Analysis of Kwetiau Adulterated with Lard: Case Study of Effect of Sample Weight and Concentration of n-hexane as Solvent

Desi Ardilla[1], Muhammad Taufik[2] and Kusti Ayu Ningtias[1]
[1]*Department of Agricultural Technology, Universitas Muhammadiyah Sumatera Utara, Medan, Indonesia*
[2]*Department of Chemistry, Faculty of Mathematics and Natural Sciences, Universitas Sumatera Utara, Medan, Indonesia*

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Abstract: It has been analyse that kwetiau adulterated with lard by approximating the sample weight and concentration of n-hexane as a solvent. This study used a Factorial Completely Randomized Design (CRD) with two (2) replications. Factor I is the difference in sample weight (B) consisting of 4 levels, namely: B1 = 50 g, B2 = 60 g, B3 = 70 g and B4 = 80 g. The second factor is the difference in the concentration of n-hexane (N) consisting of 4 levels, namely: N1 = 20%, N2 = 30%, N3 = 40% and N4 = 50%. The parameters observed were: specific gravity and refractive index. The analysis results for Specific gravity: sample weight and n-hexane concentration both had no significant effect ($P > 0.05$) on both lard and non-lard kwetiau. The interaction between sample weight and n-hexane concentration also had no significant effect ($P > 0.05$) on both lard and non-lard kwetiau. Refractive index: The sample weight on lard kwetiau had a very significant effect ($P < 0.01$) on the refractive index. The highest refractive index is found in treatment B4 which is 1.786 and the lowest value can be seen in treatment B1 which is 1.668. The concentration of n-hexane in kwetiau lard gave a very significant effect ($P < 0.01$) on the refractive index. The highest refractive index is found in treatment N4 which is 1.755 and the lowest value can be seen in treatment N1 which is 1.683. Treatment interactions had no significant effect ($P > 0.05$) on the refractive index. Meanwhile, sample weight on kwetiau without lard had a very significant effect ($P < 0.01$) on the refractive index. The highest refractive index is found in treatment B4 which is 1.503 and the lowest value can be seen in treatment B1 which is 1.469. The concentration of n-hexane in kwetiau without lard had a very significant effect ($P < 0.01$) on the refractive index. The highest refractive index is found in treatment N4 which is 1.497 and the lowest value can be seen in treatment N1 which is 1.474.

1 INTRODUCTION

Food is one of the primary needs of humans besides clothing and shelter (Firmansyah 2019). Food plays an important role in human life, therefore we need a guarantee that the food consumed daily by humans has a high level of safety, so that humans can be free from disease or danger from food (Gustiani 2009).

The total population of Indonesia in 2020 is projected to reach 271,066 million people. Around 209.28 million people in Indonesia are Muslims. Based on these data, in terms of food safety, of course the Indonesian people, especially Muslims, must have a guarantee that the products consumed are halal and good food (Taufik et al. 2021).

One of the halal concepts in Islam is that food must not contain any lard or food fat derived from pork. Regardless of the lard content in food, it will make the unclean food for consumption (Salehudin 2014). Pork or its derivatives refers to any object or compound produced from pork such as pork, lard and gelatin produced from pork bones or skin. Pig derivatives are usually cheaper than products derived from cows, it is on this basis that pork derivatives are often used as counterfeiters in food systems. Pork is often mixed with beef by rogue traders with the aim of making large profits (Rohman et al. 2012).

Along with technological advances, there are various food products that are very diverse with excellent quality and prices. It's just that sometimes to get it you need ingredients that are obtained from one or several parts of the pig's body and then mix these parts with other food processed products. The deliberate mixing of unwanted ingredients in a particular product is called adulteration. Adulteration

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is a mixture or counterfeiting of a product that does not meet standards (Taufik et al. 2018).

The case of food containing ingredients from pork is rife in Indonesia (Mutmainah 2018). In 2015, a case of kwetiau was found which was allegedly made from pork oil in Tanjung Pinang. Kwetiau is a type of noodle made from rice flour, white in color with a width of 1 cm, served in a processed form that is fried or put in sauce. Therefore, research on methods of analyzing pork content in food products must be developed so that it is more accurate and efficient (Lusiana Berti, Yetti, and Asra 2020).

