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UTILIZATION OF RIPE NUTMEG HUSK (*Myristica* sp.) AS THE MAIN INGREDIENT ON SPICE BLEND POWDER

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Abstract: Nutmeg's kernel and mace has been known widely as spices. Nutmeg husk that is the largest part of nutmeg fruit, however, is almost remaining as waste. Nutmeg husk has a different character of flavour comparing to nutmeg kernel or mace that makes it potential to be developed as flavour material. This research aimed to explore the possibility of using ripe nutmeg husk as flavour material in the form of spice blend powder. The present study consisted of the determination of pre-treatment for reducing browning reaction, selection of appropriate drying process to obtain nutmeg husk powder, flavour description of the husk powder and the possibility of its application in food products. Optimum drying condition for producing nutmeg husk powder can be achieved by using tray dryer at temperature of 40° C. Flavour of nutmeg husk powder could be described as spicy, pungent, hot, sweet, fresh, and sour, with the strong intensity of spicy and pungent. Hot, pungent, and sweet were the main characters of nutmeg husk powder. Combination of nutmeg husk powder with cinnamon and or ginger powders could create a spice blend powder, which is suitable for food product such as cookies.

I. INTRODUCTION

Nutmeg husk is the largest part of nutmeg fruit (83.4%), which lacks of economic value comparing to nutmeg kernel or mace. After the nutmeg kernel and mace taken from the fruit, nutmeg husk is often thrown away as waste or only being used as organic fertilizer (Hadad *et al.*, 2000).

The use of aromatic plant materials to impart distinctive, enjoyable flavours has occurred throughout the world. The latest trend shows that consumers prefer spice blend than a regular single serving spices (Kuntz, 2001). Considering its strong and specific flavour, nutmeg husk could be developed as spices or flavour material. According to Hustiany (1994), nutmeg husks extract yielded 0.66% volatile oil and 5.79% oleoresin.

This research attempted to explore the possibility of using nutmeg husk as flavour material in the form of spice blend powder. The objectives of the present study were (1) obtaining an appropriate drying method to produce nutmeg husk powder, (2) to obtain characterisation of nutmeg husk powder flavour, (3) formulation of spice blend powder and its application in food products.

II. MATERIALS AND METHODS

Ripe nutmeg husk of Patina accession, harvested at the age of 9 to 10 months from IPPT Cicurug Collection Plantation, at Sukabumi, West Java. Cinnamon powder, ginger powder, clove powder, and chemical material such as toluene and natrium bisulphite were obtained commercially from stores at Bogor.

Determination of Pre-treatment for Reducing Browning Reaction

Pre-treatments were including blanching at 80°C with time variation of 5, 8, and 10 minutes; and soaking nutmeg husk in natrium bisuphite solution (2000 ppm) for 2, 6, and 12 hours. The most suitable pre-treatment was selected through organoleptic test and whiteness degree analysis.

Nutmeg husk powder production

Drying process was carried out by oven, tray dryer, and fluidized bed dryer, with drying temperature range between 40°C to 90°C. The optimum drying condition selection is based on two analysis, sensory analysis and physicochemical analysis (moisture, a_w, pH, whiteness degree, yield, and particle size). The dried husk was powdered by using warring blender.

Nutmeg Husk Flavour Description

Flavour description was conducted through sensory analysis using Quantitative Descriptive Analysis (QDA) method. For comparison, sensory analysis was also conducted to nutmeg kernel and mace powder

Spice Blend Powder Formulation and Application

As pre-study, a simple survey using questionnaire has been conducted to learn the consumer preferences on the type of spice used as blend mixture, and also the type of food product to apply the obtained spice blend in. Spice blend formulation was done through dry mix method. Nutmeg husk powder was blended with other spices powder such as ginger, clove and or cinnamon in several ratios. The selected spice blend then was applied to cookies.

III. RESULTS AND DISCUSSION

Pre-treatment for Reducing Browning Reaction

Browning reaction effected product's appearance, flavour and nutritional content (Eskin *et al.*, 1971). Non-enzymatic browning can cause off flavour, which giving stale character on food product after storage at certain temperature (Reinneccious, 1994). Higher whiteness degree of nutmeg husk powder could be achieved through soaking the raw material at 2000 ppm natrium bisulphite solution prior to the drying process. Blanching seems also being able to inhibit enzymatic browning, but natrium bisulphite exhibiting better inhibition because it might be able to inhibit both enzymatic and non-enzymatic browning.

