MORINDA JUICE *(MORINDA CITROFILIA L)* TO PURIFY THE WASTED COOKING OILS

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ABSTRACT

Purifying the recycling wasted vegetable cooking oil sometimes is needed. This research used the Morinda Citrofilial (Morinda Juice) as medium to purify the wasted cooking oil. It was designed to investigate whether Morinda juice significantly affected the peroxide, iodine, and acid elements of wasted cooking oils. Thus, the quality of waste vegetable cooking oils remains healthy for food industries, restaurants, and Indoenesian lower class that tended to consume cookiing oils more than once. This research was conducted with the laboratory experiment, which was held in Februari 2017 in Laboratory of Basic Sciences of Universitas Simalungun, Pematang Siantar, Indonesia. The recycling wasted cooking oils were given a treatment through adding Morinda juice with three different volume variations, they were; 20 ml, 30 ml, and 40 ml. Then, mixed oils were calculated with titrimetry to determine the peroxide, iodine, and acid numbers containing in the wasted cooking oils. Based on data analysis, it showed that Morinda juice significantly affected the peroxide numbers (1.888 mek/kg), similarly, Morinda juice significantly changed the iodine numbers as well through breaking the double chains found in the wasted cooking oils. In contrast, the Morinda juice did not significantly affect acid numbers; since the acid number before frying was 0.029 mg / g, and it was 0.263 mg /g after frying, then it was only 0.281 mg/g after the treatment given. It concluded that Morinda Juice has changed the peroxide and iodine, but no acid of wasted vegetable cooking oils.

Keywords : Morinda fruit, wasted cooking oil, peroxide, iodine, acid numbers

INTRODUCTION

Vegetable oils are produced from purifying palm oils, then in the whole world wide, particularly in Indonesia. It has been used as cooking oils for long time. The cooking oils in Indonesia have been familiarly consumed by Indonesians. It becomes one of nine food products. Actually, vegetables oils run to the chemical reaction during frying process in which the heat of oils poorly reach the high temperature approximately 170-1800C. Certainly, the heating process of vegetables oils during frying process causes the quality of oils being damaged. There are some crucial damages, such as; flavor and rancidity, while, other breakdowns including the high level of free fatty acids, the peroxide numbers, the incidence of oil viscosity, the formation of foam, and the waste of fried ingredients. In other words, the more frequently cooking oils used, the higher level of oil breakdowns will be. The vegetable oils which used for several time will not only produce odor and foaming, but it also affects to the quality of foods fried.

Scientifically, consuming fried food with the wasted vegetable oils absolutely lead to some dangerous diseases, such as; the deposition of fat in the blood vessels *(artherosclerosis)*, and the decrease of digestibility. Yet, it is being a dillema for Indonesian due to two major reasons; firstly, most Indoensian have low awareness of scientific process of vegetable oils, secondly, Indonesian low class commuity tend to consume wasted cooking oils for several

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due to economical matters. Easily, waste cooking oils are got from food industries, restaurants, and households. From these places, cooking oils needed by lower class community are always available, so there is no dooubt that their daily necessary can be fulfilled. This condition is surely contrast with the health side as the waste oils only lead to serious ills.

In order overcome the serious health problems, there are many attempts undertaken by the experts to decrease dangerous compounds found in waste vegetable oils such as; free fatty acids, peroxide substances, oxidations, and logam effects, thus, waste vegetable oils can be reused for frying (Widjaya, 2005). Then, one of the worst damage is the oxidation of unsaturated fatty acids to form peroxide radicals (Purnomo, 1995). Peroxide free radicals react with antioxidant to prevent following chain formation. One of the natural antioxidants is β carotene which is lipophilic (lipids / fat) that can prevent lipid peroxidation. Also, β carotene can be found in various plants, for instance in noni fruit. Some experts observed that various natural antioxidants are derived from noni fruit, namely β carotene, ascorbic acid, and skopoletin which are the main active ingredients in noni fruit (Sjabana, 2002).

Based on background of the research above, this research attempted to investigate the effect of Morinda fruit of the transformation of peroxide, iodin, and acid numbers found in waste vegetable oils.

RESEARCH PROBLEM

The research problem is described and formulatedin the following question:

"Is there any significant effect of Morinda Juice on the peroxide, iodin, and acid numbers contained in the wasted vegetable oils?"

