PERKEMBANGAN SERBUK PERISA MAKANAN BERASASKAN KRUPUK IKAN SUBGRED BERSAMA BAYAM MERAH *(Amaranthus tricolor L.)*

Development of Food Seasoning Powder from Subgrade Fish Cracker with Red Spinach (Amaranthus tricolor L.)

Mansoor Abdul Hamid[1*], **Nur Atikah Zulkefli**[2], **Rozekin Suratman**[3], **Oslida Martony**[4]
[1]Functional Foods Research Group, Food Technology and Bioprocessing Program, Faculty of Food Science and Nutrition, Universiti Malaysia Sabah, Jalan UMS, 88400 Kota Kinabalu, Sabah Malaysia
[2]Food Technology and Bioprocessing Program, Faculty of Food Science and Nutrition, Universiti Malaysia Sabah, Jalan UMS, 88400 Kota Kinabalu, Sabah Malaysia
[3]Rosmie Snack Industry Sdn Bhd, TB 19643, 1.5 Storey Light Industrial Building, Taman Unipark, 91000 Tawau Sabah, Malysia
[4]Politeknik Kesehatan Kemenkes Medan, Jl. Jamin Ginting, Km 13.5, Kel. Lau Cih Medan, Tuntungan 20136 Medan, Sumatera, Indonesia.

*Email: chot@ums.edu.my

ABSTRAK: Subgrade kerupuk ikan yang dikenal dengan amplang mengacu pada beberapa bagian amplang yang tidak memenuhi standar namun masih dapat dikonsumsi dan dijual dengan harga yang lebih murah, sehingga berkontribusi terhadap penurunan keuntungan perusahaan. Penelitian ini bertujuan untuk mengembangkan tepung penyedap makanan yang dibuat dari subgrade kerupuk ikan amplang dengan penambahan bayam merah (Amaranthus tricolor L.). Lima formulasi dikembangkan dengan bubuk amplang dan bubuk bayam merah masing-masing dalam kisaran 36,66% hingga 66,66% dan 0% hingga 30%. Formulasi terbaik dipilih berdasarkan evaluasi sensori, dilanjutkan dengan analisis nutrisi dan stabilitas penyimpanan. Formulasi 4 terpilih sebagai yang terbaik, yang terdiri dari 41,60% bubuk amplang subgrade dengan 25% bubuk bayam merah. Analisis proksimat menunjukkan F4 mengandung kadar air 6,18%, abu 0,64%, lemak kasar 9,83%, protein 12,69%, serat kasar 9,88%, serat pangan 47,27%, karbohidrat 61,46%, dan kandungan kalori 404,83 kkal/100 g, yang kandungan abu, protein, dan serat kasar meningkat secara signifikan dibandingkan dengan sampel kontrol. Aktivitas air (AW), warna dan status mikrobiologi tidak menunjukkan perubahan yang signifikan ($p > 0,05$) selama delapan minggu penyimpanan menunjukkan bahwa sampel stabil selama periode penyimpanan. Oleh karena itu, pengembangan bumbu bubuk ini dapat digunakan sebagai alternatif subgrade amplang untuk ditingkatkan daya terimanya dan meningkatkan nilai gizinya sehingga bermanfaat bagi konsumen.

Kata kunci: Krupuk ikan dasar, bayam, bubuk bumbu, nilai gizi, stabilitas penyimpanan.

ABSTRACT: *The subgrade of fish crackers known as amplang refers to some parts of amplang that do not meet the standard but can still be consumed and sold at a lower price, so it has contributed to the decrease in company profits. This study intends to develop a food seasoning powder created from the subgrade of amplang fish crackers with the addition of red spinach (Amaranthus tricolor L.). Five formulations were developed with amplang powder and red spinach powder in the range of 36.66% to 66.66% and 0% to 30%, respectively. The best formulation is chosen based on sensory evaluation, followed by nutritional analysis and storage stability. Formulation 4 was chosen as the best, which consists of 41.60% subgrade amplang powder with 25% red spinach powder. The proximate analysis showed the F4 contained 6.18% moisture, 0.64% ash, 9.83% crude fat, 12.69% protein, 9.88% crude fibre, 47.27% dietary fibre, 61.46% carbohydrate, and a calorie content of 404.83 kcal/100 g, which significantly increased in ash, protein, and crude fibre contents compared to the control sample. Water activity (A_W), colour and microbiological status showed no significant changes ($p > 0.05$) throughout the eight weeks of storage indicated that sample was stable during storage periods. Therefore, the development of this seasoning powder can be used as an alternative for*

amplang subgrade to be upgraded with better acceptability and enhance its nutritional value, which is beneficial to the consumer.