Based on these analysis results as well as the sensory analysis (hedonic test) upon the whiteness degree, soaking the raw material in 2000 ppm natrium bisulphite solution for 12 hours prior to drying has been selected as pre-treatment method

Nutmeg Husk Powder Production

Four types of hot-air flow dryers have been utilized in this experiment. Each type of dryer has different optimum temperature. In order to reveal the optimum temperature for nutmeg husk drying, a range of temperatures 40° to 90°C has been investigated. The subjective sensory observation indicated that the optimum temperature for oven were 40° C and 60°C; for tray dryer were 40°C and 70°C, while for fluidized bed dryer were 40°C and 90°C. The common temperature range to dry spices is between 40° C to 70°C (Reinneccious, 1994).

Tray-dried powders were more preferred sensorically comparing to the powders produced by other drying methods (Table 1). Tray drying at 40° C gave powder with the best sensory acceptability.

The results of physicochemical measurements are shown at Table 2. The moisture content of obtained nutmeg husk powders range between 7.7% to 11.2%. This value fulfilled to the SNI (Indonesian National Standard) number 01-3709-1995 in related with the moisture content of spice powder, which maximum value 12

Table 1. Result of sensory preferences nutmeg husk powders produced by different drying conditions

Treatment	Parameter				Total value
	Aroma	Colour	Particle size	Appearance	
Oven40°C	5.20^{b}	5.05^{a}	3.90^{a}	4.40^{a}	4.75
Oven60°C	$4.90^{a.b}$	4.80^{a}	$4.45^{a.b}$	4.35^{a}	4.68
FBD40°C	4.20^{a}	4.90^{a}	$4.70^{a.b}$	4.45^{a}	4.49
FBD90°C	$4.60^{a.b}$	5.00^{a}	5.20^{b}	4.80^{a}	3.88
TD 40° C	5.25^{b}	4.95^{a}	4.90^{b}	5.15^{a}	5.10
TD 70° C	5.10^{b}	4.95^{a}	5.05^{b}	4.95^{a}	5.03

Note: TD = tray dryer, FBD = fluidized bed dryer
$^{a.b}$ different letter shows significance difference at $\alpha = 0.005$

Table 2. Physicochemical measures of nutmeg husk powders produced by different drying conditions

Sample	Moisture content (%)	a_w	Whiteness degree (%)	PH	Yields (%)	Particle size (%)
Oven 40°C	11.20^{e}	0.6608^{c}	50.3^{d}	$3.02^{a,b}$	9.12^{b}	67.65^{b}
Oven 60°C	11.17^{d}	0.6335^{b}	47.3^{b}	2.97^{a}	$8.70^{a,b}$	53.10^{a}
FBD 40°C	9.32^{c}	0.6337^{b}	43.8^{a}	3.00^{a}	$8.74^{a,b}$	$68.84^{b,c}$
FBD 90°C	7.77^{a}	0.6115^{b}	48.6^{c}	3.09^{c}	8.18^{a}	$71.52^{b,c}$
TD 40°C	9.07^{b}	0.5551^{a}	51.3^{d}	$3.06^{b,c}$	9.04^{b}	54.97^{a}
TD 70°C	9.32^{c}	0.6145^{b}	50.2^{d}	$3.02^{a,b}$	8.38^{a}	75.06^{c}

Note: TD = tray dryer, FBD = fluidized bed dryer
^{a,b} different letter shows significance difference at $\alpha = 0.005$

Water activity (a_w) is a critical factor for shelf life determination. It influences the microbiological deterioration, as well as enzyme and vitamin activity. It also affects the colour, taste and aroma of food material (Decagon, 2002). All samples had a_w value range between 0.5551- 0.6608. This value was also match with the a_w standard of powder product, which is maximum of 0.65. Since non-enzymatic browning, such as Maillard reaction, will occur more often at higher level of a_w and will reach its peak reaction at a_w value of 0.60-0.70, the products with a_w value under 0.60 will have better inhibition toward non enzymatic browning as well as enzymatic browning during storage. A_w value under 0.60 could only be achieved through drying material using tray dryer at 40°C temperature.