Several methods have been used to identify lard in food, including UPLC with myoglobin markers, polymerase chain reaction and nanobiophrobe (Yanty et al. 2018). The weaknesses of these methods require a lot of effort and time so that a fast analysis technique is needed (Lusiana Berti, Yetti, and Asra 2020).

The extraction method used in this study is maceration. Maceration is an extraction process that aims to extract the whole compound based on the polarity of the solvent used in stages. The advantage of using this method is that it does not require heat during the extracting process and only requires a container and a lid. The organic solvents most often used to extract phenolic compounds include methanol, ethanol, ethyl acetate and n-hexane (Satriavi et al. 2013). The advantage of this method is easy and does not need heating so that natural materials are less likely to be damaged or decomposed. The selection of solvents based on their solubility and polarity facilitates the separation of natural substances in the sample. The long operation of the maceration method and the stationary state during maceration allows many compounds to be extracted (Nees et al. 2017). Electrosynthetic coupling maceration is a way to synthesize or produce a material based on electrochemical techniques. In this method there is a change in the element or chemical compound into the desired compound (Taufik et al. 2017).

The Maceration method generally uses a non-aqueous or non-polar solvent. The choice of the type of solvent in maceration extraction needs to be considered, among others, the ability to dissolve oleoresin, boiling point, toxicity, flammability and influence on the extraction equipment. The use of n-hexane as a solvent is due to its non-polar nature so that it dissolves fat faster and makes the extraction process easier when compared to a solvent (Chemat et al. 2019).

In statistics, doing an experiment is one way to get data. This study used a factorial complete randomized design model. A factorial experiment is an experiment whose treatment consists of all possible combinations of levels of several factors. A factorial experiment can be applied directly to all experimental units if the unit experiments are relatively homogeneous. Such a design is called a factorial design with the basic design of the RAL or further called the factorial RAL (Ardilla et al. 2018). In this work, the effect of sample weight and concentration of n-hexane as solvent will be studied and this will be compared with the specific graffity and refractive index values.

2 MATERIALS AND METHOD

2.1 Material

The materials used in this study were kwetiau and kwetiau adulterated with lard, n-hexane, aquadest, alcohol, aluminum foil, plastic wrap, whattman paper No 41.

2.2 Methodology

This Method of research was carried out by the factorial Completely Randomized Design (CRD) method which consisted of 2 factors, namely:

Factor I: Material Weight (B) which consists of 4 levels, namely:

B1 = 50 g B3 = 70 g

B2 = 60 g B4 = 80 g

Factor II: Concentration of n-Hexane (N) which consists of 4 levels, namely:

N1 = 20% N3 = 40%

N2 = 30% N4 = 50%

The number of treatment combinations (Tc) is 4 x 4 = 16, then the number of repetitions (n) is as follows:

Tc (n-1) $\geq$ 15

16 (n-1) $\geq$ 15

16 n-16 $\geq$ 15

16 n $\geq$ 31

n $\geq$ 1,937 .... rounded to n = 2

then for research accuracy, repeated 2 (two) treatments.

2.3 Experimental Design

The research was conducted with a factorial Completely Randomized Design (CRD) with the model:

$\tilde{Y}ijk = \mu + \alpha i + \beta j + (\alpha\beta)ij + \varepsilon ijk$

Caption ;

Ỹijk: Observation of factor B from level i and factor N at level j :

k-th repeat.

μ: Middle value effect

αi: Effect of factor B at level-i.

βj: Effect of factor N at level j.

(αβ) ij: The interaction effect of factor B at level i and factor N at level j.

εijk: The error effect of factor B at level i and factor N at level j in k-th test.

2.4 Sample Extraction

Kwetiau weighed according to the treatment, namely 50 g, 60 g, 70 g and 80 g, and then mashed using a mortar and pestle. The noodles that have been refined are put into a beaker glass then added with n-hexane according to the treatment, namely 20%, 30% 40% and 50%. Maceration process was developed used electro synthetic method at 120 minutes with a strong current of 2,2 volts using an aluminum cathode and anode. The macerated kwetiau are then filtered with gauze. The filter results are centrifuged at 3000 rpm for 20 minutes. The sample is then filtered again with Whattman paper No 41. Furthermore, the sample is tested for density and refractive index, then analyzed.

