Journal of Phytology 2026, 18: 85-90
https://doi.org/10.25081/jp.2026.v18.10056

Research Article

Nutrient composition, antioxidant activity and sensory properties of ready-to-use product from food flavouring plants *Syzygium polyanthum* (Wight) Walp.

Nurul Aisyah Yusli[1], Noorasmah Saupi[1,3]*, Hanisah Kamilah[1,2], Shiamala Devi Ramaiya[1]

[1]*Department of Crop Science, Faculty of Agricultural and Forestry Sciences, University Putra Malaysia Bintulu Sarawak Campus, Bintulu, Sarawak, Malaysia*
[2]*Halal Products Research Institute, University Putra Malaysia, Serdang, Selangor, Malaysia*
[3]*Institute of Ecosystem Science Borneo, University Putra Malaysia Bintulu Sarawak Campus, Bintulu, Sarawa, Malaysia*

(Received: January 19, 2026; Revised: July 10, 2026; Accepted: July 14, 2026; Published: August 14, 2026)
*Corresponding author: Noorasmah Saupi, E-mail: noorasmah@upm.edu.my

Abstract

Utilization of *Syzygium polyanthum* (Wight) Walp. as a food flavouring and aroma enhancer plants seems to diminish over time. From a preliminary study, this problem is due to the difficulty of collecting the plants from the wild, longer preparation time and shorter shelf life even though it has the potential to be commercialized as a natural flavouring source. Therefore, this study was conducted to develop the ready-to-use (RTUP) product and evaluate the differences between the fresh leaves and the RTUP developed. The proximate composition was determined using standard AOAC methods. The antioxidant activity was determined using DPPH and FRAP assays. The rehydration ratio of RTUP was determined based on the effect of temperature on recovery time. Sensory test involving 80 semi-trained panellists was conducted to study the acceptability of product developed. Ready-to-used product has higher content of ash (6.61%), crude protein (6.83%), crude fat (3.28%), carbohydrate (84.68%), and energy (396.33 kcal/100 g). Scavenging capacity against free radicals between fresh leaves (1.7 mg/mL) and RTUP (1.4 mg/mL) showed no significant different meanwhile the ferric reducing power ability showed a significant difference at 9.4 mg/g and 5.6 mg/g respectively. This study recorded that the recovery time of RTUP decreases as the temperature increase. Furthermore, the panellist showed positive response toward sensory perception of RTUP. However, it is suggested to improve the formulation of RTUP in order to allow more functions and value to be domesticated.

Keywords: Food acceptability, Food additive, Instant cube, Seasoning, Sensory

Introduction

Flavour has become the most critical factor influencing food quality and global competitiveness (Weerawatanakorn *et al.,* 2015). Previously, only herbs and spices could be used for flavouring; today, a wide range of flavourings were available and not for home use only but also for industrial food production (Ziegler, 2007). Studies about flavour allow the industry to serve the new food experiences and cause demands on the food processing business (Attokaran, 2017). Loliger (2000) wrote that flavouring can serve a significant nutritional role by adding appeal to foods that are less delicious. The adulteration of foods and beverages with synthetic flavours is becoming increasingly widespread, since the demand for natural food and beverage products is growing rapidly. Synthetic flavours such as ethyl vanillin, ethyl maltol, ethyl propionate, isoamyl acetate, 2,6- lutidine, manzanate, menthone, and methyl anthranilate were examples of flavour produced synthetically for the food industry as flavour enhancers. These flavours imitate the natural flavour and should be precisely controlled during the production of the food products.

Nowadays, traditional foods have begun to fade away throughout time as they were more complex to prepare and needed more spices that are difficult to find (Akhtar *et al.,* 2014). On the other hand, instant spices can be manufactured using technology to address the time consuming nature of homemade spices and indigenous spices are hard to come by (Niththiya *et al.,* 2014; Maser & Marsella, 2019). Instant products have created a wide range of suitable meals for households that are convenient to use without further processing and help housewives reduce the time and effort required to gather various ingredients, clean, and prepare food (Vasan, 2019). Instant products can be prepared as canned, dehydrated, or frozen depending on the suitability of the ingredients and their function (Niththiya *et al.,* 2014). According to Brown (1989), the concept of convenience encompasses anything that improves human comfort or saves time; beneficial, convenient, or useful goods, article, or services. More recent studies suggested that convenience can improve or facilitate a fragmented and demanding mothering role (Carrigan & Szmigin, 2006) and convenience is one aspect of a larger customer choice resulting from new marketing perspectives (Vargo & Lusch, 2004).

