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BANANA PEEL POWDER AS THE POTENTIAL INGREDIENT TO SUBSTITUTE WHEAT FLOUR IN NOODLES PROCESSING

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ABSTRACT

Banana production often produces abundant banana peels, which are considered agricultural waste. With the purpose of utilizing banana waste during the production process to create value-added products, the study was conducted to investigate the influence of pretreatment conditions ($NaHSO_3$ concentration 500-800 ppm) on color of banana peel powder and use it to replace part of wheat flour in noodle recipes (substitution ratio: 20-35% based on the total weight of banana peel powder and wheat flour). Research results have shown that when pretreating banana peels with $NaHSO_3$ at a concentration of 800 ppm for 30 minutes (28±2ºC), banana peel powder with the brightest color was created. The recipe M3 with a ratio of 30:70% banana peel powder: wheat flour has created a noodle product with high quality, high sensory value and this product was the most acceptance by the consumers. This study is provided the added information for further development the the various product from agricultural waste as banana peel.

1. Introduction

In recent years, plant by-products accounted for a large part and were very worrisome because of its high density and moisture content. Peels/seeds from fruits and vegetables have an economic value below the cost of reuse and considered waste. By using appropriate treatment techniques, these wastes can be used to generate valuable by-products (Scheiber et al., 2001). Based on the 3R principle (reduce, reuse, and recycle), these materials cannot be considered as waste but become a valuable resource to be added to existing materials to increase the cost (Kabirifar et al., 2020). Therefore, the use of waste by-products to process valuable food both creates economic value and contributes to environmental protection. Banana (*Musa* spp.) is one of the most popular and important tropical fruits consumed by people all over the world, especially in Vietnam. Banana was favored by people for its nutritional properties and benefits to human health, ranking first in total fruit production due to its high consumption rate (Imam & Akter, 2011). Banana peel made up about 30% of the total weight of the fruit and contains about 20% of the dry matter, which also contained minerals, various amino acids and antioxidant compounds, but discarded as a waste product (Tai et al., 2021b; Vatanasuchart et al., 2012). In the banana peel contained antioxidant compounds and the fiber part has great potential in the production of functional foods. The flesh and skin of green bananas were high in resistant starch, ranging from 47% to 57%. The significant amount of carbohydrates, protein and fiber made banana peels an ideal source of raw materials to produce value-added products (Demir et al., 2004).

Pasta products are increasingly diversified through the addition of plant ingredients (such as potatoes, tapioca, pulse, sweet potatoes) (Kolarič et al., 2020; Melini et al., 2020; Thuy et al., 2020). As mentioned, banana peel powder contains high levels of fiber, protein, and resistant starch, which can be used to partially replace wheat flour in recipes, creating pasta products with high levels of bioactive compounds that help reduce the oxidation process in body metabolism. Furthermore, the low energy and GI (glycemic index) in banana peels, when used for food processing, might create products with low energy value and help prevent obesity commonly found in developed societies (Kumar et al., 2023; Vatanasuchart et al., 2012). Thus, the aim of this study to determine the treatment condition for making banana peel powder and investigate their application on noodle processing. With this research might not only create the new and healthy recipes for noodle making but also reduce the impact of waste on environment to ensure sustainability.

2. Materials and methods

2.1. Materials

The banana peel (Figure 1) used for the study were obtained from banana production company at Can Tho city (Vietnam). Chicken eggs and salt were purchased at Mega Maket Hung Loi supermarket (Can Tho city). Global Wheat Flour (No. 13) produced by Interflour Vietnam Company. Potato starch is produced by Vinh Thuan Import-Export Production Trading Co., Ltd. Semolina durum flour imported from Singapore, xanthan gum manufactured by Hodgson Mill Company (US).

Figure 1. Banana peel for this study

2.2. Experiment design

Banana peels were pre-sorted to remove damaged parts, washed and drained. Sample was soaked in 0.5% citric acid solution, the banana peel must be submerged in water to avoid contact with air, producing browning pigment. Then, sample were treated in $NaHSO_3$ solution with different concentrations (500-800 ppm) for 30 minutes. Banana peels were dried at 70^{o}C until the moisture content is 6÷8% (Tai et al., 2021a). Dried banana peel was ground into powder (80 mesh) and packaged into dark bag. Bana peel powder (BPP) was analysis color, total phenolic content, total flavonoid content to choosing pretreatment condition.

