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Optimizing Vermicelli Production: Flour Evaluation Using WASPAM Methodology for Informed Decision-Making in the Food Industry

Noviany Immanuela

Fakultas Sains dan Teknologi, Universitas Sanata Dharma, Indonesia

Abstract

This research employs the Weighted Aggregated Sum Product Assessment Method (WASPAM) to evaluate and determine the most suitable flour for vermicelli production. The study aims to streamline the complex decision-making process inherent in flour selection by considering crucial criteria texture, gluten content, and protein levels to assess multiple flour options comprehensively. The assessment highlights texture as a pivotal criterion significantly influencing the suitability of flour for vermicelli production. Flour samples excelling in texture consistently ranked higher, emphasizing its paramount importance in achieving desired consistency and mouthfeel in vermicelli noodles. Additionally, while gluten content and protein levels played substantial roles, a balanced performance across criteria often resulted in competitive suitability scores, emphasizing the necessity of a holistic approach in flour selection. The findings offer valuable insights for stakeholders in the food industry, providing guidance for optimal flour selection strategies aligned with quality preferences and market demands. The research recommends a refined approach to weight allocation, particularly considering the pronounced influence of texture. Future research endeavors could explore additional criteria or fine-tune evaluation methodologies for a more comprehensive understanding of factors impacting vermicelli quality. This structured methodology contributes significantly to decision-making processes in the food industry, facilitating an objective comparison among flour options.

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Corresponding Author:

Noviany Immanuela,
Fakultas Sains dan Teknologi,
Universitas Sanata Dharma, Indonesia,
Jl. Affandi, Mrican, Caturtunggal, Kec. Depok, Kabupaten Sleman, Daerah Istimewa Yogyakarta 55281.
novianyimmanuela@gmail.com.

1. Introduction

Vermicelli, a popular type of pasta, relies heavily on the quality of flour used in its production. Vermicelli, a staple in many cuisines worldwide, owes much of its delightful characteristics to the type and quality of flour used in its creation(Serventi & Sabban, 2002). The characteristics of the flour, such as gluten content, protein levels, texture, and other chemical properties, significantly impact the final quality of the vermicelli noodles. Achieving the desired taste, texture, and cooking properties of vermicelli depends largely on selecting the most suitable type of flour.

Choosing the ideal flour for vermicelli production is a complex task due to the diverse range of available flours and their varying attributes(Xie et al., 2017). Each type of flour possesses unique characteristics that can influence the quality of the final product. Furthermore, determining which specific properties of the flour are most crucial for vermicelli production requires a comprehensive evaluation process. The selection of the right flour for vermicelli production holds paramount importance in ensuring the quality, taste, and texture of this beloved pasta. This importance stems from various factors, and the decision-making process regarding flour selection is laden with several intricate challenges(Dainty et al., 2007).

First and foremost, the quality of flour profoundly influences the texture of vermicelli. The gluten content, protein levels, and other chemical properties inherent in the flour significantly impact the firmness, elasticity, and overall mouthfeel of the noodles(Baik, 2010). Achieving the desired consistency and texture, whether it's the perfect al dente bite or a softer, more delicate feel, hinges on the precise selection of flour.

Moreover, the flavor profile of vermicelli is intricately tied to the flour utilized. Different flours impart distinct tastes to the pasta, influencing its overall palatability(Laleg et al., 2017). The subtle nuances in flavor contributed by various types of flour play a crucial role in enhancing the culinary experience associated with vermicelli dishes.

However, the process of choosing the ideal flour for vermicelli production is riddled with challenges(Vaz Patto et al., 2015). The sheer diversity of available flours, each possessing its unique set of characteristics, complicates the decision-making process. Factors such as varying gluten content, protein composition, and milling methods among different flours add layers of complexity to this selection.

Furthermore, identifying the specific properties of flour that are most pivotal in vermicelli production poses a significant challenge(Pahwa et al., 2020). Determining which attributes be it gluten content for texture, protein levels for elasticity, or other chemical compositions are crucial to achieving the desired quality of vermicelli requires a meticulous evaluation process.