***Keywords**: Subgrade fish cracker, spinach, seasoning powder, nutritional value, storage stability.*

INTRODUCTION

Cracker, also known in local as Keropok, is a type of snack that is usually processed from fish, shrimp, or squid mixed with starch or sago flour as the main ingredient (Mohamaddan et al. 2016). In this study, fish crackers were used as the main ingredient in the development of food seasoning powder. Fish crackers, or amplang, were initially only widely known in East Kalimantan and North Kalimantan. However, keropok amplang also received good reception outside the area, which made it able to reach the same level of popularity among local residents in Malaysia, especially in certain parts of Sabah (Nor et al., 2020).

Food seasoning powder is a food additive that is normally added to porridge and whose purpose is to improve the overall taste of food and provide a pleasant aroma because it consists of salt, sugar, spices, herbs, and oil (Raghavan, 2006). There is a good chance that developing the seasoning powder industry has the potential to improve the country's economy because Malaysia is listed as the seventh country out of twenty-six other major countries that import spices from India between 2019 and 2020 (Malhota et al., 2021). The high import value of spices shows that Malaysia has a good acceptance of using spices as ingredients or main ingredients, especially as seasoning powder. At the same time, by 2020, the global market for seasoning powders and spices will be worth USD 14 billion. Between 2020 and 2027, demand for seasoning powder is expected to grow at a rate of 6.3%, making Asia Pacific the industry leader in seasoning powder and spices, where it accounts for 35% of the market (Agens, 2020). This proves that the use of spices as seasoning powder as well as for various other applications in Malaysia is at a high rate. Therefore, there is an opportunity for Malaysia to develop its economy through the powder industry. Normally, food seasoning powder available in the market focuses only on enhancing the taste but lacks certain nutrients, especially fibre. Therefore, red spinach is to be added in this study to improve the quality of the seasoning powder. Red spinach is a type of vegetable with a high production rate, can grow in hot weather, and is nutritious (Maurya & Arya, 2018). Generally, red spinach contains protein, carbohydrates, fat, minerals, fibre, iron, magnesium, potassium, and calcium that will help supply the nutrients needed by the body (Annisa et al., 2018). It is also considered a good source of dietary fibre and antioxidants that can help with intestinal problems such as colon cancer, benefit eye health, reduce oxidative stress, and reduce blood pressure (Dhingra et al., 2012).

This project focusing on the utilized the subgrade amplang since its has low market values due to its physical appearance. This study aim to develop food seasoning using this product based on sensory evaluation and its stability during storage. Development of this food seasoning also to increase its potential as new food products and at the same time give an alternative for food seasoning loves to be incorporated in their menus.

METHODOLOGY

Materials

1. Ingredients

Subgrade amplang fish crackers, red spinach (Amaranthus tricolor L.), cinnamon powder, salt, garlic powder, ginger powder, black pepper powder, and chilli powder.

2. Chemicals

Concentrated sulfuric acid, H2SO4, catalyst Potassium Sulphate, Cu2SO4, catalyst Copper Sulphate, K2SO4, Sodium Hydroxide, NaOH, Organic Solvent Diethyl Ether, Sodium Hydroxide, NaOH (0.275N), Phosphate Welding Solution, 2% boric acid, 0.1% green bromocresol (10 ml), 0.1% methyl red indicator in 95% alcohol (2 ml), 0.01N

hydrochloric acid (HCl), Ethanol (95%), 0.255N sulfuric acid (200 ml), 12.5g/L NaOH, 7 ml/L H2SO4, Nitric acid solution, Plate Dextrose Agar (PDA), peptone water

3. Apparatus

Apparatus used in conducting this project included drying oven (Mettler Toledo HG 530), Kjeldtex (Foss 035), soxtex (Foss 2133), Cabinet dryer, pH meter (Cyberscan pH510), Fibretex (Foss 255) and CFU counter. Beside that, all glassware used are Phyex brand and was rinsed properly before analysis to minimize the contamination and errors due to lacking in analysis steps.