Statistical analysis showed that there was significance relationship between drying condition with whiteness degree. The higher the temperature will be the lower the whiteness degree. The test showed that sample from tray dryer with drying temperature of 40°C had the lowest a_w value and the highest whiteness degree. Water activity (a_w) affects the non-enzymatic and enzymatic browning inhibition. Product with low a_w able to reduce browning reaction, thus decrease the deterioration effect cause by it.

Based on its pH value, nutmeg husk powder can be classified as acid food with pH range between 2.97 to 3.09. No influence of drying condition on its acidity.

The yield of powders ranged from 8.18 to 9.12%. Oven and also try dried at 40°C revealed the high yields as 9.12% and 9.04%, respectively.

Particle size was measured using vibration filter with 50-mesh size. Particle size for samples range between 53.1% to 75.06%. It has statistically proven that drying condition has a significance relation with particle size value and coarseness. High temperature and low humidity might cause complex chemical and physical changes to product's surface and the formation of a hard impermeable skin, also known as case hardening reaction. When it occurs, the product's surface will look dry, while the inside is still wet. That condition will turn product into coarse upon grinding (Fellows, 1990).

As showed at the results of physicochemical as well as the sensory analysis, the tray dryer at temperature of 40° C performed nutmeg husk powder with the most optimal properties.

Nutmeg Husk Powder Flavour Description

There are 6 main flavour attributes that could be identified by trained panellist, including spicy, hot, fresh, pungent, sweet, and sour. Figure 1 shows that spicy has the highest intensity, followed with pungent. That might be mean that the first impression which panellists perceived after they sniffed the nutmeg husk powder was dominated by that spicy followed with pungent.

As shown at Table 3, there are differences between mace, nutmeg kernel, and nutmeg husk powder flavour attributes. The kernel powder possessed 5 attributes that could be identified as spicy, pungent, sweet, hot, and fresh. In mace, there are only four attributes that could be identified including spicy, fresh, oily and strong green. Spicy was found as the highest intensity in all powders. It seems that due to this attribute, the all three powders having role as spices.

Nutmeg kernel had similar attributes to the husk. Sour was the only attribute that did not appeared in the nutmeg kernel powder character, which might give the nutmeg husk powder a specific flavour. The different intensity of each attribute, however, might also contribute the different flavour characteristic of these two powders.

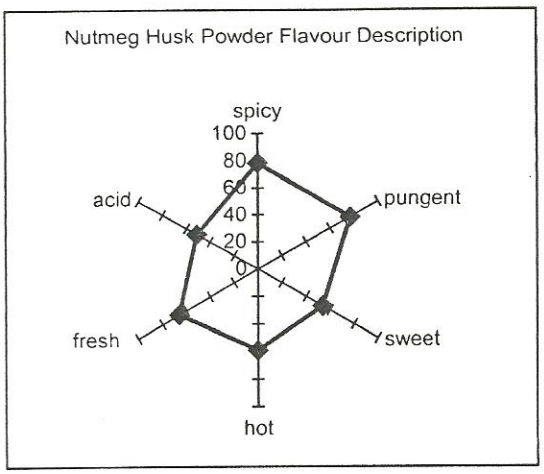

Figure 1. Polar coordinate (cobweb) graph of the mean intensity of the nutmeg husk powder flavour attributes

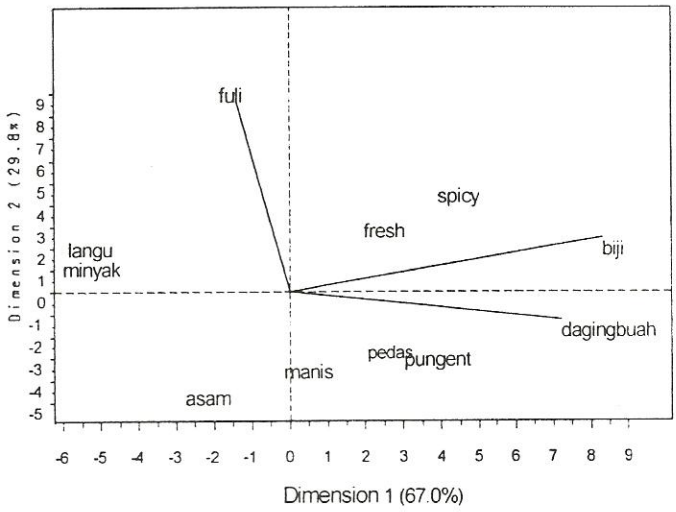

Figure 2. Principal component analysis (PC 1 and 2) of the mean ratings of the 3 powders for its attributes