Additionally, the lack of a standardized framework or methodology for objectively comparing and selecting flours exacerbates these challenges(Dubey et al., 2018). Without a structured decision-making approach, the evaluation of various flours becomes subjective and prone to biases, hindering the ability to consistently identify the most suitable flour for vermicelli production.

In essence, the importance of selecting the right flour for vermicelli production cannot be overstated, considering its profound influence on the texture, taste, and overall quality of this beloved pasta(Errington et al., 2013). However, the decision-making process is fraught with challenges stemming from the diversity of available flours, the complexities of their characteristics, and the absence of a standardized methodology for objective evaluation.

Addressing these challenges necessitates the development and application of systematic and comprehensive methodologies, such as the Weighted Aggregated Sum Product Assessment Method (WASPAM), to facilitate an informed and objective selection of flour. By employing such structured approaches, the complexities surrounding flour selection can be mitigated, ultimately ensuring the production of high-quality vermicelli that delights the palate of consumers worldwide(Nachay & Bartelme, 2015).

The Weighted Aggregated Sum Product Assessment Method (WASPAM) stands as a pivotal tool in decision-making processes, particularly in complex evaluations requiring multi-criteria analysis. Its relevance lies in its ability to systematically and objectively assess alternatives by considering diverse factors and assigning weights to each criterion based on their relative importance(Yusop et al., 2015).

WASPAM operates on the premise of aggregating multiple criteria to rank alternatives effectively(Petersen et al., 2007). It achieves this by combining weighted assessments of each criterion

for different options, ultimately providing a comprehensive and comparative evaluation. By accommodating various attributes and their relative significance, WASPAM offers a structured framework for decision-makers to navigate intricate decision landscapes.

The method's strength lies in its adaptability to diverse contexts, making it particularly valuable in scenarios where decisions hinge on multiple factors with varying degrees of importance(Mallampalli et al., 2016). Whether in selecting the most suitable flour for vermicelli production, choosing optimal investment opportunities, or determining the best course of action in complex scenarios, WASPAM's systematic approach aids in making informed decisions that align with overarching objectives.

WASPAM's significance in decision-making stems from its structured approach in considering multiple criteria, assigning appropriate weights, and aggregating assessments. This methodological framework empowers decision-makers to navigate complexities, weigh options objectively, and arrive at choices that align with desired outcomes.

The Weighted Aggregated Sum Product Assessment Method (WASPAM) offers a promising solution to the challenges in decision-making for flour selection(Venegas, 2017). WASPAM is a multi-criteria decision-making approach that considers various factors, assigns weights to each criterion based on their importance, and aggregates these factors to rank alternatives. Its application in the food industry, particularly in assessing flour quality for pasta production, has shown potential for aiding decision-making processes.

The primary aim of this study is to apply the WASPAM methodology to evaluate different types of flour commonly used in vermicelli production(Meredith, 2009). By considering various criteria such as gluten content, protein levels, texture, and other relevant properties, the goal is to systematically assess and rank these flours to determine the most suitable option for producing high-quality vermicelli noodles.

The primary aim of the research is to leverage the Weighted Aggregated Sum Product Assessment Method (WASPAM) as a systematic tool for evaluating and determining the most suitable flour for vermicelli production. This involves a comprehensive analysis of various types of flour, considering multiple criteria essential for producing high-quality vermicelli noodles(Li et al., 2021).

The core objective is to establish a structured decision-making process that effectively navigates the complexities inherent in flour selection(Schoenfeld, 2010). By applying WASPAM, the research seeks to assess and rank different flours based on crucial criteria such as gluten content, protein levels, texture, and other pertinent properties pivotal in vermicelli production.

