

Umami Flavor Formulation of Agarwood Leaf Extract Powder

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Abstract

Fragrant, black, and resinous, agarwood (*Aquilaria spp.*) is utilised in many products, such as oils, incense, and perfumes. It has been utilised for medicinal purposes for thousands of years. One of the priciest non-timber wood products available worldwide is agarwood. Thus, another choice is to use the agarwood leaves because it is easier to find to be used in a variety of products. Although this leaf extract has been processed into a powder, the powder has an unpleasant, bitter taste. Therefore, the goal of this project is to transform the bitter taste of agarwood leaves into an umami taste and make them taste more palatable. Umami is known as the five basic tastes, along with sweet, salty, sour, and bitter. The end product, which is the treated umami-flavoured powder is a powder that can be used as food seasoning, snack coating and also can be a salt substitute in cooking. Bromelain enzyme has been used in the enzyme hydrolysis process to extract the umami flavour from this powder. Following that, three sample formulations were made that consisted of treated agarwood powder, sugar, salt, and sodium benzoate as preservatives. These three samples then went through two types of sensory evaluation, namely a 7-point hedonic test and a descriptive test to know the consumer's acceptance of this powder. The results of this test will then be evaluated using the ANOVA test. As a result, the best sample is the sample with the second formulation (sample 288) which uses 93.91% agarwood powder because it tastes not too salty and not too bitter with a mean score of 6.26 ± 0.876 .

1. Introduction

Agarwood is a non-timber forest product widely used in religious and cultural events in Asia as scent and aroma, and traditional medicine. The wood is also known as Gaharu in Malaysia and Indonesia in addition to its name. In Malaysia, the species of *Aquilaria* are referred to as karas, candan, kepong, tabak, and depu [1]. To qualify agarwood and access the marketing prices, it is crucial to know the contents and composition of the resin in the wood [2].

Unfortunately, the high demand of this plant causes the rapid extinction of this species' natural habitats. This plant species has been listed as one of the most endangered tree species in the world, due to the loss of its natural habitat, it is endangered. The high demand for this tree species causes the price to increase.

Due to the expensive price of this tree, another alternative was taken by utilizing its leaves as a food product. However, the problem was when agarwood leaf was transformed into powder, the taste is not palatable and bitter. Thus, to enhance the quality of agarwood leaf extract powder in the palatability aspect, this study will focus more on adding the umami flavour to the powder by using some chemical and biological reactions.

Many traditional dishes, such as soy sauce, cheese, and fermented Asian foods, have been associated with the umami flavour for a long time, even though this flavour attribute was just recently given official recognition. Umami, which refers to a pleasant savoury or MSG-like flavour, was recognised as the fifth basic taste in 2002 (after salty, sweet, sour, and bitter).

To create the umami flavour in this powder, the approach that is suitable to be used is by using a hydrolysis enzyme, which is Bromelain. A group of enzymes called hydrolases, commonly referred to as hydrolysis enzymes, catalyse the disintegration of different biomolecules through a hydrolysis reaction [3]. The end product, which is umami-flavoured agarwood powder, can be used in various ways such as snack coating, food seasoning or acting as salt substitute.

Thus, the aim of this study is to enhance the umami flavour of agarwood leaf extract powder by enzyme hydrolysis, to formulate the umami flavour for agarwood leaf extract powder and to evaluate the sensory acceptability of umami flavour of agarwood powder among participants.

2. Materials and Methods

2.1 Materials

The fresh and dried leaves were provided by Agarwood Global Ventured and collected in *Aquilaria* sp. plantation area. The bromelain enzyme was bought online from Bionutricia Extract (Official). The additional ingredients used were salt and sugar that were bought in Malaysia. Sodium benzoate that has been used to preserve the agarwood powder was bought online at A&T Ingredient Sdn Bhd.

2.2 Methods

2.2.1 Sample preparation

The chosen leaves are those that are free of pests and were collected and washed with tap water to remove all the dirt and impurities. The cleaned leaves then were dried in a smokehouse machine at 80°C for 1 hour and 40 minutes until a consistent weight was reached [4]. Then, the dried powder will be ground by using a bowl chopper for 5 minutes. The ground powder was filtered using a muslin cloth to make sure the powder had a fine texture. Then, the powdered sample was infused in water maintained at 95-100°C (1:10 w/v) for 30 min and the supernatant was filtered and lyophilized to obtain a dried aqueous extract of *A.malacencis* leaves [5].