3 RESULTS AND DISCUSSION

3.1 Effect of Sample Weight

The effect of sample weight on Parameters of Kwetiau adulterated with lard and kwetiau non lard can be seen in Table 1.

Table 1: Effect of sample weight

Weight (g)	Density (g/mL)	Refractive index (°Brix)
Kwetiau with lard		
50	0.829	1.668
60	0.880	1.684
70	0.955	1.738
80	0.960	1.786
Kwetiau non lard		
50	0.864	1.469
60	0.879	1.475
70	0.923	1.485
80	0.955	1.503

Based on the reference list of variance, it can be seen that the effect of sample weight of lard kwetiau and non-lard kwetiau has a very significant effect ($p < 0.01$) on the refractive index. The level of difference has been tested with the average difference test and can be seen in Table 2 below.

Table 2: Results of the Mean Difference Test of the Effect of Sample Weight of Kwetiau with lard on Refractive Index

Distance	LSR		Treatment	Average	Notation	
	0.05	0.01	B (gram)		0.05	0.01
-	-	-	B_1 = 20	1.668	b	B
2	0.00818	0.01126	B_2 = 30	1.684	b	B
3	0.00859	0.01183	B_3 = 40	1.738	b	A
4	0.00881	0.01213	B_4 = 50	1.786	a	A

Table 2 shows that B1 is significantly different from B2, B3 and B4. B2 is very different from B4 and not significantly different from B3. B3 is very different from B4. The highest value can be seen in treatment B4 = 1.786 and the lowest value can be seen in treatment B1 = 1.668. The results of the average difference test for the effect of sample weight kwetiau without lard on the refractive index can be seen in Table 3.

Table 3: The Results of the Mean Difference Test The Effect of Sample Weight Kwetiau without lard on the Refractive Index

Distance	LSR		Treatment	Average	Notation	
	0.05	0.01	B (gram)		0.05	0.01
-	-	-	$B_1 = 20$	1.474	b	B
2	1.07711	1.48282	$B_2 = 30$	1.478	b	B
3	1.13096	1.55821	$B_3 = 40$	1.484	b	A
4	1.15968	1.59771	$B_4 = 50$	1.497	a	A

Note: Different letters in the notation column show a significantly different effect at the level of $p < 0.05$ and very significantly different at the level of $p < 0.01$.

Table 2 and Table 3 shows the effect of sample weight on the refractive index. The higher the sample weight used, the higher the refractive index produced. The refractive index of a substance is the ratio of the speed of light in the air to the speed of light in the substance. Overall, the refractive index value of kwetiau with lard ranged from 1.668°Brix to 1.768°Brix. The oil component extracted by the solvent increases along with the increasing weight of the sample used as simplicia so that the oil density will increase and the light coming will be difficult to refract causing the refractive index value to be larger. This can be explained that the greater the content in the oil, the smaller the speed of light due to being obstructed by oil particles. Thus it can be understood that the more content in the oil, the greater the refractive index of the oil (Prasetyo et al., 2014).

However, the refractive index value of lard rice noodles was higher than that of non-lard rice noodles. The increase in the value of the refractive index is thought to be due to the large number of combinations of meat and oil used in the kwetiau, the more components will be extracted from the compound. The difference in refractive index is influenced by differences in diffraction patterns between the mediums due to differences in optical density between the two mediums (Supriyadi et al., 2014). Oil extracted from lard kwetiau has a higher optical density than oil extracted from kwetiau without lard.

3.2 Effect of Hexane Concentration

The effect of n-hexane concentration on parameters of Kwetiau adulterated with lard and kwetiau non lard can be seen in Table 4.