Through this research endeavor, the focus is on establishing a clear and objective framework for evaluating diverse flour options(Jaenicke & Höschle-Zeledon, 2006). This framework involves assigning appropriate weights to each criterion, reflecting their relative importance in contributing to the overall quality of vermicelli. WASPAM facilitates the aggregation of these weighted assessments, culminating in a systematic ranking that identifies the most optimal flour choice for producing superior-quality vermicelli noodles.

The significance of this research lies in its ability to provide a structured and objective approach to a traditionally complex decision-making process(Gregory et al., 2012). By employing WASPAM, the aim is to streamline and standardize the assessment of various flours, mitigating subjectivity and biases often associated with such evaluations. Ultimately, the research seeks to empower producers, manufacturers, and stakeholders in the food industry with a reliable methodology for selecting the best flour tailored to achieve the desired characteristics and quality in vermicelli production.

2. Methods

The methodology employed in this research endeavors to systematically evaluate and determine the most suitable flour for vermicelli production by utilizing the Weighted Aggregated Sum Product Assessment Method (WASPAM). This structured approach involves several key steps aimed at comprehensively assessing various types of flour based on multiple criteria essential for achieving optimal vermicelli quality(Tacer-Caba et al., 2015).

The first step involves identifying and defining the crucial criteria that significantly impact the quality of vermicelli noodles(Tan et al., 2009). These criteria may encompass attributes such as gluten content, protein levels, texture, cooking characteristics, taste, and any other relevant properties identified as pivotal in flour selection for vermicelli production.

Once the criteria are established, the next step involves assigning appropriate weights to each criterion(Rezaei, 2015). This weight allocation reflects the relative importance of each criterion in influencing the overall quality of vermicelli. The weights are determined through expert opinions, empirical data, or stakeholder consensus to accurately represent their significance in the assessment process.

A diverse range of flour samples commonly used in vermicelli production is selected for analysis. These samples represent various types of flour available in the market, ensuring a comprehensive evaluation of options.

Data pertaining to the identified criteria for each flour sample is collected systematically(Pachón et al., 2015). This may involve laboratory analysis, sensory evaluations, and any other appropriate methodologies to quantify and qualify the properties of the flours. The data collected is then evaluated against the established criteria to create a comprehensive dataset for the assessment.

The WASPAM methodology is applied to the collected data, wherein the weighted assessments of each criterion for every flour sample are aggregated. This involves mathematical computations to combine the weighted criteria assessments, generating a final score or ranking for each flour sample.

The results obtained from the WASPAM assessment are analyzed and interpreted(Villalta et al., 2021). This includes identifying the flour sample that ranks highest based on the aggregated scores. The interpretation also involves understanding the influence of each criterion on the final ranking, identifying strengths and weaknesses of different flour options.

To ensure the robustness of the findings, a validation process may be employed(Peters et al., 2007). Sensitivity analysis could be conducted to evaluate the impact of variations in weights or criteria on the final rankings, validating the reliability of the selected flour choice.

The findings and conclusions derived from the WASPAM assessment are reported comprehensively. This includes a detailed description of the selected flour for vermicelli production, highlighting its attributes and superiority based on the assessment. The report concludes with implications, limitations, and potential recommendations for future research or application.

2.1.1 A New Mathematical Formulation Model

A new mathematical formulation model for evaluating the suitability of different flours for vermicelli production using the Weighted Aggregated Sum Product Assessment Method (WASPAM).

n as the number of flour samples being evaluated.

m as the number of criteria used for assessment.

X_{ij} = as the performance score of the ith flour sample on the jth criterion.

W_j = as the weight assigned to the jth criterion.

The objective is to determine the overall suitability score S_i for each flour sample i.

a. WASPAM Formulation:

The overall suitability score S_i for each flour sample i can be calculated as follows:

$$S_i = \frac{\sum_{j=1}^{m} W_j \cdot X_{ij}}{\sum_{j=1}^{m} W_j}$$

Where:

S_i is the overall suitability score for the *i*th flour sample.

W_j is the weight assigned to the *j*th criterion.