However, the local people in Sarawak, Malaysia still widely use various indigenous plants as source of food flavour enhancer in their daily life. For instance, locals tend to use *Syzygium polyanthum* (Wight) Walp. (Chai, 2000; Saupi *et al.,* 2020; Yusli *et al.,* 2021) as natural flavour and aroma enhancer which the traditional knowledge has been passed down from their elders. *Syzygium polyanthum* is a species from the family Myrtaceae which is known as Indonesian bay leaf, "daun salam", "serai kayu", or "samak" in Malaysia (Ismail & Wan Ahmad, 2019). According to Halim and Maryani (2022), this species is different from the *Laurus nobilis* (true bay leaf) from the family Lauraceae. *S. polyanthum* possesses a mild scent and a slightly sour or astringent taste (Ravindran, 2017) that is usually used as a culinary herb or a traditional medication (Harismah & dan Chusniatun, 2016; Jediut *et al.,* 2018; Ismail & Wan Ahmad, 2019). In Borneo, the leaves are used fresh by adding into dishes such as soup, curry or during the marination of foul odour protein.

Despite that, preliminary study results indicate that the local community faces problems in collecting these species as most of them live in the wild, and it is hard to maintain the shelf-life for a long time. Thus, the present study was conducted to develop the ready-to-use product (RTUP) in order to shorten the preparation time of meal for the local people and allow the indigenous plants to be domesticated and easy to carry. The final formulation of RTUP was analysed by using standard methods of food analysis and compared with fresh samples.

Materials and Methods

Sample preparations

Syzygium polyanthum (Wight) Walp. leaves were collected from bushes around Bintulu, Sarawak (Figure 1). After collection, samples were cleaned and washed in order to remove any dirt and inedible parts. Then, samples were air-dried using the method by Rajurkar and Hande (2011). Samples were exposed in an open area at the Food Processing Lab, Universiti Putra Malaysia Bintulu Campus with a temperature of 30 °C for 8 hours per day of sunlight. Samples were dried for 10 to 15 days approximately depending on the presence of sunlight. Later, dried samples were crushed and sieved under 100 meshes. The samples were stored in an air-tight container for further food nutritional composition analysis and seasoning developments.

Ready-to-use product development

Product was developed using the method by El-Sherif and El-Hadidy (2018) with some alterations. 90 g of dried sieving powder of the sample were mixed well together in 100 mL distilled water, 1 g of salt, and xanthan gum. The concentration of xanthan gum was adjusted at 4% to provide strong binding. Next, the mixture was pressed inside the cube mold (20 mm × 20 mm × 15 mm) and dried in a vacuum-oven at 40 °C for 24 hours. The formed cubes were packed using aluminium foil for storage and further analysis.

Figure 1: *Syzygium polyanthum*

Proximate analysis

The moisture content, ash, crude fibre, crude protein, and crude fat were determined by the method of Association of Official Agricultural Chemists (AOAC, 1990). The available carbohydrate was estimated by subtracting the crude protein, crude fat, crude fiber and ash from 100% dry matter sample. The calculation involved as follows:

$$\text{Carbohydrate (\%)} = 100 - (\text{crude protein} + \text{crude fat} + \text{crude fiber} + \text{ash})$$

The calorific value estimated by multiplying the percentages of crude protein, crude fat and carbohydrate by the recommended factors. The calculation involved as follows:

$$\text{Energy (kcal/100 g)} = (\text{crude protein} \times 2.44) + (\text{crude lipid} \times 8.37) + (\text{carbohydrate} \times 3.57)$$

Antioxidant activity

Total antioxidant activity (TAA) of developed products was determined using DPPH free radical scavenging activity and FRAP assay. DPPH free radical scavenging activity was conducted according to Brand-Williams *et al.* (1995) with some modifications. The stock solution of DPPH was prepared with absolute methanol (100 μM). The sample extracts were diluted into a series of known concentrations using 80% methanol. Then, the assay started by adding 1.0 mL of the sample extract to 3.0 mL of DPPH stock. The solutions were incubated for 30 min under dark conditions and the absorbance was taken at 517 nm using a PerkinElmer Lambda 25 UV/Vis Spectrometer. The percentage of DPPH free radical scavenging activity was calculated using the following formula:

$$\frac{\text{absorbance control} \times \text{absorbance sample}}{\text{absorbance control}} \times 100$$

The determination of ferric reducing antioxidant power of the extracts was carried out using the FRAP assay followed the modified method of Benzie and Strain (1996). FRAP reagent was prepared at 37 °C with 300 mmol L^{-1} acetate buffer, 10 mmol TPTZ in a 40 mmol L^{-1} HCl solution and 20 mmol L^{-1} $FeCl_3$ in the ratio of 1:1:10 under dark conditions. Trolox was used as a standard and TPTZ working reagent used was as a blank reference. The absorbance of samples and standards was read at 593 nm using a PerkinElmer Lambda 25 UV/Vis Spectrophotometer.