After choosing appropriate pre-treatment condition, BPP was applied into yellow alkaline noodle. Wheat flour was replaced with a portion of BPP with the weight of 40, 50, 60 and 70 g, respectively, for the formulas M1 (20% replacement), M2 (25% replacement), M3 (30% replacement) and M4 (35% replacement) [M0: the control sample (using 100% wheat flour)] (Table 1).

Table 1. Formulation for noodle production

Ingredient (g)	**M0**	**M1**	**M2**	**M3**	**M4**
BPP	0	40	50	60	70
Wheat flour	200	160	150	140	130
Semolina	50	50	50	50	50
Potato starch	50	50	50	50	50
Salt	2	2	2	2	2
Egg	65	65	65	65	65
Water	63	63	63	63	63
Xanthan gum	5.8	5.8	5.8	5.8	5.8
Total	425.8	425.8	425.8	425.8	425.8

BPP was mixed with wheat flour, semolina, and xanthan gum. The mixture was then sifted and put into the PHILIPS noodle maker. Stirring well for the first time, after the mixture was stirred for 1.5 minutes, start adding the egg, salt and water into mixture. Continue to stir for 5 minutes and let the dough rested for 30 minutes. After incubation, the mixture was stirred for the second time and extruded (Figure 2). After pressing, the noodles were boiled in boiling water at 100°C for 2.5 minutes and dried at 60°C for 4.5 hours (Thuy et al., 2020).

Figure 2. Pasta with banana peel powder and control noodles after extruded

2.3. Quality analysis

The color of dried noodles enriched with BPP and control sample was measured on the Hunter scale for L, a, and b using a Minolta chroma meter (CR-400, Konica Minolta, Tokyo, Japan) (Thuy, Chi, et al., 2020). Protein, carbohydrate and moisture content were analyzed as Thiex (2009). The Folin-Ciocalteu assay was used for determination of total phenolic content (TPC), based on the coloration reaction between the hydroxyl groups of phenol with the reagent Folin-Ciocalteu (Fu et al., 2011). TPC was calculated as mg gallic acid equivalent per gram sample (mgGAE/g) through standard curve (Tai et al., 2021b). The Aluminum Chloride Colormetric method was applied to determine the flavonoid content (TFC) in the product (Mandal & Madan, 2013; Tai et al., 2021b). Texture attributes were analyzed with a Brookfield CT3 Texture Analyzer equipped with a 1,500 g load cell and software version 1.8 (Brookfield Engineering Laboratories, Middleboro, MA, USA) (Thuy et al., 2020). Scanning election microscopy was used as method of Thuy et al. (2020). Briefly, samples were examined at 15 kV, the sample distance to the 7 cm ejection glass, using a JEOL model J550 scanning electron microscope (Japan). Cooking quality and sensory evaluation also was followed as performance of Thuy et al. (2020).

2.4. Data analysis

The experiments were performed with three replicates. One-way analysis of variance was performed to test the differences using Stagraphic Centurions XV.I. Experimental results were expressed as the mean ± standard deviation (SD). Sensory data was analyzed by XLSTAT 2014 (USA).

3.Results and discussions

3.1 Effect of pretreatment condition on color and antioxidant compounds of BPP

Evaluation of the color change of BPP samples presented through L, a and b values. The color change of banana peel powder after treatment with $NaHSO_3$ solution at different concentrations is shown in Table 2 and Figure 3.

Table 2. Effect of concentration of $NaHSO_3$ on color of BPP

Concentration of $NaHSO_3$ (ppm)	Colorimeter		
	L	a	b
Control (without $NaHSO_3$)	41.44^a	3.43^d	11.50^a
500	50.62^b	0.74^c	26.49^b
600	51.55^c	0.66^c	27.55^c
700	57.35^d	-0.36^b	29.52^d
800	60.52^e	-0.54^a	30.59^e

Values with different superscripts are significantly different (P<0.05).