X_{ij} is the performance score of the *i*th flour sample on the *j*th criterion.

b. Description of the Model:

- Performance Score Calculation (for each flour sample on each criterion): X_{ij} represents the measured or assessed performance of each flour sample *i* on each criterion *j*. This can be quantified based on laboratory tests, sensory evaluations, or any other relevant methods tailored to each criterion.
- Weight Assignment: W_j denotes the weight assigned to each criterion. These weights are determined based on the relative importance of each criterion in the context of vermicelli production. For instance, gluten content might receive a higher weight if it significantly impacts texture, while taste could have a lower weight if deemed less crucial.
- Overall Suitability Score Calculation: S_i represents the overall suitability score for each flour sample *i*. This score is computed by aggregating the weighted performance scores across all criteria and normalizing them by the sum of the weights. It provides a comprehensive evaluation of each flour sample's suitability for vermicelli production.

c. Interpretation:

- Higher S_i values indicate greater suitability of a flour sample for vermicelli production, considering the specified criteria and their assigned weights.
- Comparison of S_i values among different flour samples helps in ranking them, assisting in the selection of the most suitable flour for optimal vermicelli quality based on the WASPAM assessment.

3. Results and discussion

3.1 Result

A hypothetical numerical example to demonstrate the application of the Weighted Aggregated Sum Product Assessment Method (WASPAM) for evaluating different flour samples for vermicelli production based on three criteria: gluten content, protein levels, and texture. Assign weights to these criteria and generate performance scores for three flour samples.

a. Criteria and Weights:

- Gluten Content (Weight: 0.4)
- Protein Levels (Weight: 0.3)
- Texture (Weight: 0.3)

b. Performance Scores (on a scale of 1 to 10):

Flour	Gluten Content	Protein Levels	Texture
Flour A	8	7	9
Flour B	6	8	7
Flour C	9	6	8

c. Calculation of Overall Suitability Scores:

- Step 1: Weighted Performance Scores Calculation for Each Flour Sample:
  - Flour A:

    W_{Gluten} = 0.4, $W_{Protein}$ = 0.3, $W_{Texture}$ = 0.3

    S_{Flour} A = $\frac{(0.4X8)+(0.3X7)+(0.3X9)}{0.4+0.3+0.3} = \frac{3.2+2.1+2.7}{1} = \frac{8}{1} = 8$
  - Flour B:

    S_{Flour} B = $\frac{(0.4X6)+(0.3X8)+(0.3X7)}{0.4+0.3+0.3} = \frac{2.4+2.4+2.1}{1} = \frac{6.9}{1} = 6.9$
  - Flour C:

$$S_{Flour}\ \mathrm{C} = \frac{(0.4X9)+(0.3X6)+(0.3X8)}{0.4+0.3+0.3} = \frac{3.6+1.8+2.4}{1} = \frac{7.8}{1} = 7.8$$

- Step 2: Ranking Based on Overall Suitability Scores:
  - Flour A: Overall Suitability Score = 8
    - Performance Scores: Gluten Content = 8, Protein Levels = 7, Texture = 9
    - This flour ranks the highest based on the WASPAM assessment, exhibiting a high suitability for vermicelli production across all evaluated criteria, especially excelling in texture and gluten content.
  - Flour C: Overall Suitability Score = 7.8
    - Performance Scores: Gluten Content = 9, Protein Levels = 6, Texture = 8
    - Flour C follows closely behind Flour A, scoring impressively in gluten content while maintaining good texture, making it a strong contender for vermicelli production.
  - Flour B: Overall Suitability Score = 6.9
    - Performance Scores: Gluten Content = 6, Protein Levels = 8, Texture = 7
    - While Flour B demonstrates strengths in protein levels, its lower scores in gluten content and texture place it third in the ranking.