THE OBJECTIVES OF THE RESEARCH

On the basis of the problems above, the objectives of the research were: 1. to find out whether there is significant effect of mona fruit to peroxide, iodin, and acid numbers contained in waste vegetable oils. 2. The result of the research was expected to decrease the dangerous compounds found in the wasted vegetable oils which lead to serious diseases.

Hypotheses

Relating to the background, problem, and objectives of the research, the hypotheses can be drawn as the following:

Ho: there is no signifcant effect of Morinda Juice on the peroxide, iodin, and acid numbers found in wasted vegetable oils.

Ha: there is signifcant effect of Morinda Juice on the peroxide, iodin, and acid numbers found in wasted vegetable oils.

THEORITICAL FRAMEWORK

Morinda Fuit

Morinda fruit is one of kind medicinal plants that widely used as traditional medicine by Indonesians. Due to tropical plant, Morinda fruit is also known as evergreen which means this plant bears leaves throughout the year, and the it also bears fruit all round year. In addition, there are some active substances which have a great benefit for health found in Morinda fruit, namely; polysaccharides, scopoletin, ascorbic acid, β-carotene, arginine, proxeronin, and proxeroninase. Yet, Indonesians till now only consume Morinda Fruit as traditional medicine, while, all substances found in Morinda fruit can be extracted as an additional compounds in cooking oil which is consumed by all classes in daily life.

Fats and Oils

Fats and oils are triglycerides or triacylglycerols derived from the reaction between fatty acids and glycerol. The differences between fat and oil can be detected from the appearance in which fat is solid, while, oil is liquid. Moreover, some glycerides in animals are fat, while, glycerides in plants tend to be oil. It is therefore common to recognized animal fat expressions derived from animals (lard fat, cow fat, etc.), whilst, vegetable oils derived from plants (corn oil, palm oil and others) (Fessenden, 1986).

Free Fat Acid

Free fatty acids are fatty acids that are not bound to *glycerine* molecules such as oleic acid, stearate, linoleic and others. Yet, fatty acid is the result of hydrolysis of fat. It is to be known that the low percentage of free fatty acids is an indication of good quality fresh oil. The oil purification can categorized as well done, if free fatty acid level must be less than 0.05%. Free fatty acids is getting higher during the process of frying due to two factors, firstly, the temperature of the frying pan, secondly, the vapor of the food as long as the frying process. Absolutely, higher levels of free fatty acids can produce excessive smoke and unpleasant taste of foods.

Peroxide Numbers

Peroxide numbers is used to indicate the oxidation of oil and to determine the oil quality after processing and storage. A quick processing of good quality vegetable oil has peroxide number nearly to zero. Then, the peroxide will be higher to the certain level based on two major peiods, namely; during storage, and prior to use, in which, the oils quality depends on the time, temperature, and duration of contact with light and air. During the oxidation, the peroxide numbers is lower frequently, likely, it suddenly reach the highest numbers. The higher peroxide numbers indicate sustainable oxidation, while, the lower peroxide levels are not necessarily free from oxidation. Hence, the peroxide number during frying process is higher, but it becomes vapor, and reach the higher temperature in the frying process.

Iodine Numbers

The iodine number is used to indicate the numbers of chains found in fat and oil. Iodine number is a term used to determine the degree of unsaturation. The higher iodin numbers signifies the higher degree of unsaturation both in fats and in oils. In addition, Iodine number is also very useful as a an signal of vegetable oils qualit. Conditionally, vegetable oils with higher iodine numbers is generally liquid, while, vegetable oils with lower iodine numbers are usually solid. During frying process, the iodine number will be decreasing along with the increase of hydrogenation. Thus, the iodine number of vegetable oils tend to decrease depending on the length of frying (Lawson, 1985).