Figure 3. Color of BPP treated at different concentrations of $NaHSO_3$

The L value [brightness value: black (0) to white (100)] of BPP increased with increasing concentration of NaHSO3 solution from 500 to 800 ppm. The b (-b to +b: showing the color from blue to yellow) value also increased with increasing NaHSO3 solution concentration from 500 ppm to 800 ppm. This may be due to the retardation of polyphenol oxidase (PPO) (Iqbal et al., 2019). Sulfites inhibit PPO through the reaction between sulfite and quinine ions, inhibiting PPO activity and depleting oxygen (Thamsenanupap & Prommi, 2020). All samples of BPP that were treated with $NaHSO_3$ solution at different concentrations had more attractive colors than untreated samples, the highest L value was obtained when soaking the banana peels in the $NaHSO_3$ 800 ppm solution. Pretreatment with $NaHSO_3$ solution can prevent the development of brown color of banana peels during the drying process. Research results of Vatanasuchart et al. (2012) showed that sulfite pretreatment prevented significant color loss, while water and steam blanching also suppressed enzymatic browning in convection drying, resulting in relative stability for the color parameter. The quality of raw materials is one of the important factors determining the quality of the final product. The results of content analysis of some components in BPP were observed. The moisture content of the BPP fluctuated in the range of 7.21±0.08%, the protein content was 1.54±0.08%. While the largest content in BPP was carbohydrate 73.57±0.35%. Vitamin C content in BPP accounted for 41.62±0.73 mg%, this value is only half of the study of Mosa and Khalil (2015). In addition, BPP contained a large amount of biologically active compounds. TPC and TFC in BPP were 54.84±0.56 mgGAE/g and 15.33±0.29 mgQE/g, respectively, as consist with our pervious result for extraction (Tai et al., 2021b). The difference of the above values is due to the difference in banana varieties, soil, growing conditions.

3.2. Effect of mixing ratio of BPP:wheat flour (%) on the quality of noodle

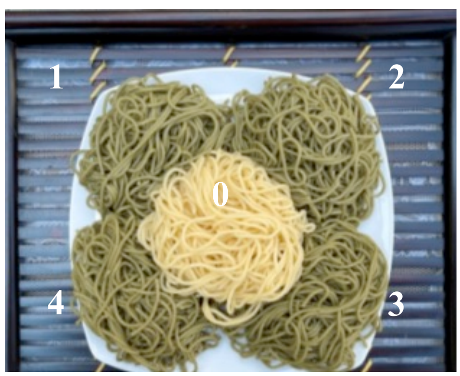
3.2.1. Physicochemical properties

Color is one of the important factors in assessing the quality of the final product. Table 4 showed the color values L of noodle products supplemented with BPP in different proportions. The results show that the L and b values in sample M3 were 67.04 and 31.90, respectively, higher than that of another sample. When partially replacing the BPP, the noodles was more yellow, and the brightness also increased. The measured a value of sample M3 is -3.07, so the noodle product processed from formula M3 is greener than the control sample (Figure 4), mainly due to the color of the BPP used. The hardness of noodle could be measured through impact force (Wang et al., 2008). Hardness of noodles supplemented with BPP was affected when changing the different mixing ratios of BPP:wheat flour. The hardness of sample tended to increase when gradually increasing the mixing ratio of BPP:wheat flour. Specifically, samples at the mixing ratio of BPP:wheat flour (20:80%) showed the lowest value of hardness (88.04 g force), while samples at the ratio 35:65% shows the highest hardness value (96.39 g force). One of the causes affecting the hardness of noodle was probably the high amylose content and this is considered an important factor affecting the hardness of cooked noodle (Guo et al., 2003). Research by Ravi and Mustaffa (2013) showed that starch content in the peel of different banana varieties was recorded in the range of 80.35 to 86.76%. The content of amylose in banana peel has been reported to range from 24.41 to 36.87%. The amylose content in the starch of the banana peel was significantly higher than that in the pulp of the banana (Li et al., 2011). Therefore, when increasing the mixing ratio of BPP:wheat flour (%) into the noodle recipe, the hardness of the noodles increased gradually. After extrusion, samples of noodles with different compositions were dried at a fixed temperature of 70^{o}C until the moisture content reached 6-8%. The content of total polyphenols and flavonoids in the products was analyzed (Table 3). When increasing the mixing ratio of BPP:wheat flour (%), TPC and TFC in the samples of boiled noodles also increased. Specifically, at the mixing ratio of BPP:wheat flour of 20:80%, TPC and TFC reached the smallest value of 0.97 mgGAE/g and 0.43 mgQE/g, respectively. When increasing the mixing ratio of BPP:wheat flour (%) to 35:65%, TPC and TFC reached the highest value of 2.45 mgGAE/g and 1.98 mgQE/g, respectively. Banana peel was a source rich in antioxidant compound (Tai et al., 2021b), as increase the supplementation proportion of BPP also led to increase antioxidant compound in noodle.