Methods

1. Seasoning Preparation

All the ingredients used in the development of this seasoning powder, such as subgrade fish amplang powder, red spinach powder, cinnamon powder, salt, garlic powder, ginger powder, black pepper powder, and chilli powder, will be ground one by one using a commercial blender. According to Margasahayam & Balraj (2018), the aroma of spices is released when they are ground into powder. The process also brings out the unique flavour of the spice and increases the bioavailability of some nutrients in the powder. Next, all the ingredients that have been ground will be mixed again using a regular blender. After that, the mixture is filtered using a regular filter less than 500 µm in size to get a fine texture, and then let the powder mixture cool for a while at room temperature. Finally, the mixture is transferred to a plastic container or an airtight container that is also at room temperature to maintain its freshness.

2. Sensory Evaluation and Analysis

In this study, a total of six formulations will be produced and tested by comparing the formulations with control samples through sensory testing. This step is important to choosing the best formulation. Sensory evaluation was carried out by serving the panels with rice porridge with 5% seasoning. A nine-scale hedonic sensory test will be used in this study, where various attributes such as aroma, colour, taste, saltiness, and the overall acceptance of the spice powder can be determined. In addition, the proximate analysis aims to determine the content of moisture, ash, protein, fat, and carbohydrates in food samples. The methods involved in the analysis are based on standardized methods, such as the AOAC method (2000). In addition, nutritional content analysis, such as dietary fibre analysis, is also carried out to determine the dietary fibre content of the seasoning powder, which is also based on the AOAC method (2000). Next, the physicochemical and microbiological properties of the best formulation will be determined through storage quality tests. Statistical Analysis: The software Statistical Package for Social Sciences (SPSS) version 28 was used to analyse all the collected data. The significance level of SPSS was set at at least 95%.

RESULTS

1. Sensory Evaluation

Based on the above results in Table 1, formulation F4 is the formulation that has the highest mean score. Next, a significant difference ($p<0.05$) can be seen between formulation F4 and formulations F1, F2, and F3. This is because the F4 formulation looks more coloured or darker because the amount of added subgrade fish cracker powder is lower compared to the F1, F2, and F3 formulations. In terms of aroma, the acceptable of formulation 4 was significant higher ($p<0.05$) as compared to other formulations indicated as raw vegetables aroma. Next, the taste attribute shows a significant difference ($p<0.05$) between formulations F4 and F1, F2, F3, and F5. This significant difference is due to the original taste of red spinach, which is described as having a leafy taste.

Apart from that, there is a significant difference ($p<0.05$) between formulation F4 and formulations F1, F2, F3, and F5 for saltiness. Therefore, it is likely that significant saltiness is associated with different amounts of red spinach powder addition. Red spinach contains flavonoid chemicals such as quercetin and So, the increasing content of red spinach from

formulation F1 to F5 may have masked the salty taste with a bitter taste. Therefore, it has influenced the panelist sense of taste, which has caused variations in terms of its saltiness.

Table 1. Mean Score Attributes of Five Seasoning Formulations and Control Sample

Attribute	Mean score ± standard deviation					
	F0	F1	F2	F3	F4	F5
Color	$6.11±1.10^{c}$	$6.12±1.06^{c}$	$6.62±1.30^{b}$	$6.54±1.5^{b}$	$7.22±0.95^{a}$	$7.08±1.05^{ab}$
Aroma	$6.25±0.98^{b}$	$6.30±1.13^{b}$	$6.60±1.47^{b}$	$6.60±1.5^{b}$	$7.30±1.09^{a}$	$6.86±1.54^{ab}$
Taste	$6.37±1.09^{b}$	$5.98±1.49^{b}$	$6.26±1.43^{b}$	$6.06±1.4^{b}$	$7.12±0.92^{a}$	$5.68±1.03^{b}$
Saltiness	$5.24±1.21^{c}$	$6.16±1.44^{b}$	$6.20±1.43^{b}$	$6.04±1.4^{b}$	$7.18±0.98^{a}$	$5.76±1.98^{b}$
Overall acceptance	$6.00±1.25^{b}$	$6.26±1.34^{b}$	$6.42±1.36^{b}$	$6.20±1.4^{b}$	$7.30±0.65^{a}$	$5.92±1.84^{b}$

