahmood [21], the flavours and aromas formed during cooking can be attributed to the Maillard reaction. The Maillard process produces flavour precursors, which are necessary intermediates for the development of the distinctive aroma or fragrance molecules found in bread. The ratio of raw materials, the time the dough proofs, and the type of leavening agent used all affect the bread's baking flavour [22]. The differences in the amounts of various flours among the 3 bread formulations might affect the baked bread's taste. The overall perception of a mixture of flavours can be enhanced by altering the concentrations of protein, starch, and fat [23]. For the aroma of the bread samples, some panellists described the F2 bread as having a strong yeasty smell, while others said it had a slightly sourdough-like aroma. The low scores for F2 bread's aroma and taste may be due to its stronger sour taste compared to F1 and F3 bread. Most of the panels might be more familiar with Asian-style buns, which are commonly soft, springy, and sweet, leading them to prefer the taste of F2 bread least [24].

Table 4 presents the sensory attributes for the 3 bread formulations tested. For the texture attribute, there was no significant difference among the 3 bread types ($p=0.944$; $p>0.05$). Similar to the aroma and taste, F1 ranked first for texture, while F2 ranked last. Many panellists suggested that F2 bread was the hardest, while F1 was the softest bread among the 3 different breads. This is in alignment with Durai (2021) [25], by which softer and lighter breads are more favoured by Malaysians. Flour type is one of the factors impacting bread texture [26]. Different types of flour yield different amounts of protein [27]. The texture and bread volume can be influenced by the amount of protein present [28]. Rice flour and glutinous rice flour are gluten-free flours. The absence of gluten makes it difficult for dough to form networks during breadmaking, reducing volume, yielding a rigid texture, and degrading the end product's sensory qualities [29]. Similar observations were obtained when wheat bread was compared to gluten-free bread, showing outstanding texture characteristics [12]. F1 bread, which was made from wheat flour that contains more protein when compared to F2 and F3 bread, involved partial wheat flour substitution with rice flour or glutinous rice flour. The gluten network development in F2 and F3 bread may be affected, increasing the bread's hardness by reducing the dough's ability to retain gas and decreasing the specific volume. Overall, F1 was ranked first (5.89 ± 1.87), F3 was ranked second (5.70 ± 2.14), and F2 was ranked last (5.44 ± 2.07). The p-value of 0.485 ($p>0.05$) indicates that there was no significant difference in overall acceptance among the 3 types of bread. F1 bread was the most preferred bread among the other formulations in terms of its colour, aroma, taste, texture, and overall acceptance, as it obtained the highest score in all of these sensory attributes. However, all the sensory attributes were similar for the various flour formulations ($p>0.05$). In short, the panels showed similar liking for the bread with or without partial wheat flour substitution.

Table 4. Sensory attributes for the 3 bread formulations tested

Attributes	F1	F2	F3
Colour	6.79 ± 1.56	6.47 ± 1.98	6.30 ± 2.04
Aroma	6.37 ± 1.82	5.82 ± 1.97	6.02 ± 2.02
Taste	5.77 ± 2.06	5.33 ± 2.22	5.53 ± 2.40
Texture	4.98 ± 2.18	4.84 ± 2.27	4.94 ± 2.42
Overall Acceptance	5.89 ± 1.87	5.44 ± 2.07	5.70 ± 2.14

4. Conclusions

Physicochemical, rheological, and sensory analyses were carried out on different formulations. There is no difference in the mean physicochemical properties across all formulations ($p>0.05$). For the rheological properties of bread, the dough from all formulations showed a similar trend, where G' of the dough for three of the formulations is always greater than loss modulus G''. This indicates that the dough exhibited elastic solid behaviour. The value of G' and G'' of F3 were all greater than the corresponding G' and G'' values for the dough of F2, followed by the dough of F1, which showed that the F3 dough was the hardest, followed by F2 and F3. All sensory attributes, including colour, aroma, taste, texture, and overall acceptance, for the breads made from the three different formulations were similar ($p>0.05$). In terms of sensory evaluation, this indicates that the panels had similar liking towards the bread with (100% wheat flour) or without partial wheat flour substitution (20% wheat flour substitution with rice or glutinous rice flour). Hence, both bread formulations with partial substitution of wheat flour with rice flour and glutinous rice flour are well accepted by general consumers.

Acknowledgements
The authors express their gratitude to the Faculty of Industrial Sciences and Technology, Universiti Malaysia Pahang, and Al-Sultan Abdullah for allowing us to complete this project.

Funding
This study was not supported by any grants from funding bodies in the public, private, or not-for-profit sectors.