Table 3. Physicochemical of noodle from different formulations

Sample	L	a	b	Hardness (g-force)	TPC (mgGAE/g)	TFC (mgQE/g)
M1	68.50^{c}	-0.77^{d}	29.71^{a}	88.04^{a}	0.97^{a}	0.43^{a}
M2	67.54^{b}	-1.38^{c}	31.14^{b}	92.84^{b}	1.43^{b}	1.07^{b}
M3	67.04^{b}	-3.07^{a}	31.90^{b}	95.68^{c}	2.17^{c}	1.77^{c}
M4	62.29^{a}	-2.19^{b}	33.39^{c}	96.39^{d}	2.45^{d}	1.98^{d}

Note: L, a, b and hardness of the control sample was 65, -2.7, 12 and 53.47 g-force, respectively. Values with different superscripts are significantly different (P<0.05)



0 is M0 sample
1 is M1 sample
2 is M2 sample
3 is M3 sample
4 is M4 sample

Figure 4. Noodle sample with different recipes and control noodle sample

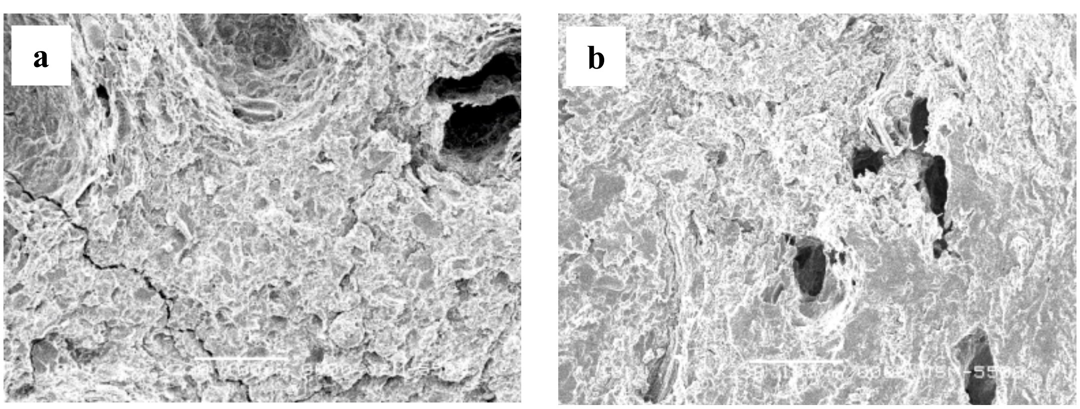


Figure 5. SEM of noodle samples: a. M0 sample; b. M3 sample

3.2.2. Morphological of noodle

Scanning electron microscopy (SEM) helps to provide information about the size, shape, and arrangement of particles in the pasta matrix (Tudorica et al., 2002). Scanning electron microscopy images can help analyze the appearance, texture, or integrity of food products (Gorinstein et al., 2004). Scanning electron microscopy cross-section of the pasta sample with partial replacement of flour by banana peel powder and the control sample (100% flour) shows the binding force between starch particles and proteins of both samples were very tight (Figure 5).