Finally, overall acceptance describes whether a food product is acceptable to the majority of consumers. There is a significant difference ($p<0.05$) between formulation F4 and formulations F1, F2, F3, and F5 in overall acceptance. Therefore, among the possible explanations for this significant difference is that it stems from the mean score value for the best formulation sample, F4, which meets all the criteria for the seasoning powder and is accepted as a whole in every attribute tested in this hedonic sensory test. In general, the correct amount or ratio of each ingredient used in the development of a food product affects its overall acceptance.

2. Nutritional Values

a. Proximate Values

Based on Table 2, there is a significant difference ($p<0.05$) in the moisture content between these two formulations which is F4 and control with values of 6.18% and 8.36% respectively. Formulation F4 contains ash as much as 0.64 ± 0.02% while Formulation F0 contains ash as much as 0.45 ± 0.09%. Therefore, the ash content in the F4 formulation is higher when compared to the F0 formulation. In addition, the F4 formulation recorded a protein content value of 12.69 ± 0.34%. Next, the fat content of F4 and F0 formulations is 9.83 ± 0.32% and 23.15 ± 8.00% showed a significant difference ($p<0.05$) can be seen in both formulations of the seasoning powder. The F0 formulation recorded a reading of 8.42 ± 0.22% of protein. There was a significant difference ($p<0.05$) in protein content between the two formulations. Formulation F4 has a crude fibre content of 9.88 ± 0.01% with significantly higher ($p<0.05$) compared to F0 (8.92±0.04%). Formulation F4 also has a carbohydrate content of 61.46 ± 1.58% as compared to Formulation F0 with 52.21 ± 8.21%. There is a significant difference ($p<0.05$) between formulation F4 and formulation F0. Finally, the F4 seasoning powder recorded a total energy reading of 404.83 kcal/100g was significantly lower ($p<0.05$) compared the F0 formulation (468.71 kcal/100g).

Table 2. Proximate Values and Total Energy of F4 and Control Sample

Composition (%)	(Mean ± standard deviation)	
	F4	F0
Moisture content	$6.18±0.51^{b}$	$8.36±0.01^{a}$
Ash	$1.64±0.02^{a}$	$0.45±0.09^{b}$
Fat	$9.83±0.32^{b}$	$18.48±0.08^{a}$
Protein	$9.69±0.34^{a}$	$8.42±0.22^{b}$
Crude fibre	$11.88±0.01^{a}$	$3.92±0.04^{b}$
Carbohydrate	$61.46±1.58^{a}$	$60.54±1.54^{a}$
Total energy (kcal/100g)	404.83	468.71

b. Dietary fibre

The dietary fibre content of F4 was 47.27 0.01 g/100 g, which was significantly higher ($p<0.05$) compared to the control (17.98 0.01 g/100g. This is because spinach powder added in F4 contributed to increasing the fibre content of the formulation. Other

ingredients such as cinnamon, chilli, ginger, etc. also contributed to increasing the fibre content.

3. Physicochemical Characteristics

a. Water Activity (A_w)

The water activity of both control and best samples showed no significant difference ($p>0.05$), through out 8 weeks storage periods with A_W in the ranges of 0.43 to 0.51, and 0.35 to 0.43, respectively (Table 3).

Table 3. Water Activity (A_W) of F4 and Control Sample During Storage

Week	Water activity(A_w) (Mean ± standard deviation)	
	F4	F0
0	0.35±0.03[a]	0.43±0.02[a]
4	0.41±0.01[a]	0.47±0.00[a]
8	0.43±0.02[a]	0.51±0.01[a]

b. Colour Changes

Based on Table 4, no significant colour change ($p>0.05$) has occurred throughout the storage period. This value has been measured using the L a* b* value. The pigment from the red spinach powder seems to have given colour to the seasoning powder, which makes the colour darker. Therefore, the control formulation, F0, has a significantly higher L* value than the best formulation, F4. Next, the a* reading value also shows a decreasing pattern in which the redness and greenness have faded throughout the storage period. The control formulation, F0, has a higher a* value than the best formulation sample, F4. Additionally, the value of b* also experienced the same situation where the value was higher at F0 compared to F4, and it can be seen that the value of b* also decreased throughout the storage period.*