Rehydration ratio

The rehydration ratio of RTUP was determined according to Krokida and Marinos-Kouris (2003) method with some alterations. Each cube was immersed in a 100 mL water bath at constant temperature (70 °C, 80 °C, 90 °C, 100 °C). Time taken for the cube to dissolve is recorded. Samples were repeated in triplicate.

Sensory evaluation

The sensory evaluation was conducted using consumer acceptability test. RTUP of *S. polyanthum* were added into dishes and served to 80 semi-trained respondents for sensory evaluation in terms of overall acceptability using a five-point hedonic scale. The score was assigned from (1) extremely not agree to (5) extremely agree. The sensory evaluation covered the properties that perceived by the sensory organs; taste, smell, texture, colour, and appearance. The quality number was calculated according to the Nieβen and Thö Iking (2007) equation:

$$QN = \frac{\text{Appearance} + \text{Colour} + \text{Aroma}}{3}$$

QN was classified as follows: 5.00-4.50 (very good quality), 4.49-3.50 (good quality), 3.49-2.00 (average quality), 1.99-1.90 (satisfactory quality), and 1.89-1.00 (unsatisfactory quality).

A blind sensory test was conducted by comparing the 'chicken pansuh' dish that was cooked using *S. polyanthum* in the traditional method (fresh leaves) and RTUP developed. Dish was represented as Dish A for 'chicken pansuh' cooked using RTUP meanwhile 'chicken pansuh' cooked using traditional method presented as Dish B (Figure 2). Firstly, 1.5 kg of chicken was washed and cut into small pieces. Then, 38.5 g of ginger, 97.5 g of garlic, and 15.5 g of chillies were mashed using a pestle and mortar. After that, marinate the chicken together with ginger, garlic, chillies, 27 mL of cooking oil, 20 g of salt, and 3 g of dried *S. polyanthum* or one RTUP for 10 minutes. Later, wrap the marinated chicken in aluminium foil and cooked over the fire for 30 minutes.

All 80 untrained respondents were briefed before tasting the dishes and filled out the questionnaires. The questionnaire consisted of four sections; personnel information, hedonic scale based on served dishes, comparison between dishes, and sensory evaluation. Respondents were required to cleanse their palate with milk before tasting other dishes to prevent biased decisions.

Statistical analysis

Data on proximate and mineral were analysed by Statistical Analysis Software (SAS 9.3). Means of each parameter measured were analysed using one way analysis of variance (ANOVA). Significant differences between means were then compared using Tukey's Range Test at a significant level of $p \leq 0.05$. The data for sensorial evaluation were analysed by Statistical Package for Social Science (SPSS) using IBM SPSS Statistics V22.0 541 Software.

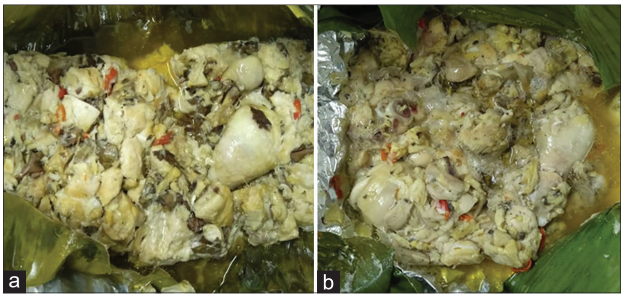

Figure 2: Chicken "pansuh" dish; a) Chicken "pansuh" cooked using fresh leaves of *S. polyanthum*, b) Chicken "pansuh" cooked using RTUP of *S. polyanthum*