The grain size and starch grain distribution in the gluten network of the two samples are quite similar. However, the structure of the noodles with a portion of banana peel powder has a higher hardness than the control sample, leading to the noodles breaking more easily.

3.2.3. Cooking quality

Three important factors related to the quality of noodles during cooking are cooking time, percent mass gain and volume increase after heating and percent dry matter loss (Ho & Noomhorm, 2011). The mixing ratio made a statistically significant difference for cooking quality. Specifically, when increasing the mixing ratio of peel powder, the percentage of pasta volume after cooking also increased as the smallest was in sample M1 (65.70%) and the highest was in sample M4 (67.33%) (Table 4). Besides, the percentage of cooking loss was one of the parameters to evaluate the amount of dry matter lost to the cooking water (Sozer et al., 2007). The maximum cooking loss was obtained in sample M1 (5.13%). While there was no statistically significant difference between sample M2, M3, and M4. The expansion rate of pasta was calculated from the volume increase during cooking (Kaur et al., 2012; Rani et al., 2019). The obtained results showed that volume of noodles tended to increase when increasing the substitution rate of BPP into the recipe, the lowest was 77.72% corresponding to the proportion of BPP : wheat flour was 20:80% (M1) and the highest was 79.14% at the mixing ratio of 35:65% (M4).

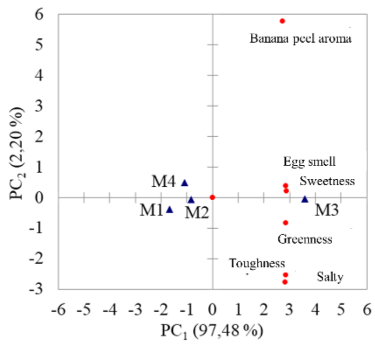
Table 4. Cooking quality of noodle from different recipes

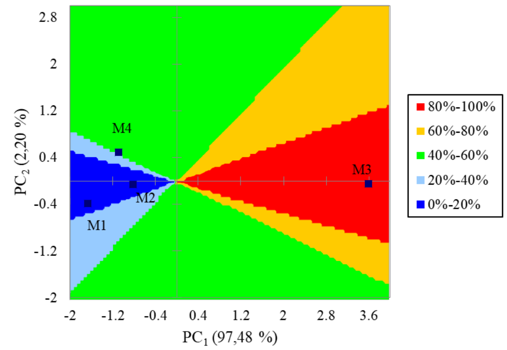
Sample	Weight increase (%)	Cooking loss (%)	Volume increase (%)
M1	65.70^{a}	5.13^{c}	77.72^{a}
M2	66.32^{b}	4.94^{b}	78.39^{b}
M3	66.77^{c}	4.88^{ab}	78.80^{c}
M4	67.33^{d}	4.81^{a}	79.14^{d}

Values with different superscripts are significantly different (P<0.05)

3.2.4. Sensory characteristic

The method of Quantitative Descriptive Analysis (QDA), Principle Component Analysis (PCA) and Preference mapping have been applied and shown to be effective in describing sensory properties of many products such as milk, soup, pickled vegetables and fruits (Ghosh & Chattopadhyay, 2012; Nazir et al., 2018). The sensory properties of the noodles were analyzed using the PCA method and preference mapping is presented in Figure 6. To describe the organoleptic properties of prepared noodle with the addition of BPP, the relationship between the attributes and sample is shown Figure 6a. When showing noodle samples and sensory attributes on the PCA graph, noodles samples located close to each other have similar sensory properties. The dispersion of samples on the graph shows that changing the proportion of BPP in the noodle recipe greatly affected the organoleptic properties. Sample M3 was evaluated as having egg smell, sweet taste, and green color because it is located near the first major component axis. Sample M2 and M4 was located close to each other, so they have similar properties. Preference mapping to confirm PCA questions and results, sample M3 accounted for 80-100% of the highest, samples M1 and M2 belonged to the position with the lowest percentage (0-20%) (Figure 6b). Therefore, the sensory results have shown that the best rated was in sample M3, which determined as the most acceptability of consumers in noodles supplemented with BPP.