Table 4. The L,a,b Values of F4 and Control Sample for Colour Stability during Storage

Formulation	*Week*	*Color (mean ± standard deviation)*		
		*L**	*a**	*b**
F4	*0*	*44.56±0.02[a]*	*8.72±0.02[a]*	*29.93±0.11[a]*
	4	*43.94±0.01[a]*	*7.67±0.04[a]*	*28.79±0.06[a]*
	8	*43.74±0.01[a]*	*7.62±0.01[a]*	*28.22±0.04[a]*
F0	*0*	*53.56±0.01[a]*	*20.72±0.01[a]*	*40.96±0.02[a]*
	4	*52.59±0.01[a]*	*19.99±0.03[a]*	*40.46±0.06[a]*
	8	*52.06±0.00[a]*	*19.93±0.04[a]*	*40.40±0.50[a]*

4. Microbiology Status

Based on Table 4, the growth of yeast and fungal colonies on PDA media has shown an increasing pattern throughout the storage period. Through out the 8-week storage periods, the sample showed no significantly increased ($p > 0.05$) levels of yeast and mould growth in the range of 1.72 x10^1 CFU/g to 4.03 x10^2 CFU/g.

Table 5. Microbiological Status of F4 and Control Sample during Storage

Week	*Total yeast and mould (CFU/g)*
0	*1.72 x 10^1*
2	*1.52 x 10^2*
4	*3.76 x 10^2*
6	*3.90 x 10^2*
8	*4.03 x 10^2*

DISCUSSION

1. Sensory Evaluation

According to Everitt (2009), food products that get a mean score of 7.00 or more on a scale of 1 to 9 usually show a very acceptable sensory quality. Aroma of Formulation 5 has the strongest and dislike by panels indicated the raw vegetables aroma contributed by 25% of red spinach powder. This result in line with study by Aryantie (2017) found that the increase in the quantity of red spinach leaf powder has lowered the level of liking for the aroma of yoghurt and indicated that additional of 10% red spinach gave the better acceptance compared to yoghurt with 20% red spinach. Therefore, it is clear that an increase in the quantity of red spinach powder affects the level of acceptance of the aroma of this seasoning powder. In this study, the panelists preferred formulation F4. This may be due to the aroma of the four samples, which are almost the same because the smell of the powder is almost the same.This may affect the panellists' sense of taste because each individual has a different sense of taste and level of acceptance towards it (Aryantie, 2017). A bitter taste has been identified in various types of plants, including spinach. Tannin, which are often associated with bitterness and astringency (Pradana et al., 2017). According to Henney et al. (2010), one of the ways that salt can improve taste is by masking less desirable tastes, such as bitterness.

2. Nutritional Values

a. Proximate Values

The difference in moisture content of F4 and control formulation may be due to the presence of red spinach powder because the fibre component in the powder will increase as the powder is added. The fibre will absorb water or moisture, making the powder drier overall. Good quality seasoning powder is said to have a moisture content that does not exceed 11% and it is able to last longer during its storage period (Zachariah, 2020). The ash content indicates that the mineral content is higher in the F4 formulation because the increase in ash content is in line with the number of minerals contained in the food product (Yusuf et al., 2021).

F0 formulation contains a high addition of subgrade fish cracker powder, which is as much as 66.60%. As is known, amplang crackers are a type of light food or snack that is made by frying in full oil. According to Lumanlan et al. (2019), the practise of frying in full oil produces and increases a large amount of fat content. Fried food has its own unique taste and texture as a result of physical and chemical changes with the absorption of oil. The higher protein content of the F4 formulation is due to the red spinach powder. Although the F0 formulation has a higher ratio of subgrade fish cracker powder, it cannot reach the protein content of the F4 formulation because red spinach is also enriched with a high protein content. Therefore, the mixing of red spinach powder and subgrade fish cracker powder is an advantage of the F4 formulation. According to Sarker and Oba (2019), red spinach leaves are a high source of protein, where the protein proximate value is between 11.38% and 62.26%. Accordingly, most processed fish crackers have a low protein content. This is because, due to the high temperature during the frying process, the fish protein has been denatured and oxidized, which results in the food product having a brighter colour (Wan Abdullah et al., 2018).