Results and discussion

Proximate composition in fresh leaves and RTUP

Based on the result shown in Table 1, it showed that the proximate composition of the RTUP was significantly higher compared to the fresh leaves. The RTUP of *S. polyanthum* contained a high amount of carbohydrate (84.68%), fiber (15.79%), and a low amount of fat (3.28%). Significant difference between the fresh and RTUP may be due to the presence of xanthan gum during the development process of the RTUP. Xanthan gum used contained around 77.5 g/100 g of carbohydrate and fibre which may influence the total nutrient composition after being processed. Moisture content between the fresh sample and RTUP exponentially dropped as the development of RTUP involved drying process twice. Low moisture content indicates that the shelf life has been extended and that quality degradation owing to microbial activity of the RTUP may be limited (Lilian *et al.,* 2013). According to El-Sherif and El-Hadidy (2018), food that has been dehydrated may have the benefit of being protected against enzymatic and oxidative deterioration and having flavour stability at room temperature for extended periods of time (6-12 months). Dehydrated foods are also highly nutritious and do not require refrigeration for storage purposes which is ideal for hotels, hospitals, restaurants, and working families (El Wakeel, 2007).

Antioxidant content in fresh leaves and RTUP

Antioxidants are chemicals that engage with reactive free radicals and block the onset or spread of oxidative chain reactions before important molecules are destroyed (Ismail et al., 2004). Based on Table 2, the results showed that there is no significant different on scavenging activity between the fresh leaves and RTUP of *S. polyanthum*. The IC_{50} values were ranged from 0.17 mg/mL and 0.14 mg/mL respectively. A lower IC_{50} value suggested that the sample had higher antioxidant activity (Ramaiya *et al.,* 2014). The inhibition values obtained in this study were slightly higher than the findings of Hidayati *et al.* (2017) which was 0.04 mg/mL and Pratama *et al.* (2021) that ranged from 0.02 mg/mL to 0.03 mg/mL respectively on the methanol extract of *S. polyanthum*. DPPH assay is a straightforward procedure that is frequently utilised. It is based on the antioxidant reducing the violet DPPH radical via a hydrogen atom transfer process, resulting in stable pale-yellow DPPH molecules (Sirivibulkovit *et al.,* 2018).

FRAP assay was first introduced by Benzie and Strain (1996) as a way to assess antioxidant power. It works by reducing Fe^{3+} to Fe^{2+} in the presence of Tripyridyl-s-Triazine

Table 1: Mean proximate composition between fresh and RTUP of *Syzygium polyanthum*

	Moisture (%)	Ash (%)	Crude protein (%)	Crude fiber (%)	Crude fat (%)	CHO (%)	Energy (kcal/100 g)	Composition trend
Fresh leaves	62.43±0.68[a]	1.88±0.03[b]	1.44±0.06[b]	16.22±2.53[a]	0.35±0.04[b]	61.32±2.56[b]	225.37±8.84[b]	CHO > moisture > fiber > ash > protein > fat
RTUP	0.74±0.12[b]	6.61±0.05[a]	6.83±0.08[a]	15.79±0.08[b]	3.28±0.13[a]	84.68±1.03[a]	396.33±3.51[a]	CHO > fiber > protein > ash > fat > moisture

Means in the same column with a different letter are significantly different (t-test, P<0.05)

Table 2: Antioxidant activity between fresh leaves and RTUP

	DPPH IC_{50} (mg/mL)	FRAP (mg/g)
Fresh leaves	0.17±0.005[a]	9.4±0.011[a]
RTUP	0.14±0.005[a]	5.6±0.0242[b]

Means and standard error value in the same column with a different letter are significantly different (t- test, p<0.05)

(TPTZ), resulting in a blue-colored ferrous tripyridyl triazine complex. UV absorbance, which is best read at 593 nm, is used to measure the intensity of violet blue coloured complexes (Henderson *et al.,* 2015; Lubaina *et al.,* 2016). Fresh leaves and RTUP of *S. polyanthum* have significant difference with 9.4 mg TE/g and 5.6 mg TE/g respectively (Table 2). However, both samples had medium to high ferric reducing power ability.

Effect of temperature towards recovery time of RTUP

Figure 3 shows that the rehydration time of the RTUP decrease when the temperature increases. Different temperatures significantly affect the recovery time of the RTUP. This outcome could be explained by the water diffusing into the material more quickly as the temperature of the steeping water rises (Soysal & Ismail, 2017). The aroma and colour of RTUP were also stronger when the water bath temperature increases. Use of xanthan gum as a binder enables the capture of the enhancing volatile oils and pigments, which transform into mucilage upon contact with hot water.