Table 4: Effect of hexane concentration

Weight (g)	Density (g/mL)	Refractive index (°Brix)
Kwetiau with lard		
20	0.855	1.683
30	0.903	1.696
40	0.913	1.742
50	0.923	1.755
Kwetiau non lard		
20	0.890	1.474
30	0.899	1.478
40	0.910	1.484
50	0.921	1.496

Table 4 shows that N1 is significantly different from N3 and N4 and not significantly different from N2. N2 is very different from N3 and N4. N3 is not significantly different from N4. The highest value can be seen in treatment N4 = 1.755 and the lowest value can be seen in treatment N1 = 1.683. The level of difference has been tested with the average difference test and can be seen in Table 5 below.

Table 5: Results of the Mean Difference Test of the Effect of n-hexane Concentration of Kwetiau with lard on Refractive Index

Distance	LSR		Treatment	Average	Notation	
	0.05	0.01	B (gram)		0.05	0.01
-	-		$N_1 = 20$	1.683	b	B
2	0.00818	0.01126	$N_2 = 30$	1.696	b	B
3	0.00859	0.01183	$N_3 = 40$	1.742	b	A
4	0.00881	0.01213	$N_4 = 50$	1.755	a	A

Note: Different letters in the notation column show a significantly different effect at the level of $p < 0.05$ and very significantly different at the level of $p < 0.01$.

Table 5 shows that N1 is very significantly different from N3 and N4 and not significantly different from N2. N2 is very different from N3 and N4. N3 is not significantly different from N4. The highest value can be seen in treatment N4 = 1.755 and the lowest value can be seen in treatment N1 = 1.683. The Results of the Mean Difference Test The Effect of Sample Weight Kwetiau without lard on the Refractive Index.

Table 6: The Results of the Mean Difference Test of The Effect of n-hexane Concentration Kwetiau without lard on the Refractive Index

Distance	Treatment B (gram)	Avg.	Notation 0,05	Notation 0.01
-	$N_1 = 20$	1.474	b	B
2	$N_2 = 30$	1.478	b	B
3	$N_3 = 40$	1.484	b	B
4	$N_4 = 50$	1.497	a	A

Note: Different letters in the notation column show a significantly different effect at the level of $p < 0.05$ and very significantly different at the level of $p < 0.01$.

Table 6 shows that N1 is very significantly different from N4 and not significantly different from N2 and N3. N2 is significantly different from N4 and not significantly different from N3. N3 is very different from N4. The highest value can be seen in treatment N4 = 1.497 and the lowest value can be seen in treatment N1 = 1.474

Table 5 and Table 6 shows that the effect of n-Hexane concentration on the refractive index. The higher the concentration of n-hexane used as the solvent, the higher the refractive index produced. The refractive index of a substance is the ratio of the speed of light in the air to the speed of light in the substance. Overall, the refractive index value of lard rice noodles ranged from 1.683 ° Brix to 1.755 ° Brix and the overall refractive index value for non-lard rice noodles ranged from 1.474 ° Brix to 1.469 ° Brix.

This is because the components in the oil extracted by n-hexane are extracted more so that the density of the oil will increase and the light will be difficult to refract, causing the refractive index value to be larger. Diffraction is one of the wave behaviors where the wave will experience a deflection because it passes through a narrow gap (Young and Freedman, 2001).

The refractive index value of lard kwetiau is not much different from the refractive index value of lard based on the research of Taufik et al. (2018) that the refractive index of lard is between 1.502 ° Brix to 1.505 ° Brix. While the refractive index value of kwetiau without lard is presumed that the type of oil used in this kwetiau without lard is cooking oil because this value is close to the refractive index value of cooking oil based on data from the National Standardization Agency (1995), namely the quality standard for cooking oil has a range of refractive index criteria. between 1.448 ° Brix to 1.450 ° Brix.

4 CONCLUSION

The sample weight had a very significant effect ($p < 0.01$) on the refractive index and had an insignificant difference ($p > 0.05$) on the specific gravity of lard kwetiau. The concentration of n-hexane had a very significant effect ($p < 0.01$) on the refractive index and had an insignificant difference ($p > 0.05$) on the specific gravity of lard kwetiau.