Table 3. Comparison of flavour attributes intensity between husk, kernel and mace powders

Flavor	Sample		
	Nutmeg husk powder	Nutmeg seed powder	Mace powder
Spicy	79.38	86.55	65.79
Pungent	76.53	68.65	0
Sweet	53.55	38.03	0
Hot	58.78	66.27	0
Fresh	65.86	67.89	54.18
Sour	50.96	0	0
Oily	0	0	49.37
Strong green	0	0	54.10

In case of mace, there are only two flavour attributes that match with attributes found in husk powder, i.e. spicy and fresh. The oily and strong green attributes were not found in husk powder, while the pungent, hot and sweet were not found at mace.

Statistical analysis using Principle Components Analysis (PCA) recommended the utilisation of two main components, PC1 and PC2. Graphic scores of PC1 and PC2 classified the three samples into different group. Based on the PC1, there is a close relation between nutmeg husk powder flavours with nutmeg kernel flavour while the relation with mace powder is far (Figure 2).

Graphic loading of PC1 and PC2 shows the relation between one attribute with the others. The main components PC1 (67.0%) shows close relation between spicy, fresh, hot, pungent and sweet as well as between flavour oily, sour and strong green. Spicy and fresh has a very close relation in PC1, while hot, pungent, and sweet on the other hand. PC2, however, shows distance and different quadrant between the two flavour groups. It means that there is a close impression between spicy and fresh group with hot,

sweet, and pungent group, but both groups could still be easily differentiated. This relation also implies for oily and strong green group with sour attribute, where even though the impression for both groups is close, they could easily be differentiated. The combine plot between score and loadings of PC1 and PC2 could be described with 96.8% of total data variances. The first PCA correlation matrix described 67.0% of total data variances, while the next 29.8% of total data variances can be described by the second PCA matrix correlation. The X line indicated the first PCA, while the Y line indicated the second PCA. The combine plots could be seen in Figure 2.

The Combine plots shows that the three powders could be differentiated based on their flavour. Nutmeg husk powder could be characterised by hot, pungent, and sweet; nutmeg kernel powder's main characteristics were spicy and fresh, while mace powder could be characterised by oily and strong green flavour..

Formulation and application of spice blend powder

The result of survey on consumer preferences toward the type of spices used in spice blend, and the type of food product suitable for husk powder application has been comprised in Table 4.

Table 4. Questionnaire evaluation

Question	Evaluation	Percentage (%)
Does nutmeg husk powder suitable for flavour material or as a form of spices	Suitable	100%
What type of food product suitable for nutmeg husk powder application	Cookies Cake Bread Noodle Beverage	36.2% 27.8% 19.4% 5.5% 11.1%
Does mixing nutmeg husk powder with other spices would be suitable	Suitable No	80% 20%
What spices suitable for it?	Cinnamon Clove Ginger Pepper	40% 20% 35% 5%

Referring to the evaluation result and comparing to the commercial formula, spices selected for spice blend formulations were ginger, clove, and cinnamon. According to Farrel (1990), cinnamon, clove and ginger are classified to spices with warm, spicy, and very aromatic flavour. Cloves and cinnamon can be described as pungent, woody and sweet, while cloves can be described as pungent and hot. There was a resemblance between nutmeg husk powder flavour with these spices flavour characters. Spice blend powder formulation was based on flavour compatible and ratio of each component (Table 5).