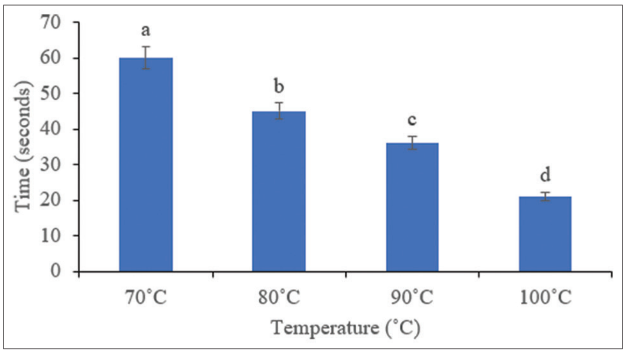

Figure 3: Effect of different temperature on recovery time of RTUP

Organoleptic evaluation of RTUP

Sensory evaluation of overall acceptability was conducted using a five-point hedonic scale. Based on the results, the products from both species were perceived as having high value in the organoleptic evaluation. Product for *S. polyanthum* have high value in taste (4.51), followed by aroma (4.3), texture (4.28), appearance (4.21), and colour (4.04). The quality number of the cube is quite high with 4.18 (Table 3). High quality number can help to identify the critical sensory features that influence acceptance of consumer. Sensory features such as smell, taste, and appearance have a greater impact on food acceptability than nutritional content, and they play an important part in food selection (Chepkosgei & Orina, 2021). Therefore, sensory evaluation has become an important part of the creation of food products, and standards for setting up, testing, analysing, and interpreting sensory results have improved significantly (Sharif *et al.,* 2017).

Sensory profile of different dishes served

Sensory perception of a food may influence the individual's appetite, food selection and acceptability, food consumption volume, and post-meal fullness and satisfaction (Sørensen *et al.,* 2003). Food flavour (i.e., taste, smell, and chemaesthetic experience) may have a significant impact on the amount of food consumed and the level of satisfaction (Mouritsen, 2012). Based on the finding of this study, the sensory profile between both dishes showed a slightly different pattern (Figure 4). The taste of a dish prepared using RTUP (Dish A) is most likely to have quite sour, salty and umami flavour. The hedonic number of umami taste for Dish B also slightly higher compared to Dish B (fresh leaves). Savoury, meaty, or broth-like flavours are some examples of umami flavours (Ghirri & Bignetti, 2012). Previous studies described that savoury foods containing a lot of umami are linked to higher customer acceptance from the perspective of palatability. In addition, panellists detected that the aroma of both dishes were fragrant and citrusy. However, hedonic number of fragrant and citrusy was higher in Dish A. These two-aroma profiles were very important to improve the perception and acceptability of the consumers towards the food. In culinary, citrusy aroma has usually been used to eliminate foul odour from the protein source (Yusli *et al.,* 2021). Response and sensations towards food initiated by aroma can also influence the food bite size (de Wijk *et al.,* 2009). The result of previous study showed that consumers self-regulate their experiences via bite size, whereby weak sensations are increased via bigger bite sizes and stronger sensations are diminished via smaller bite sizes (de Wijk *et al.,* 2009). This leads them to reduce the bite size when sensations grow more powerful. However, consumer expectations and needs determine whether food will be accepted or rejected in its whole (Mosca *et al.,* 2015).

From the sensory profile obtained for both dishes, the present study found that the panellists were more attracted to Dish A compared to Dish B. Positive response toward Dish A proved that RTUP is able to improve the sensory profile, acceptability, and palatability of dishes. About 68.8% of panellists prefer Dish A as more appealing compared to Dish B with only 32.5%. This may be due to the sensory

Table 3: Organoleptic evaluation of RTUP

Taste	Appearance	Texture	Colour	Aroma	Quality number
0.51±0.76[a]	4.21±0.88[a]	4.28±0.84[a]	4.04±0.91[a]	4.3±0.79[a]	4.18±0.13[a]

Values are means and standard deviation according to the number of respondents (n=80) where different letter in the same row are significant different (Tukey, p<0.05)