Based on the WASPAM assessment considering gluten content, protein levels, and texture as criteria, Flour A emerges as the most suitable option for producing high-quality vermicelli noodles. Flour C follows closely behind, showcasing strengths in gluten content, while Flour B ranks third due to comparatively lower scores across the evaluated criteria.

3.2 Discussion

3.2.1 The Implications Of The Findings, Including Which Criteria Were Most Influential In Determining The Best Flour And Any Unexpected Results

The findings obtained from the Weighted Aggregated Sum Product Assessment Method (WASPAM) evaluation of various flours for vermicelli production offer insightful implications regarding the criteria influencing the selection of the best flour, along with unexpected results that may have emerged during the assessment process.

The assessment highlighted texture as a significant factor influencing the suitability of flour for vermicelli production. Flour samples with higher texture scores were notably ranked higher in the overall assessment, indicating the paramount importance of achieving the desired consistency and mouthfeel in vermicelli noodles.

Gluten content was another influential criterion in determining the best flour. Flours with higher gluten content tended to fare better in the assessment, possibly due to their ability to impart better elasticity and structure to the noodles, resulting in superior quality vermicelli.

While protein levels contributed to the evaluation, their influence was comparatively less pronounced. Nevertheless, flours with higher protein content still demonstrated advantages, particularly in contributing to the overall texture and nutritional value of the vermicelli.

Contrary to initial expectations, the direct correlation between high protein levels and overall suitability for vermicelli production was not consistently observed. Some flour samples with lower protein content exhibited competitive performance, suggesting that other factors, such as gluten content and texture, compensated for lower protein levels.

The assessment revealed the importance of considering a balance among criteria rather than focusing solely on one aspect. Flour samples excelling in multiple criteria, even if lacking dominance in a single criterion, often ranked higher overall. This emphasizes the need for a holistic approach in flour selection for vermicelli production.

The assessment might prompt reconsideration of weight allocation for criteria. For instance, if texture proved more decisive in determining vermicelli quality than initially presumed, a higher weight assigned to this criterion in future assessments might yield more accurate results aligning with quality preferences.

3.2.2 Comparison Of Flour Options, Highlighting Strengths And Weaknesses Based On The Criteria Considered

d. Flour A:
- Strengths:
  - Texture: Flour A exhibits exceptional texture, scoring highest among the assessed samples. This characteristic contributes significantly to the desirability of vermicelli, ensuring a delightful mouthfeel and consistency.
  - Balanced Scores: While not the highest in gluten content, Flour A maintains a good balance across criteria, showcasing above-average performance in both gluten content and protein levels.
- Weaknesses:
  - Moderate Gluten Content: Although Flour A doesn't have the highest gluten content, its balanced performance across criteria compensates for this and might not be considered a significant weakness.

b. Flour C:
- Strengths:
  - High Gluten Content: Flour C boasts the highest gluten content among the assessed samples, a crucial factor in determining the elasticity and structure of vermicelli noodles.
  - Decent Texture: While not the top scorer in texture, Flour C still maintains a satisfactory score, contributing to its overall suitability.
- Weaknesses:
  - Lower Protein Levels: Compared to other samples, Flour C exhibits relatively lower protein levels, which might impact its nutritional value and slightly affect its overall texture.

c. Flour B:
- Strengths:
  - Higher Protein Levels: Flour B stands out with the highest protein levels among the assessed samples, potentially contributing to improved nutritional content in vermicelli.
  - Moderate Scores: While not excelling in any single criterion, Flour B maintains moderate scores across all assessed criteria.
- Weaknesses:
  - Lower Texture Score: Flour B falls behind in texture compared to other samples, which might affect the final quality of vermicelli by potentially resulting in a less desirable mouthfeel.

d. Comparative Analysis:
- Texture:
  - Flour A excels in texture, presenting a significant advantage over the other options.
  - Flour C and Flour B, while scoring moderately, fall slightly behind Flour A in texture.
- Gluten Content:
  - Flour C leads in gluten content, offering a strength in providing the necessary structure to vermicelli.
  - Flour A and Flour B have moderately high gluten content, with Flour A showcasing a balanced overall performance.
- Protein Levels:
  - Flour B stands out with the highest protein levels, potentially enhancing the nutritional value.
  - Flour A and Flour C exhibit slightly lower protein levels but compensate with strengths in other criteria.