2.2.2 Enzyme hydrolysis

A sample of three formulation samples of agarwood sample was created which is Sample 171 presents for first formulation which is T1 with 83.71% of agarwood powder, 8.37% of salt, 3.96% of sugar and 3.96% of Sodium Benzoate. Sample 288 presents the second formulation which is T2, this formulation consists of agarwood powder with 93.91 percent, salt with 3.13 percent, sugar with 1.48 percent and sodium benzoate with 1.48 percent. The third sample (857) represents the last formulation which is T3. This formulation has 96.25% of agarwood powder, 1.93% of salt, 0.91% of sugar and 0.91% of Sodium Benzoate. 2 types of sensory evaluation that was carried out which is 7-point hedonic test [8] and descriptive test. For the hedonic test, 50 untrained panelists were provided with the scoresheet with 7 scales starting from very unpleasant to very pleasant. For descriptive, 30 semi-trained panelists, sensory evaluation was assessed to know about the flavor profiling and the intensity of attributes which is flavor, aroma, umami, salty, bitterness, sweetness, after taste and overall acceptance. The gathered data then was examined using ANOVA by using SPSS 20.0 and Microsoft Office Excel 2019.

2.2.3 Sensory evaluation

A sample of three formulation samples of agarwood sample was created which is Sample 171 presenting for first formulation which is T1 with 83.71% of agarwood powder, 8.37% of salt, 3.96% of sugar and 3.96% of Sodium Benzoate. Sample 288 presenting the second formulation which is T2, this formulation consists of agarwood powder with 93.91 percent, salt with 3.13 percent, sugar with 1.48 percent and sodium benzoate with 1.48 percent. The third sample (857) represents the last formulation which is T3. This formulation has 96.25% of agarwood powder, 1.93% of salt, 0.91% of sugar and 0.91% of Sodium Benzoate. There were 2 types of sensory evaluation that was carried out which is 7-point hedonic test [8] and descriptive test. For the hedonic test, 50 untrained panelists were provided with the scoresheet with 7 scales starting from very unpleasant to very pleasant. For descriptive, 30 semi-trained panelists, sensory evaluation was assessed to know about the flavour

profiling and the intensity of attributes which is flavour, aroma, umami, salty, bitterness, sweetness, after taste and overall acceptance. The gathered data then was examined using ANOVA by using SPSS 20.0 and Microsoft Office Excel 2019.

3. Results and discussion

3.1 Sensory evaluation

There were 2 types of sensory evaluation that was carried out which is 7-point hedonic test and descriptive test. Three samples were presented to the panelist: 171, 288, and 857. The first formulation, T1, contained 83.71% agarwood powder, 8.37% salt, 3.96% sugar, and 3.96% sodium benzoate. The second formulation, T2, had 93.91% agarwood powder, 3.13% salt, 1.48% sugar, and 1.48% sodium benzoate. The third formulation, T3, had 96.25% agarwood powder, 1.93% salt, 0.91% sugar, and 0.91% sodium benzoate. Salt and sugar were used as flavor enhancers to remove the blunt and sweet taste.

Table 3.1 formulation of ingredient for umami flavour of *Aquilaria* powder

Ingredients	Treatment					
	T1		T2		T3	
	Tsp	%	Tsp	%	Tsp	%
Agarwood powder	5	83.71	15	93.91	25	96.25
Salt	1/2	8.37	1/2	3.13	1/2	1.93
Sugar	1/4	3.96	1/4	1.48	1/4	0.91
Sodium Benzoate	1/4	3.96	1/4	1.48	1/4	0.91

3.1.1 7-point hedonic

Table 3.2 Mean score for 7-point hedonic test

Attributes	171	288	857
Appearance	6.00	6.06	5.78
Odor	5.60	5.74	5.42
Color	5.76	5.90	5.50
Umami	5.54	5.88	4.90
Bitterness	4.96	5.70	5.28
Overall acceptance	5.72	6.26	5.32