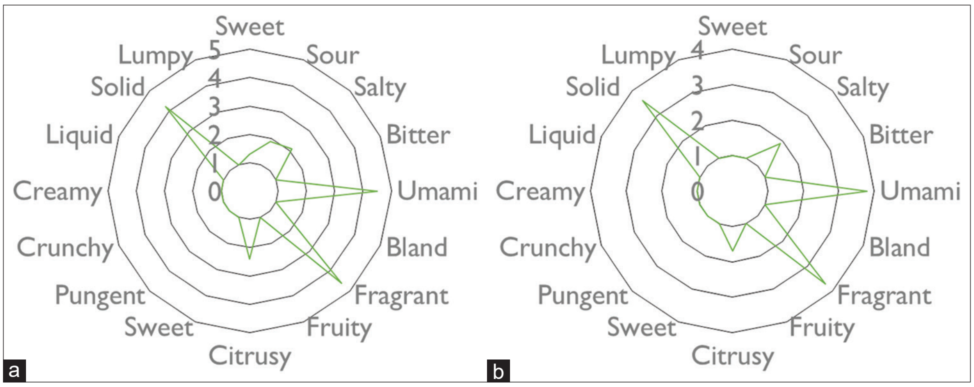

Figure 4: Sensory profile between two different dishes; a) Sensory profile of Dish A (RTUP), b) sensory profile of Dish B (fresh leaves)

profile of Dish A that high in hedonic number especially for the flavour and aroma. 67.5% of panellists also informed that Dish A will be eaten more frequently compared to Dish B. Therefore, the development of RTUP showed positive outcome and allow a chance for domestication.

Conclusion

From a previous study, *Syzygium polyanthum* has been identified as a crop that has potential to be developed as a food flavour enhancer. This allows development of the crop as an instant product that can be introduced to the market and to be domesticated. After considering all the preceding findings, it can be concluded that food processing does make some alteration toward the nutrient composition and antioxidant content of the crops. Throughout the course of this development, also has been discovered that *S. polyanthum* not only capable of being used as a flavour enhancer but these species are also recorded to have advantages referring to medicinal functions. Further study can be conducted to strengthen the development record of the product not only as a food additive but also as a functional food and various formulation to improve the RTUP can be introduced.

Author contributions

Nurul Aisyah Yusli: Data curation, Investigation, Formal analysis, Methodology, Writing – original draft. Noorasmah Saupi: Funding acquisition, Supervision, Writing – review & editing. Hanisah Kamilah: Project administration, Supervision, Validation. Shiamala Devi Ramaiya: Supervision, Writing– review & editing. All authors approved the final manuscript.

Acknowledgment

The authors are thankful for the use of laboratory facilities of the Faculty Agricultural Science and Forestry, University Putra Malaysia Bintulu Campus. The authors also thank Sarawak Biodiversity Centre for the approval (18) JKM/SPU/608-8/2/1 Vol.3 to conduct research and collect the living sources for research purposes.

References

Akhtar, S., Ali, J., Khan, F. A., Javid, B., Hassan, S., & Abbas, S. (2014). Preparation of instant tomato ketchup powder and comparison of its physiochemical composition with different brands of tomato ketchup available in market. *American-Eurasian Journal of Agricultural and Environmental Sciences, 14*(3), 190-192.

AOAC. (1990). *Official methods of analysis* (14th ed.). Washington, D.C.: Association of Official Analytical Chemists.

Attokaran, M. (2017). *Natural food flavors and colorants*. Wiley-Blackwell.

Benzie, I. F. F., & Strain, J. J. (1996). The Ferric Reducing Ability of Plasma (FRAP) as a measure of "Antioxidant Power": The FRAP Assay. *Analytical Biochemistry, 239*(1), 70-76. https://doi.org/10.1006/abio.1996.0292

Brand-Williams, W., Cuvelier, M. E., & Berset, C. (1995). Use of a free radical method to evaluate antioxidant activity. *LWT - Food Science and Technology, 28*(1), 25-30. https://doi.org/10.1016/S0023-6438(95)80008-5

Brown, L. G. (1989). The strategic and tactical implications of convenience in consumer product marketing. *Journal of Consumer Marketing, 6*(3), 13-19. https://doi.org/10.1108/EUM0000000002550

Carrigan, M., & Szmigin, I. (2006). Mothers of invention: Maternal empowerment and convenience consumption. *European Journal of Marketing, 40*(9-10), 1122-1142. https://doi.org/10.1108/03090560610681041

Chai, P. (2000). Ethnobotanical survey in the Lajak Entimau Wildlife Sanctuary. In P. P. K. Chai & K. S. Yaw (Eds.), *Proceedings of the ITTO Workshop 2000: Development of Lajak Entimau Wildlife Sanctuary as a Totally Protected Area*. International Tropical Timber Organization.