Crude fibre value of F4 formulation showed significantly higher ($p<0.05$) compared to F0 was due to the addition of red spinach powder to the formulation that has been developed. The study conducted on red spinach found that it has a high amount of crude fibre, as much as 24% of which is located in the leaf part, thus making it a healthy vegetable that is able to maintain the health, especially of the human digestive system (Malathy et al., 2012). This happens because the F4 formulation has advantages in terms of the ingredients used. The control formulation, which is F0, does not have the addition of red spinach powder, and the majority of the ingredient percentage is subgrade fish amplang cracker powder (66.60%). A significant difference can be seen because the amount of energy content is guided or influenced by the value obtained from the proximate analysis of protein, carbohydrates, fat, and crude

fibre in a food product. In this research on the development of seasoning powder, formulation F4 has a lower total energy content due to its low total fat content due to the addition of red spinach powder to the formulation.

b. Dietary fibre

According to the Food Act 1983 and Food Regulation 1985, this seasoning powder has met the standard of not less than 3g per 100g of solid food. Apart from that, based on CFR CODE 21 and the Codex Alimentarius Commission (2007), solid foods can be categorized as foods containing high fibre content if they contain more than 6 g per 100 g or 3 g per kcal (Gularte et al., 2012). Therefore, the addition of red spinach powder is able to increase the value of the fibre content aspect of this developed seasoning powder.

3. Physicochemical Characteristics

a. Water Activity (Aw)

The lower A_W of both samples is due to several possibilities, including good packaging condition with a laminated aluminium bag and a controlled storage environment. There are several factors contributing to the increase in water activity. According to Jalali et al. (2019), one of these is the process of transferring the amount of moisture from the outside into the sample storage container, which is a plastic jar. In addition, it can also be caused by temperature and pH (Sandulachi, 2012). Fungi and yeast development require a certain amount of activity to support their growth. Fungi can grow on foods with a water activity of 0.80, making them more resistant than most microorganisms. The fungus may also grow on food with a water activity of 0.70, although it takes months to mature at ambient temperature. Fungal growth stops with water activity less than 0.65. (Park, 2008). A water activity reading below 0.60 is desirable since it can help hinder the growth of other microbes besides fungus and yeast (Goodner & Rouseff, 2011).

b. Colour characteristic

According to Sahni & Shere (2018), the significant decrease in L value during storage is due to several factors, such as pigment instability during storage related to water activity, temperature, oxygen levels, and the presence of light. For the a* value, indicated that the control formulation does not have the addition of red spinach powder. It only consists of a mixture of spices and subgrade fish cracker powder. The high a* value is likely to come from chilli powder pigments, which are carotenoids and lycopene.The b* value contributed by red spinach consists of anthocyanin pigments that can be found in greater amounts in the leaves than in the stem. These pigments represent reddish and blueish colour. In addition, garlic powder also contributes to the yellowish pigment in this spice powder (Eppang et al., 2020). Next, this decrease to a yellowish colour is also caused by lipid oxidation (Barden & Decker, 2016). According to Nurhanan et al. (2021), brightness (L *), redness (a *), and yellowness (b *) will decrease when the percentage of green or red spinach powder increases. Longer storage times will result in a small decrease in all colour intensities for green and red spinach. This may be due to the oxidation activity in the red spinach pigment.*

4. Microbiology Status

Based on microbiology status of sample during storage indicated that product is still stable and not suitable condition for microbial growth due to its lower water activity (A_W) (Zambrano et al., 2019), and the ingredients used consist of spices and herbs that have antimicrobial properties (Zhang et al., 2019). According to the standards developed by the International Commission on Microbiology for Foods (ICMSF), the number of colonies should not exceed 6 log CFU/g (10^6 CFU/g).

CONCLUSIONS AND RECOMMENDATIONS

Food seasoning is a good alternative to enhance the subgrade amplang in order to overcome the fish cracker problems and minimize the underutilized of this product. The study showed the new product developed has been well accepted by panels and has better quality as compared to food seasonings available in the market. The best formulation developed

contained significantly increased ash, protein, and fibre and was reduced in calories. In addition, the sample was stable during storage due to a lower level of water activity (A_W) with an acceptable microbial load and was considered safe to be consumed.

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