Conclusion

The evaluation of various flour options for vermicelli production through the Weighted Aggregated Sum Product Assessment Method (WASPAM) has provided a comprehensive understanding of the nuanced factors influencing the quality and suitability of flours. This research aimed to streamline the complex decision-making process inherent in flour selection for vermicelli, shedding light on crucial criteria, unexpected outcomes, and implications that guide informed decisions in the food industry. The findings of this research underscore the multifaceted nature of flour evaluation. Texture emerged as a standout criterion, significantly influencing the ranking of flour options. The importance of achieving the desired consistency and mouthfeel in vermicelli noodles was evident, emphasizing the need to prioritize texture in flour selection. Additionally, while gluten content and protein levels played significant roles, the balanced performance across criteria often yielded competitive suitability scores, highlighting the necessity of a holistic approach rather than singular dominance in specific attributes. For stakeholders in the food industry, these insights hold substantial implications. They serve as a guide for optimal flour selection strategies, allowing producers to align their choices with quality preferences and market demands. The research recommends a refined approach to weight allocation, considering the pronounced influence of texture. Furthermore, there's a potential for future research endeavors to explore additional criteria or fine-tune evaluation methodologies, offering a more comprehensive understanding of factors impacting vermicelli quality. The structured methodology employed in this research presents a significant contribution to decision-making processes in the food industry. By employing WASPAM, stakeholders can navigate the complexities of flour selection, ensuring a systematic and informed approach. The evaluation process facilitates an objective comparison among flour options, allowing for a clearer understanding of their comparative strengths and weaknesses, thereby aiding in the selection of the most suitable flour for vermicelli production. This research extends beyond a mere evaluation of flour options; it offers a structured framework that empowers decision-makers to make informed choices aligned with quality objectives. The nuanced insights derived from the WASPAM assessment regarding influential criteria, unexpected outcomes, and the importance of a balanced approach serve as a valuable reference for stakeholders seeking to enhance the quality and consistency of vermicelli noodles in the food market. Ultimately, this research endeavors to elevate the standards of vermicelli production by providing a reliable and systematic approach to flour selection, ensuring the creation of superior-quality vermicelli that delights consumers' palates worldwide.

References

Baik, B. (2010). Effects of flour protein and starch on noodle quality. *Asian Noodles: Science, Technology, and Processing*, 261–283.

Dainty, A., Moore, D., & Murray, M. (2007). *Communication in construction: Theory and practice*. Routledge.

Dubey, H. M., Pandit, M., & Panigrahi, B. K. (2018). An overview and comparative analysis of recent bio-inspired optimization techniques for wind integrated multi-objective power dispatch. *Swarm and Evolutionary Computation*, *38*, 12–34.

Errington, F., Gewertz, D., & Fujikura, T. (2013). *The noodle narratives: the global rise of an industrial food into the twenty-first century*. University of California Press.

Gregory, R., Failing, L., Harstone, M., Long, G., McDaniels, T., & Ohlson, D. (2012). *Structured decision making: a practical guide to environmental management choices*. John Wiley & Sons.

Jaenicke, H., & Höschle-Zeledon, I. (2006). *Strategic framework for underutilized plant species research and development: With special reference to Asia and the Pacific, and to Sub-Saharan Africa*. Bioversity International.

Laleg, K., Barron, C., Cordelle, S., Schlich, P., Walrand, S., & Micard, V. (2017). How the structure, nutritional and sensory attributes of pasta made from legume flour is affected by the proportion of legume protein. *LWT-Food Science and Technology*, *79*, 471–478.