Declaration of Competing Interest
The author declares no conflicts of interest.

CRediT Authorship Contribution Statement
T P.K. Hong: Conceptualisation, Formal analysis, Writing - review & editing, Supervision
S.Y. Chong: Methodology, Data curation, Writing - original draft; Resources
M.Y. Tey: Methodology, Data curation, Writing - original draft.

Availability of Data and Materials
The data supporting this study's findings are available on request from the corresponding author.

Ethics Declarations
This study did not involve human participants or animals. Ethical approval was therefore not required.

Generative Artificial Intelligence Declarations
The authors claim that artificially intelligent-assisted technologies, such as generative AI, were not used to generate content, ideas, or theories. We have just utilised AI to enhance readability and refine the language. This was used with extreme human control and oversight. The authors take full responsibility for reviewing and approving the content.

References

[1] B.J. Bhosale, "Wheat prices rise 4% in two weeks," *The Economic Times*, May 18, 2023. [Online]. Available: https://economictimes.indiatimes.com/news/economy/agriculture/wheat-prices-rise-4-in-two-weeks/articleshow/-100337983.cms

[2] M.M. Abdullah, A.D.H. Aldughpassi, J.S. Sidhu, M.Y. Al-Foudari, A.R.A. Al-Othman, "Effect of psyllium husk addition on the instrumental texture and consumer acceptability of high-fibre wheat pan bread and buns," *Annals of Agricultural Sciences*, vol. 66, no. 1, pp. 75–80, 2021. https://doi.org/10.1016/J.AOAS.2021.05.002

[3] I. Elahi, U. Saeed, A. Wadood, A. Abbas, H. Nawaz, S. Jabbar, "*Effect of climate change on wheat productivity*," Wheat, IntechOpen, Nov. 16, 2022. https://doi.org/10.5772/INTECHOPEN.103780

[4] U.S. Global Leadership Coalition (USGLC), "COVID-19 Brief: Impact on Food Security," Apr. 2022. [Online]. Available: https://www.usglc.org/coronavirus/global-hunger/

[5] T. Ben Hassen, H. El Bilali, "Impacts of the Russia-Ukraine war on global food security: Towards more sustainable and resilient food systems?" *Foods*, vol. 11, no. 15, p. 2301, 2022. https://doi.org/10.3390/FOODS11152301

[6] A. Hazim, "Malaysia's food supply unsustainable in the long term, say experts," *The Malaysian Reserve*, Dec. 5, 2022. [Online]. Available: https://themalaysianreserve.com/2022/12/05/malaysias-food-supply-unsustainable-in-the-long-term-say-experts/

[7] S.E. Choi, Sensory Evaluation, Burlington, MA: Jones & Bartlett Learning, 2013.

[8] A. Gámbaro, M.B. McSweeney, "Sensory methods applied to the development of probiotic and prebiotic foods," *Advances in Food and Nutrition Research*, vol. 94, pp. 295–337, 2020. https://doi.org/10.1016/BS.AFNR.2020.06.006

[9] Bake Magazine, "*The science of fermentation*," Jun. 19, 2015. [Online]. Available: https://www.bakemag.com/articles/836-the-science-of-fermentation

[10] K. Saito, M. Okouchi, M. Yamaguchi, T. Takechi, Y. Hatanaka, K. Kitsuda et al., "Quality improvement of gluten-free rice flour bread through the addition of high-temperature water during processing," *Journal of Food Science*, vol. 87, no. 11, pp. 4820–4830, 2022. https://doi.org/10.1111/1750-3841.16333

[11] A. Sandra, Y.F. Kurnia, A. Sukma, E. Purwati, "The chemical characteristics of yoghurt (Lactobacillus fermentum MGA40-6 and Streptococcus thermophilus) with additional puree from Senduduk fruit (Melastoma malabathricum, L.)," *IOP Conference Series: Earth and Environmental Science*, vol. 287, no. 1, p. 012024, 2019. https://doi.org/10.1088/1755-1315/287/1/012024

[12] A.M. Galal, J.A. Johnson, E. Varriano-Marston, "Lactic and volatile (C2-C5) organic acids of San Francisco sourdough french bread," *Cereal Chemistry*, vol. 55, no. 4, pp. 461–468, 1978. [Online]. Available: https://www.cerealsgrains.org/publications/cc/backissues/1978/Documents/chem55_461.pdf

[13] M.E. Ronie, H. Mamat, A.H. Abdul Aziz, M.K. Zainol, "Proximate compositions, texture, and sensory profiles of gluten-free bario rice bread supplemented with potato starch," *Foods*, vol. 12, no. 6, p. 1172, 2023. https://doi.org/10.3390/FOODS12061172