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REFERENCES

Ardilla, D., Muhammad T., Tarigan D.M., Thamrin M., Razali M., Siregar S. 2018. Analisis Lemak Babi Pada Produk Pangan Olahan Menggunakan Spektroskopi UV – Vis Analysis Of Lard In The Meat Processed Using UV - Vis Spectroscopy. AGRINTECH - Jurnal Teknologi Pangan & Hasil Pertanian 1 (2): 111–16.

Chemat, F., Vian M.A., Ravi K., Khadhraoui B, Hilali S., Perino S., Tixier A. 2019. Review of Alternative Solvents for Green Extraction of Food and Natural Products: Panorama, Principles, Applications and Prospects. Molecules 24 (16): 1–27. https://doi.org/10.3390/molecules24163007.

Firmansyah, I. 2019. Kajian Analisis Kandungan Boraks Dan Formalin Pada Produk Dan Mie Basah Di Kecamatan Ciasem Tahun 2018. Journal of Chemical Information and Modeling.

Gustiani, E. 2009. Pengendalian Cemaran Mikroba Pada Bahan Pangan Asal Ternak (Daging Dan Susu) Mulai Dari Peternakan Sampai Dihidangkan. Jurnal Litbang Pertanian 28 (80): 96–100.

Lusiana B., Desni R., Asra R. 2020. Asian Journal of Pharmaceutical Research and Development. Asian Journal of Pharmaceutical Research and Development Open 8 (9): 10–19.

Mutmainah, L. 2018. The Role of Religiosity, Halal Awareness, Purchase Intention of Halal Food Halal Certification, and Food Ingredients on Purchase Intention of Halal Food. Journal of Islamic Economics, Finance, and Banking 1 (0274): 2622–4798.

Nees, C., Blume N., Wardatun S., Rustiani E, Alfiani N., Rissani D. 2017. Study Effect Type of Extraction Method And Type of Solvent To Cinnamaldehyde and Trans-Cinnamic Acid Dry Extract Cinnamon. J Young Pharm 9 (1): 49–51. https://doi.org/10.5530/jyp.2017.

Rohman, A., Triyana K., Sismindari S., Erwanto Y. 2012. Differentiation of Lard and Other Animal Fats Based on Triacylglycerols Composition and Principal

Component Analysis Fourier Transform Infrared Spectroscopy Applied for Rapid Analysis of Lard in Palm Oil. International Food Research Journal 19 (January): 1161–65.

Salehudin, I. 2014. Halal Literacy : A Concept Exploration and Measurement Validation. SSRN Electronic Journal 1 (June 2010): 1–21. https://doi.org/10.2139/ssrn.2004762.

Satriavi, K., Wulandari Y.B.P., Subagyo, R., Prastowo S., Widyas N. 2013. Estimasi Parameter Genetik Induk Babi Landrace Berdasarkan Sifat Litter Size Dan Bobot Lahir Keturunannya. Tropical Animal Husbandry 2 (1): 28–33.

Taufik, M., Ardilla D., Ghozal A, Sinaga S.M. 2018. Total Plate Count Analysis Of Tuna Fish Adulterated With Lard In Order To Improve Halal Products Analysis. Journal of Pharmaceutical an Sciences 1 (1): 7–15.

Taufik, M., Cahyady B., Ardilla D, Alfian Z., Rid Wanto, Daulay S., Savitri R.R., Pratiwi F., Susilawati E. 2021. Nicotine Separation from the Urine of Active Smokers Using Moringa Oleifera on Column Chromatography Nicotine Separation from W He Urine of Active Smokers 8 Sing Moringa Oleifera on Column Chromatography. AIP Conference Proceedings 020007 (April): 1–10.

Taufik, M., Wanto R., Cibro S.R, Ardilla D., Razali M., Tarigan D.M. 2017. Studi Pendahuluan Maserasi Coupling Elektosintesis Dalam Mengekstraksi Nikotin Yang Terkandung Dalam Puntung Rokok. Prosiding Seminar Nasional Kimia Unmul, 182–90.

Yanty, N A M, J M N Marikkar, Y B Che Man, K Long. 2018. "Composition and Thermal Analysis of Lard Stearin and Lard Olein." Journal of Oleo Science 7 (July 2011): 333–38. https://doi.org/10.5650/jos.60.333.