a b

Figure 6. Sensory properties of noodles as analysis of PCA method (a) and Preference mapping (b)

4. Conclusions

Sodium bisulfite ($NaHSO_3$) has been shown to have a great influence on the color of banana peel powder. An increase in the brightness of banana peel powder was observed as the concentration of $NaHSO_3$ in the treatment solution increased. The selected condition is to treat the sample (banana peel) in 800 ppm $NaHSO_3$ solution for 30 minutes. Furthermore, this type of flour is also used effectively in noodle making recipes. Based on the results of physicochemical analysis and sensory testing, 30% of wheat flour was replaced by banana peel powder in the recipe chosen to produce noodles. This study provides further information for further utilization of banana wastes, which can be considered more in the future to ensure the sustainability of agriculture.

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5. References

Demir, V., Gunhan, T., Yagcioglu, A. K., & Degirmencioglu, A. (2004). Mathematical Modelling and the Determination of Some Quality Parameters of Air-dried Bay Leaves. *Biosystems Engineering*, *88*(3), 325-335.

Fu, L., Xu, B.-T., Xu, X.-R., Gan, R.-Y., Zhang, Y., Xia, E.-Q., & Li, H.-B. (2011). Antioxidant capacities and total phenolic contents of 62 fruits. *Food Chemistry*, *129*(2), 345-350.

Ghosh, D., & Chattopadhyay, P. (2012). Application of principal component analysis (PCA) as a sensory assessment tool for fermented food products. *Journal of Food Science and Technology*, *49*, 328-334.

Gorinstein, S., Pawelzik, E., Delgado, E., Yamamoto, K., Kobayashi, S., Taniguchi, H., Haruenkit, R., Park, Y.-S., Jung, S.-T., Drzewiecki, J., & Trakhtenberg, S. (2004). Use of scanning electron microscopy to indicate the similarities and differences in pseudocereal and cereal proteins. *International Journal of Food Science & Technology*, *39*, 183-189.

Guo, G., Jackson, D. S., Graybosch, R. A., & Parkhurst, A. M. (2003). Asian salted noodle quality: Impact of amylose content adjustments using waxy wheat flour. *Cereal Chemistry*, *80*(4), 437-445.

Ho, M. T., & Noomhorm, A. (2011). Physiochemical properties of sweet potato and mung bean starch and their blends for noodle production. *Journal of Food Processing and Technology*, *2*(1), 105-114

Imam, M. Z., & Akter, S. (2011). Musa paradisiaca L. and Musa sapientum L. : A Phytochemical and Pharmacological Review. *Journal of Applied Pharmaceutical Science*, *01(05),* 14-20.

Iqbal, A., Murtaza, A., Hu, W., Ahmad, I., Ahmed, A., & Xu, X. (2019). Activation and inactivation mechanisms of polyphenol oxidase during thermal and non-thermal methods of food processing. *Food and Bioproducts Processing*, *117*, 170-182.

Kabirifar, K., Mojtahedi, M., Wang, C., & Tam, V. W. (2020). Construction and demolition waste management contributing factors coupled with reduce, reuse, and recycle strategies for effective waste management: A review. *Journal of Cleaner Production*, *263*, 121265.

Kaur, B., Ariffin, F., Bhat, R., & Karim, A. A. (2012). Progress in starch modification in the last decade. *Food Hydrocolloids*, *26*(2), 398-404.

Kolarič, L., Minarovičová, L., Lauková, M., Karovičová, J., & Kohajdová, Z. (2020). Pasta noodles enriched with sweet potato starch: Impact on quality parameters and resistant starch content. *Journal of Texture Studies*, *51*(3), 464-474.

Kumar, V., Chakraborty, P., Janghu, P., Umesh, M., Sarojini, S., Pasrija, R., Kaur, K., Lakkaboyana, S. K., Sugumar, V., Nandhagopal, M., & Sivalingam, A. M. (2023). Potential of banana based cellulose materials for advanced applications: A review on properties and technical challenges. *Carbohydrate Polymer Technologies and Applications*, *6*, 100366.