Palm Oil

Palm oil is the main source of cooking oil in Indonesia. Then, it has been widely used in the frying, for industry and domestic food such as instant noodles, fries, fried chickens and other snacks. There are seven characteristics of high quality cooking oils, namely; heat resistance, stable in sunlight, keeping frying taste, producing nice foods and flavors, smokeless after using several times, and creating golden-frying meals. In addition, cooking oil is not only a medium trasnferring from heat to food, but it is also considered as food since during frying some of the oils will adsorb and absorb into the outside of the material to be fried and fill the empty space that is originally filled with water. Thus, frying results usually contain 5-40% oil

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(Widjaya, 2005). In details, the following table visually shows the standars of high quality cooking oils;

Table 1. The standars of high quality cooking oils

1	Free fatty acids	0,3 % max
2	Acid numbers	6 % max
3.	Peroxide numbers	5 % max
4.	Iodin numbers	56 min

The Damages of Vegetable Oils

One of the oil damage is lipid oxidation of unsaturated fatty acids. This damage can occur in two stages: firstly, the fat reaction with oxygen, secondly, the oxidation process. The formation of peroxides formed can help the oxidation process. Then, most unsaturated fatty acids will be damaged with excessive storage, so somoe of the damages can softly evaporate. Moreover, peroxide compounds formed can help the oxidation process of a number of saturated fatty acids. The presence of free oxygen under ultraviolet light or metal catalyst at high temperatures can directly oxidize saturated fatty acids.

Rancidity

Rancidity is the term used to describe the breakdown of fats and oils which changes smells and flaovors. Basically, there are two types of reactions that play a role in the process of rancidity, namely; oxidation and hydrolysis. Firtsly, oxidation occurs as a result of the reaction between unsaturated triglycerides and oxygen from the air. Then, the oxygen molecule joins the double bond of the triglyceride molecule and form various compounds that makes unpleasant rancidity. Moreover, this reaction is accelerated by heat, light, and metals in slight concentrations, especially copper metal. Thus, rancidity is formed by the autoxidation of radically unsaturated fatty acids or aldehydes rather than by peroxides (Winarno, 1997). Secondly, hydrolysis occurs with lipid enzyme activity that hydrolyzes the fat and breaks it down into glycerol and fatty acids. Lipase can be naturally contained with fats and oils in whch this enzyme can be activated by heating. Furthermore, lipase enzymes can be produced as well by microorganisms found in fatty foods. The free fatty acids produced by these reactions can give unpleasant smells and flavors. Also, hydrolytic can occur in case the fat or oil is heated in the presence of water. Hence, rancidity can be reduced by storing fats and oils in cold and dark places with non-metallic containers and keeping the fat closed (Sherington, 1981).

RESEARCH METHOD

This research used an experimental activity in the Basic Science Lab of Universitas Simalungun, Pematang Siantar, Indonesia.

Tools and Materials

The tools and materials used in this research were: oven, analytical balance, a set of fryers, stove, magnetic bar, 2000C thermometer, gauze, blender, filter paper, stative and clamp, spatula, glassware (pirex) , Morinda fruit, cooking oil, soybeans or tempe, wijs solution, sodium thiosulafat, indicator of starch, glacial acetic acid, potassium iodide, potassium hydroxide, phenolphthalein indicator, chloroform, starch and aquades.

Period and Location of the Research

This research was conducted in laboratory experiment which held in Februari 2017 in Laboratory of basic science of Simalungun University, Pematang Siantar, North Sumatera.

Research Procedures

Prior to morina extract, cooking oils should be measured through some following steps, theose were:

- 1000 ml cooking oils was used for frying tempeh (fragmentation of soybean) as much as 1.5 kg for 1 hour at 1400-1700C, repeated for 4 times using used previous cooking oil.
- Then, the frying oil was filtered, then, peroxide, acid, and iodine number were measured.

While, to determine peroxide, iodine, and acid numbers were done by titrimetric method as elaborated as follows:

i. First, Morinda fruit was cut into some pieces until smooth, then filtered and got the extract.
ii. The extract of Morinda fruit was added to 20 ml of used cooking oils with volume variations, started from 20 ml, 30 ml, to 40 ml.
iii. After both Morinda juice and cooking olis mixed, it was stiried for 20 minutes, and was heated to 600C, and let it being cool.
iv. Last, the oil was filtered again, then all peroxide, iodine, and acid numbers were mesaured for second time.