Table 5. Spice blend powder formula

Formula	Powder ratio				
	Nutmeg husk powder	Cinnamon	Ginger	Clove	Mace
1	1	-	-	-	-
2	1	1	1	-	-
3	1	1	1	1	-
4	3	1	1	-	-
5	3	1	-	1	-
6	3	2	1	1	-
7	5	3	-	1	-
Mace	-	1	1	-	1
Commercial	-	*	-	*	*

*Note: * the correct amount is unknown*

Top three formulas with the highest total value are formula 4, formula 5, and formula 2. Panellist evaluation showed that the cookies has a mild aroma and light sour taste. This sour taste predicted coming from the nutmeg husk powder, which has sour characteristic. Sensory evaluation of the cookies acceptances can be seen in Table 6. Searching food products which more compatible with this sour characteristis is one of future challenge.

Table 6. Spice blend added cookies acceptability

Formula	Parameter				Total value
	Aroma	Colour	Taste	Appearance	
Formula 1	4.88^{a}	5.04^{b}	$4.80^{b.c}$	5.12^{c}	4.93
Formula 2	4.80^{a}	4.80^{b}	$5.20^{c.d}$	$4.72^{b.c}$	4.90
Formula 3	4.64^{a}	3.92^{a}	$4.88^{b.c}$	3.92^{a}	4.42
Formula 4	4.92^{a}	5.00^{b}	4.72^{d}	$4.60^{a.b.c}$	5.11
Formula 5	4.24^{a}	5.24^{b}	$5.32^{c.d}$	5.08^{c}	4.93
Formula 6	4.28^{a}	3.76^{a}	$4.20^{a.b}$	$4.24^{a.b}$	4.14
Formula7 Commercial	4.72^{a}	4.12^{a}	$4.88^{b.c}$	$4.32^{a.b}$	4.56
Formula	4.68^{a}	3.84^{a}	3.96^{a}	$4.04^{a.b}$	4.16

^{a,b} *different letter shows significance difference at* $\alpha = 0.005$

IV. CONCLUSION

Soaking raw material in 2000 ppm natrium bisulphite for 12 hours, followed with drying in tray dryer at 40° C, gave the best result in nutmeg husk powder production. The nutmeg husk powder 7.7% water content, with aw value of 0.5551, 53.10% whiteness degree, 9.04% yield and particle size of 54.97 %. Nutmeg husk powder flavour could be described as spicy, pungent, sweet, hot, sour, and fresh; with spicy and pungent flavour strongly dominate. Principle component analysis showed that nutmeg husk powder had flavour characteristic resemblance to nutmeg kernel but could still easily be differentiated by its hot, pungent and sweet attributes. Formula selected for spice blend application in cookies, was the combination between nutmeg husk powder with cinnamon and or ginger powder. Optimisation on spice blending and searching more suitable food products s for application should be held further.

REFERENCES

1. Decagon, (2002). Aw (Water Activity). Available from: <http://www.decagon.com/aqualab/references.html > Accessed June, 03
2. Eskin, N.A.M., H.M. Henderson, dan R.J. Townsend, (1971) Biochemistry of Food. Academic Press, New York.
3. Farrel, K.T., (1990) Spices, Condiments and Seasonings. AVI Book, New York.
4. Fellows, P.J., (1990) Food Processing Technology Principles and Practices. Ellis Horwood, England.
5. Hadad, EA, A. Nurawan, dan Suparman (2000) Karakterisasi dan Pemanfaatan Plama Nutfah Tanaman Pala. Buletin Plasma Nutfah Vol.6 No.2. Badan Penelitian dan Pengembangan Pertanian, Departemen Pertanian.
6. Hadad, H. M., (2001) Perbaikan Budidaya dan Mutu Hasil Tanaman Pala (*Myristica fragrans* HOUTT). Balai Penelitian Tanaman Rempah dan Obat, Bogor.
7. Hustiany, R., (1994) Ekstraksi dan Karakterisasi Minyak Atsiri Serta Oleoresin Daging Buah Pala (Myristica fragrans HOUTT). Skripsi. Fateta, IPB, Bogor.
8. Kuntz, L.A. (2001) Spice Blends Beats the Bland. Available from: <http:// www.foodproductdesign.com>. Accessed June, 03
9. Reineccious, G., (1994) Source Book of Flavours. Chapman and Hall, New York.
10. Standar Nasional Indonesia, (1995) SNI 01-3709-1995. Bubuk Rempah-Rempah. Pusat Standarisasi Industri, Departemen Perindustrian, Jakarta..