Li, C., You, Y., Chen, D., Gu, Z., Zhang, Y., Holler, T. P., Ban, X., Hong, Y., Cheng, L., & Li, Z. (2021). A systematic review of rice noodles: Raw material, processing method and quality improvement. *Trends in Food Science & Technology*, *107*, 389–400.

Mallampalli, V. R., Mavrommati, G., Thompson, J., Duveneck, M., Meyer, S., Ligmann-Zielinska, A., Druschke, C. G., Hychka, K., Kenney, M. A., & Kok, K. (2016). Methods for translating narrative scenarios into quantitative assessments of land use change. *Environmental Modelling & Software*, *82*, 7–20.

Meredith, G. M. (2009). *Meredith*.

Nachay, K., & Bartelme, M. Z. (2015). Chicago Will Be the Ingredients Capital in July. *FOOD TECHNOLOGY*, *69*(6), 48-+.

Pachón, H., Spohrer, R., Mei, Z., & Serdula, M. K. (2015). Evidence of the effectiveness of flour fortification programs on iron status and anemia: a systematic review. *Nutrition Reviews*, *73*(11), 780–795.

Pahwa, A., Khamrui, K., & Prasad, W. (2020). Influence of oat flour on pasting properties of flour blends, cooking quality and sensory attributes of vermicelli. *The Annals of the University Dunarea de Jos of Galati. Fascicle VI-Food Technology*, *44*(2), 70–84.

Peters, F. T., Drummer, O. H., & Musshoff, F. (2007). Validation of new methods. *Forensic Science International*, *165*(2–3), 216–224.

Petersen, A. L., Thompson, A. M., Baxter, C. A., Norman, J. M., & Roa-Espinosa, A. (2007). A new polyacrylamide (PAM) formulation for reducing erosion and phosphorus loss in rainfed agriculture. *Transactions of the ASABE*, *50*(6), 2091–2101.

Rezaei, J. (2015). Best-worst multi-criteria decision-making method. *Omega*, *53*, 49–57.

Schoenfeld, A. H. (2010). *How we think: A theory of goal-oriented decision making and its educational applications*. Routledge.

Serventi, S., & Sabban, F. (2002). *Pasta: The story of a universal food*. Columbia University Press.

Tacer-Caba, Z., Nilufer-Erdil, D., & Ai, Y. (2015). Chemical composition of cereals and their products. *Handbook of Food Chemistry*, 1–23.

Tan, H.-Z., Li, Z.-G., & Tan, B. (2009). Starch noodles: History, classification, materials, processing, structure, nutrition, quality evaluating and improving. *Food Research International*, *42*(5–6), 551–576.

Vaz Patto, M. C., Amarowicz, R., Aryee, A. N. A., Boye, J. I., Chung, H.-J., Martin-Cabrejas, M. A., & Domoney, C. (2015). Achievements and challenges in improving the nutritional quality of food legumes. *Critical Reviews in Plant Sciences*, *34*(1–3), 105–143.

Venegas, M. (2017). *ALIENATED AFFLICTION: THE POLITICS OF GRISI SIKNIS EXPERIENCE IN NICARAGUA*. University of Pittsburgh.

Villalta, E. L., Soto Bravo, A. M., Vizcaino, L., Dzuris, N., Delgado, M., Green, M., Smith, S. C., Lenhart, A., & Macedo de Oliveira, A. (2021). Evaluation of the durability and use of long-lasting insecticidal nets in Nicaragua. *Malaria Journal*, *20*, 1–13.

Xie, L. H., Tang, S. Q., Luo, J., Wei, X. J., Shao, G. N., Jiao, G. A., Sheng, Z. H., & Hu, P. S. (2017). Physiochemical properties of rice starch for production of vermicelli with premium quality. *Journal of Food Science and Technology*, *54*, 3928–3935.

Yusop, Z. Bin, Ahmed, K., Shirazi, S. M., & Zardari, N. H. (2015). *Weighting methods and their effects on multi-criteria decision making model outcomes in water resources management*. Springer.