Table 3.3 Result for 7-point hedonic test

Sample	Appearance	Odor	Color	Umami	Bitterness	Overall acceptance
171	6.00 ± 0.881 ^a	5.60 ± 0.916 ^a	5.76 ± 0.916 ^a	5.54 ± 1.073 ^b	4.96 ± 1.525 ^a	5.72 ± 1.051 ^a
288	6.06 ± 0.793 ^a	5.74 ± 1.026 ^a	5.90 ± 0.909 ^a	5.88 ± 1.239 ^b	5.70 ± 1.542 ^b	6.26 ± 0.876 ^b
857	5.78 ± 0.996 ^a	5.42 ± 1.279 ^a	5.50 ± 1.035 ^a	4.90 ± 1.298 ^a	5.28 ± 1.443 ^{ab}	5.32 ± 1.269 ^a

Table 3.4 One way ANOVA result for 7-point hedonic test

Attributes	P-value	Conclusion
Appearances	.260	NOT SIGNIFICANT
Odor	.356	NOT SIGNIFICANT
Color	.108	NOT SIGNIFICANT
Umami	.000	SIGNIFICANT
Bitterness	.050	SIGNIFICANT
Overall acceptance	.000	SIGNIFICANT

The 7-point hedonic test is shown in Table 3.2 while the one-way ANOVA result for this 7-point hedonic test is stated in table 3.4. The sample that has the highest acceptance level is 288 because it has the highest value of mean (6.26). The highest mean indicates that most of the panelists chose to vote higher for this sample as compared to the other sample. The second acceptable sample is 171(5.72) and the last is 857 (5.32).

The highest mean in appearance attributes is 6.06 which is for sample 288 but there was no significant difference between each sample. The ANOVA test result also shows that the P value is higher than 0.05 (P>0.05) which is 0.260. In odor, the highest mean also is for sample 288 which is 5.74, followed by sample 171 with 5.60 and sample 857 (5.42) and all samples have no significant difference. The ANOVA test also shows that the P-value is higher than 0.05 (P>0.05) which is 0.356. For color attributes, the highest mean is 288 (5.90) which indicates that most panelists preferred the color of sample 288. Based on Table 3.3, there was no significant difference between all samples in this attribute. The ANOVA result for color also shows that the P-value is higher than 0.05 (P>0.05).

There was a significant difference in three attributes which are umami, bitterness and also overall acceptance. From Table 3.2, it is observable that the sample that has the highest preference for umami flavor is sample 288 (5.88). Sample 171 with a mean score of 5.54 is not really preferred because it has a high concentration of agarwood powder. The lowest acceptance value based on the mean score is 857 with a mean score of 4.90. In table 3.2 in the bitterness section, shows that the highest mean is for sample 288 which is 5.70, followed by sample 857 which is 5.28 and the lowest value is for sample 171 which is 4.96. The result of ANOVA test result that is lower than 0.05 (p<0.05) in this section indicates that the panelist can differentiate the presence of bitterness between each sample.

3.1.2 Descriptive test

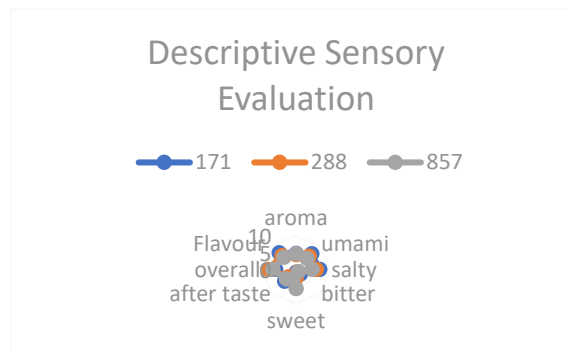


Figure 3.1 Spider web diagram for descriptive sensory attribute

Table 3.5 Mean score for descriptive test

Attributes	171	288	857
Flavour	7.00	5.80	5.12
Aroma	4.73	4.38	4.62
Umami	6.54	5.50	4.54
Salty	6.92	5.88	4.72
Bitterness	1.84	0.85	0.89
Sweetness	0.80	2.50	5.63
After taste	4.83	3.00	4.00
Overall acceptance	6.00	8.24	6.83

Table 3.6 Aroma and flavour that detected by semi-trained panelist

Attributes	
Aroma	Flavor
Savory	salty
Leafy	Umami
Bland	blunt
Sweet	sweet
Salty	
Barley	
Woody	
Flour	

Seasoning

Odourless

Earthy

Plant extract

Umami

Based on Table 3.5, the highest mean score means the highest intensity of attributes. Semi-trained panelists identified salty, umami, blunt, and sweet flavors in samples 171 (7.00), 288 (5.80), and 857 (5.12), with 857 having a threshold of sweet taste due to high enzyme-treated agarwood powder concentration. The panelist identified savory, umami, woody, and leafy aromas in samples 171 (4.62), 288 (4.38), and 171(4.73), with a high level of similarity to the signature aroma of agarwood powder.