Chepkosgei, T., & Orina, I. (2021). Quality and sensory properties of instant fried noodles made with soybean and carrot pomace flour. *African Journal of Food Science, 15*(3), 92–99. https://doi.org/10.5897/AJFS2020.2019

de Wijk, R. A., Polet, I. A., Boek, W., Coenraad, S., & Bult, J. H. F. (2012). Food aroma affects bite size. *Flavour, 1*, 3. https://doi.org/10.1186/2044-7248-1-3

El Wakeel, M. A. (2007). *Ultra structure and functional properties of some dry mixes of food*. Master's Thesis, Ain Shams University.

El-Sherif, G., & El-Hadidy, E. (2018). Production of new untraditional healthy instant cubes from some Egyptian vegetables mixes. *World Journal of Dairy & Food Sciences, 13*(2), 74-80.

Ghirri, A., & Bignetti, E. (2012). Occurrence and role of umami molecules in foods. *International Journal of Food Sciences and Nutrition, 63*(7), 871-881. https://doi.org/10.3109/09637486.2012.676028

Halim, Y., & Maryani. (2022). Functional and sensory properties of Indonesian bay leaf (*Syzygium polyanthum*) herbal tea. *Food Research, 6*(2), 25-33.

Harismah, K., & dan Chusniatun. (2016). Pemanfaatan daun salam (*Eugenia polyantha*) sebagai obat herbal dan rempah penyedap makanan [Utilization of bay leaves (*Eugenia polyantha*) as herbal medicine and food flavoring spices]. *Warta LPM, 19*(2), 110-118. https://doi.org/10.23917/warta.v19i2.2742

Henderson, T., Nigam, P., & Owusu-Apenten, R. (2015). A universally calibrated microplate ferric reducing antioxidant power (FRAP) assay for foods and applications to Manuka honey. *Food Chemistry*, *174*, 119-123. https://doi.org/10.1016/j.foodchem.2014.11.009

Hidayati, M. D., Ersam, T., Shimizu, K., & Fatmawati, S. (2017). Antioxidant activity of *Syzygium polyanthum* extracts. *Indonesian Journal of Chemistry, 17*(1), 49-53. https://doi.org/10.22146/ijc.23545

Ismail, A., Marjan, Z. M., & Foong, C. W. (2004). Total antioxidant activity and phenolic content in selected vegetables. *Food Chemistry*, *87*, 581-586. https://doi.org/10.1016/j.foodchem.2004.01.010

Ismail, A., & Wan Ahmad, W. A. N. (2019). *Syzygium polyanthum* (Wight) Walp: A potential phytomedicine. *Pharmacognosy Journal, 11*(2), 429-438. https://doi.org/10.5530/pj.2019.11.67

Jediut, M., Utama, W., & Madu, F. (2018). Pembuatan teh herbal daun salam sebagai minuman alternatif pada peserta posyandu Dusun Akel dan Dusun Cipi Kecamatan Cibal Barat [Making bay leaf herbal tea as an alternative drink for participants in the integrated health posts (Posyandu) in Akel Hamlet and Cipi Hamlet, West Cibal District]. *Jurnal Inovasi Pendidikan Dasar, 2*(2), 169-174.

Krokida, M. K., & Marinos-Kouris, D. (2003). Rehydration kinetics of dehydrated products. *Journal of Food Engineering, 57*(1), 1-7. https://doi.org/10.1016/S0260-8774(02)00214-5

Lilian, U. N., Prisca, U. I., Ozioma, M., Nkechi, O., & Ifeoma, I. (2013). Proximate analysis and mineral content of three commonly used seasonings in Nigeria. *IOSR Journal of Environmental Science, Toxicology and Food Technology, 5*(1), 11-14. https://doi.org/10.9790/2402-0511114

Loliger, J. (2000). Function and importance of glutamate for savory foods. *The Journal of Nutrition*, *130*(4), 915-920. https://doi.org/10.1093/jn/130.4.915S

Lubaina, A. S., Brijithlal, N. D., & Murugan, K. (2016). Phytochemical analysis and antioxidant potentiality of *Premna serratifolia* L.: An aromatic medicinal plant. *World Journal of Pharmaceutical Research, 5*(12), 840-852.

Maser, W. H., & Marsella, E. (2019). Preparation of instant holat spices with two formulas and sensory evaluation. *International Journal of Food Science and Nutrition, 4*(2), 16-18.