Li, W., Shao, Y., Chen, W., & Jia, W. (2011). The effects of harvest maturity on storage quality and sucrose-metabolizing enzymes during banana ripening. *Food and Bioprocess Technology*, *4*(7), 1273-1280.

Mandal, B., & Madan, S. (2013). Preliminary Phytochemical Screening And Evaluation of Free Radical Scavenging Activity Of Stevia rebaudiana Bertoni From Different Geographical Sources. *Journal of Pharmacognosy and Phytochemistry*, *2*, 14-19.

Melini, V., Melini, F., & Acquistucci, R. (2020). Phenolic Compounds and Bioaccessibility Thereof in Functional Pasta. *Antioxidants (Basel)*, *9*(4), 343.

Mosa, Z. M., & Khalil, A. F. (2015). The effect of banana peels supplemented diet on acute liver failure rats. *Annals of Agricultural Sciences*, *60*(2), 373-379.

Nazir, N., Anggraini, T., & Rahayu, L. (2018). Principal component analysis for sensory profiling of rendang from various region in West Sumatra. *International Journal on Advanced Science, Engineering and Information Technology*, *8*(2), 596-603.

Rani, S., Singh, R., Kamble, D. B., Upadhyay, A., & Kaur, B. P. (2019). Structural and quality evaluation of soy enriched functional noodles. *Food Bioscience*, *32*, 100465.

Ravi, I., & Mustaffa, M. M. (2013). Starch and amylose variability in banana cultivars. *Indian Journal of Plant Physiology*, *18*(1), 83-87.

Scheiber, M. D., Liu, J. H., Subbiah, M. T., Rebar, R. W., & Setchell, K. D. (2001). Dietary inclusion of whole soy foods results in significant reductions in clinical risk factors for osteoporosis and cardiovascular disease in normal postmenopausal women. *Menopause*, *8*(5), 384-392.

Sozer, N., Dalgıc, A., & Kaya, A. (2007). Thermal, textural and cooking properties of spaghetti enriched with resistant starch. *Journal of Food Engineering*, *81*(2), 476-484.

Tai, N. V., Linh, M. N., & Thuy, N. M. (2021a). Modeling of thin layer drying characteristics of "Xiem" banana peel cultivated at U Minh district, Ca Mau province, Vietnam. *Food Research*, *5*(5), 244-249.

Tai, N. V., Linh, M. N., & Thuy, N. M. (2021b). Optimization of extraction conditions of phytochemical compounds in "Xiem" banana peel powder using response surface methodology. *Journal of Applied Biology & Biotechnology*, *9*(6), 56-62.

Thamsenanupap, P., & Prommi, T. O. (2020). Influence of water quality parameters on larval stages of Pseudoleptonema quinquefasciatum Martynov 1935 (Trichoptera: Hydropsychidae) in streams of western Thailand. *Jordan Journal of Biological Sciences*, *13*(3), 305-311.

Thiex, N. (2009). Evaluation of analytical methods for the determination of moisture, crude protein, crude fat, and crude fiber in distillers dried grains with solubles. *Journal of AOAC international*, *92*(1), 61-73.

Thuy, N. M., Chi, N. T. D., Huyen, T. H. B., & Tai, N. V. (2020). Orange-fleshed sweet potato grown in Viet Nam as a potential source for making noodles. *Food Research*, *4*(3), 712-721.

Tudorica, C. M., Kuri, V., & Brennan, C. S. (2002). Nutritional and physicochemical characteristics of dietary fiber enriched pasta. *Journal of Agriculture and Food Chemistry*, *50*(2), 347-356.

Vatanasuchart, N., Niyomwit, B., & Wongkrajang, K. (2012). Resistant starch content, in vitro starch digestibility and physico-chemical properties of flour and starch from Thai bananas. *Maejo International Journal of Science and Technology*, *6*(2), 259-271.

Wang, J., Sun, B., Cao, Y., Tian, Y., & Li, X. (2008). Optimisation of ultrasound-assisted extraction of phenolic compounds from wheat bran. *Food Chemistry*, *106*(2), 804-810.