[14] E. Capuano, G. Garofalo, A. Napolitano, H. Zielinski, V. Fogliano, "Rye flour extraction rate affects maillard reaction development, antioxidant activity, and acrylamide formation in bread crisps," *Cereal Chemistry*, vol. 87, no. 2, pp. 131–136, 2010. https://doi.org/10.1094/CCHEM-87-2-0131

[15] D. Urbonavičienė, P. Viškelis, J. Viškelis, J. Jankauskienė, and Č. Bobinas, "Lycopene and β-carotene in non-blanched and blanched tomatoes," *Journal of Food, Agriculture & Environment*, vol. 10, no. 2, pp. 142–146, 2012.

[16] H.P. Sivaramakrishnan, B. Senge, P.K. Chattopadhyay, "Rheological properties of rice dough for making rice bread," *Journal of Food Engineering*, vol. 62, no. 1, pp. 37–45, 2004. https://doi.org/10.1016/S0260-8774(03)00169-9

[17] X. Zhang, Z. Wang, L. Wang, X. Ou, J. Huang, G. Luan, "Structural support of zein network to rice flour gluten-free dough: Rheological, textural and thermal properties," *Food Hydrocolloids*, vol. 141, p. 108721, 2023. https://doi.org/10.1016/J.FOODHYD.2023.108721

[18] M.M. Abdullah, A.D.H. Aldughpassi, J.S. Sidhu, M.Y. Al-Foudari, A.R.A. Al-Othman, "Effect of psyllium husk addition on the instrumental texture and consumer acceptability of high-fiber wheat pan bread and buns," *Annals of Agricultural Sciences*, vol. 66, no. 1, pp. 75–80, 2021. https://doi.org/10.1016/J.AOAS.2021.05.002

[19] R. Anastopoulo, "*A visual guide to bread baking*," King Arthur Baking, 2023. [Online]. Available: https://www.kingarthurbaking.com/blog/2023/12/07/visual-guide-bread-baking

[20] E. Purlis, "Browning development in bakery products – A review," *Journal of Food Engineering*, vol. 99, no. 3, pp. 239–249, 2010. https://doi.org/10.1016/J.JFOODENG.2010.03.008

[21] A.C. Noble, "Taste-aroma interactions," *Trends in Food Science & Technology*, vol. 7, no. 12, pp. 439–444, 1996. https://doi.org/10.1016/S0924-2244(96)10044-3

[22] N. Tamanna, N. Mahmood, "Food processing and maillard reaction products: Effect on human health and nutrition," *International Journal of Food Science*, vol. 2015, no. 1, p. 526762, 2015. https://doi.org/10.1155/2015/526762

[23] Y. Yang, X. Zhao, R. Wang, "Research progress on the formation mechanism and detection technology of bread flavor," *Journal of Food Science*, vol. 87, no. 9, pp. 3724–3736, 2022. https://doi.org/10.1111/1750-3841.16254

[24] L. Qin, X.H. Huang, "Flavor perception in food: Aroma, taste, texture interactions and effects of processing," *Foods*, Special Issue, 2023.

[25] A. Saini, "*Technique Thursdays: Why asian breads are softer than European breads. Michelin guide*, 2017. [Online]. Available: https://guide.michelin.com/en/article/features/technique-thursdays-why-asian-breads-are-soft

[26] A. Durai, "*Rising to the occasion*," The Star Malaysia, Dec. 5, 2021. [Online]. Available: https://www.pressreader.com/malaysia/the-star-malaysia-star2/20211205/281479279701334

[27] K. Sullivan, "*The texture of bread*," 2020. [Online]. Available: https://www.kingsleysullivan.com/post/the-texture-of-bread

[28] K. Pradhan, "*Types of flour to know for baking*," Simply Recipes, 2022. [Online]. Available: https://www.simplyrecipes.com/your-guide-to-flour-how-it-s-made-wheat-grain-types-and-how-protein-content-affects-baking-5208494

[29] Marubishi Malaysia, "*How flour characteristics affect the bread's aroma, flavor and texture*," 2023. [Online]. Available: https://marubishi-group.com/blogs/news/how-flour-characteristics-affect-the-breads-aroma-flavor-and-texture

[30] H. Dan, Z. Gu, C. Li et al., "Effect of fermentation time and addition amount of rice sourdoughs with different microbial compositions on the physicochemical properties of three gluten-free rice breads," *Food Research International*, vol. 161, p. 111889, 2022. https://doi.org/10.1016/J.FOODRES.2022.111889