Mosca, A. C., van de Velde, F., Bult, J. H., van Boekel, M. A., & Stieger, M. (2015). Taste enhancement in food gels: Effect of fracture properties on oral breakdown, bolus formation and sweetness intensity. *Food Hydrocolloids, 43*, 794-802. https://doi.org/10.1016/j.foodhyd.2014.08.009

Mouritsen, O. G. (2012). Umami flavour as a means of regulating food intake and improving nutrition and health. *The Journal of Nutrition Health and Aging, 21*, 56-75. https://doi.org/10.1177/0260106012445537

Nieβen, M., & Thö Iking S. (2007). *Sensorische Prüfverfahren – Anpassung für mittelständische Betriebe*. BEHR`S Verlag.

Niththiya, N., Vasantharuba, S., Subajini, M., & Srivijeindran, S. (2014). Formulation of instant soup mix dry using uncooked *Palmyrah* (*Borassus flabellifer*) tuber flour and locally available vegetable. In *Proceedings of the Jaffna University International Research Conference* (pp. 198-202). University of Jaffna.

Pratama, B. P., Pranoto, Y., Supriyadi & Swasono, R. T. (2022). The properties of salam leaf extract (*Syzygium polyanthum*) with different solvent ratio and processing time using ultrasonication-assisted extraction method. *Journal of Applied Science & Process Engineering, 26*(4), 581-587. https://doi.org/10.6180/jase.202304_26(4).0015

Rajurkar, N. S., & Hande, S. M. (2011). Estimation of phytochemical content and antioxidant activity of some selected traditional Indian medicinal plants. *Indian Journal of Pharmaceutical Sciences, 73*(2), 146-151. https://doi.org/10.4103/0250-474X.91574

Ramaiya, S. D., Bujang, J. S., & Zakaria, M. H. (2014). Assessment of total phenolic, antioxidant, and antibacterial activities of *Passiflora* species. *The Scientific World Journal, 2014*, 1-10. https://doi.org/10.1155/2014/167309

Ravindran, P. (2017). *The encyclopedia of herbs and spices*. CABI.

Saupi, N., Saidin, A. A., Zakaria, M. H., Sarbini, S. R., & Yusli, N. A. (2020). An ethnobotanical study of indigenous leafy vegetables among local communities in Bintulu, Sarawak, Malaysia. *Borneo Journal of Resource Science and Technology, 10*(2), 155-165. https://doi.org/10.33736/bjrst.2623.2020

Sharif, M. K., Butt, M. S., Sharif, H. R., & Nasir, M. (2017). Sensory evaluation and consumer acceptability. In I. A. Khan & M. Farooq (Eds.), *Handbook of Food Science and Technology* (pp. 362-386).

Sirivibulkovit, K., Nouanthavong, S., & Sameenoi, Y. (2018). Paper-based DPPH assay for antioxidant activity analysis. *Analytical Sciences, 34*, 795-800. https://doi.org/10.2116/analsci.18P014

Sørensen, L. B., Møller, P., Flint, A., Martens, M., & Raben, A. (2003). Effect of sensory perception of foods on appetite and food intake: a review of studies on humans. *International Journal of Obesity, 27*, 1152-1166. https://doi.org/10.1038/sj.ijo.0802391

Soysal, F., & Ismail, O. (2017). Investigation of the effect of temperature and pretreatment on the rehydration capacities of dried nectarine slices. *Acta Scientiarum, 39*, 551-558. https://doi.org/10.4025/actascitechnol.v39i5.30412

Vargo, S. L., & Lusch, R. F. (2004). Evolving to a new dominant logic for marketing. *Journal of Marketing, 68*(1), 1-17. https://doi.org/10.1509/jmkg.68.1.1.24036

Vasan, D. (2019). Consumers' preference and consumption towards instant food products. *Think India Journal, 22*(14), 8333–8337.

Weerawatanakorn, M., Wu, J.-C., Pan, M.-H., & Ho, C.-T. (2015). Reactivity and stability of selected flavour compounds. *Journal of Food and Drug Analysis, 23*(2), 176-190. https://doi.org/10.1016/j.jfda.2015.02.001

Yusli, N. A., Saupi, N., Ramaiya, S. D., & Lirong, Y. A. (2021). An ethnobotanical study on indigenous food flavourings and aromatic enhancing plants used by the native communities of the Central Region of Sarawak. *Malaysian Applied Biology, 50*(3), 105-115. https://doi.org/10.55230/mabjournal.v50i3.1989

Ziegler, H. (2007). A dynamic business with taste—The flavour industry. In H. Ziegler (Ed.), *Flavouring: Production, composition, applications, regulations* (2nd ed., pp. 1-13). Wiley-VCH Verlag GmbH & Co. KGaA.