Sample 171 exhibits the highest umami intensity with a mean score of 6.54, followed by 288 with a mean score 5.50 and 857 with a mean score 4.54, with sugar and salt added to enhance taste, with the lowest powder concentration exhibiting strong salt and sugar flavors. Flavor enhancer is a substance that, when added to food, increases or improves the dish's natural flavor. The phrase is most frequently used to describe adding savory flavors, usually by adding the amino acid L-glutamate and/or 5'-ribonucleotides.

Samples 171 (6.92), 288 (5.88), and 857 (4.72) exhibit different saltiness levels due to various concentrations of agarwood powder. Sample 171 has the strongest saltiness due to low agarwood powder concentration, while sample 857 has a higher agarwood powder concentration, making it difficult to detect salt and sugar. Sample 288, on the other hand, is preferred for affective sensory evaluation.

Table 3.5 reveals that the powder lacks bitterness, with the highest detectable bitterness in sample 171 is only 1.84, possibly due to salt. Samples 288 (0.85) and 875 (0.89) show minimal bitterness due to low salt concentration, making it difficult to differentiate between flavors.

Sample 857 has the highest sweet taste with a mean score of 5.63 due to its higher amount of agarwood powder treated with enzyme, resulting in a slightly stronger sweet taste compared to other samples and the lowest is 171 with a mean score of 0.80. The aftertaste is the intensity of a food or beverage's taste detected after consumption. In Table 3.5, 171 (4.83), 857 (4.00), and 288(3.00) have the highest levels of aftertaste due to higher salt concentrations and agarwood powder concentrations. The most acceptable sample is 288 with a mean score of 8.24, with a balanced umami taste, followed by 857 with a mean score of 6.83 and 171 with a mean score of 6.00, possibly due to its excessive saltiness, according to panelist preferences.

In table 3.6, shows the list of flavors that can be detected by the semi-trained panelist. There were panelists who can detect the salty, umami, blunt and sweet. For your information, the actual flavor and taste of agarwood powder is blunt and unpleasant, and after being treated with Bromelain enzyme, the taste was altered a bit into umami. Bromelain has the ability to improve the dish's overall umami flavor by breaking proteins and enhancing the release of free amino acids, such as glutamate.

4. Conclusion

This project successfully transformed the bitter taste of agarwood powder into a more palatable one using enzyme treatment. The enzyme effectively removed the bitterness from the original powder, resulting in a more palatable agarwood powder. The optimal pH and temperature for Bromelain catalysis were 7 pH and 50°C. Three formulations were developed to enhance the umami taste, and sensory evaluations were conducted by 50 panelists for a 7-point hedonic test and 30 semi-trained panelists for a descriptive test. In 7-point hedonic test, the most preferred formulation was sample 288 which contain 93.91% of treated agarwood powder, 3.13% of salt, 1.48% of sugar and 1.48% of sodium benzoate. In descriptive test, the semi-trained panelist was able to describe the taste and aroma of each sample such as woody, savory and leafy even though they do not know the specifics taste and aroma of agarwood powder. The end product which is Umami-flavoured agarwood powder that can be use in various function such as snack coating and salt substitute have successfully produced in this project.

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Conflict of interest

No potential conflict of interest relevant to this article was reported.

Author contribution

The authors confirm the contribution to the paper as follows: **Study conception and design:** Najwa Umairah Ramizu, Balkis A Talip; **Preparation of SPSS:** Najwa Umairah Ramizu, Balkis A Talip; **Data collection:** Najwa Umairah Ramizu; **Analysis and interpretation of result:** Najwa Umairah Ramizu; **Draft manuscript preparation:** Najwa Umairah Ramizu, Balkis A Talip. All authors reviewed the results and approved the final version of the manuscript.

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