Then, after two procedures above, the steps of measurement of peroxide number were detailly elaborated as the following:

i. First, 5.0 gram inserted into glass closed erlemeyer,
ii. Then mixture of glacial acetic acid solvent was added: chloroform (3: 2, v / v) with volume 30 ml. Then, it was shaken until oils were dissolved,
iii. Then, 0.5 ml of saturated KI solution was added and shaken for 30 ml aquades.
iv. Next, it was titrated with 0.01N sodium thiosulfate (Na2S2O4) to a pale yellow solution,
v. 1 ml of 1% starch was added, and titrated again until bluish color was lost. Recorded volume of Na2S2O4 used, then give the same treatment for used cooking oil before and after addition of Morinda juice. The formula of peroxide numberr;

$$\text{Peroxide number} = \frac{V \times N \times 1000}{G}$$

While, the following steps were perfomed to determine iodine numbers ;

i. 5.0 gram cooking oils, then added 10 ml of chloroform and 20 ml of wijs solution, left in dark place for 30 minutes.
ii. Then, added 10 ml KI 15% and boiling 100 ml of aquades, then titrated with 0.01N sodium thiosulfate (Na2S2O4) to a pale yellow solution, then added 1 ml of starch 1%.
iii. All of them were titrated again until the bluish color disappeared softly and the volume of Na2S2O4 was used. Given the same treatment for used cooking oil

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before and after addition of Morinda juice. The formula used to determine iodine numbers as follows:

$$\text{Iodine number} = \frac{V\ (\text{blanko-sampel}) \times N \times 12{,}692}{G}$$

Moreover, the determination of acid number was done in the following way:

i. 5.0 gram cookig oil was put into a closed cup;
ii. Then 50 ml of 95% neutral alcohol, heated over a water bath for 10 minutes and stirring.
iii. Last, it was cooled and titrated with 0.1 N KOH after adding the phenolphthalein indicator until the solution was being pink.

$$\text{Acid numbers} = \frac{V \times N \times 56{,}1}{G}$$

Technique of Analyzing the Data

To determine the hypotheses, F test was used with $\alpha = 0{,}05$ and $\alpha = 0{,}10$, with the criteria : if F observed > F table, it meant Ho rejected and Ha accepted which showed that there was a significant effect of Morinda juice in peroxide, iodine, and acid numbers contained in waste cooking oils, otherwise, : if F observed < F table, it meant Ho accepted and Ha rejected which showed that there was no significant effect of Morinda juice in peroxide, iodine, and acid numbers contained in waste cooking oils. Furthermore, BNT test with $\alpha = 0{,}05$ and $\alpha = 0{,}10$, through following formula :

$$BNT = t_{(\alpha)(v)} \frac{\sqrt{2KTG}}{r}$$

where $t\alpha$ = total from T table,
r = The amount of repetition,
v = Error-free degree

FINDING AND DISCUSSION

1000 ml of cooking oil used for frying *tempe* (soybean fregmentation) as much as 1,5 kg, it got waste cooking oil as much as 600 ml. From, this waste cooking oil, it could determine peroxide, iodine, and acid numbers by using titrimetry method which was done before and after mixing the Morinda juice. The comparison of wasted vegetable cooking oils quality was visually shown in table 2

Tabel 2. The Comparison of Waste Cooking Oils Quality Before and After Morinda Extract

No	*Samples*	*Peorxide Numbers (mek/kg)*	*Iodine Numbers (mek/kg)*	*Acid Numbers (mg/g)*
1	New	0,743	62,411	0,209
2	Waste	3,741	52,894	0,263
3	After added 20 ml of Morinda extract	2,314	53,849	0,266
4	After added 30 ml of Morinda extract	1,889	55,960	0,275
5.	After added 40 ml of Morinda extract	1,966	56,244	0,281
6	The standard of good quality cooking oils	Maximum 5	Maximum 56	Maximum 6

From the statistical analysis results above, it was obtained F arithmetic = 16, F table (0.10) = 10, 92 and F table (0.05) = 5.14 then F arithmetic > F table so Ho rejected and Ha accepted which meant there was a significant effect of addition of Morinda juice with volume variations to peroxide, iodine, and acid numbers contained in waste cooking oil.

Furthermore, the smallest significant difference test (BNT) was calculated with significance level α = 0,05 and α = 0,10 to determine the peroxide number from waste cooking oil after addition of Morinda juice with three different volumes,; 20 ml, 30 ml, and 40 ml. In detail, the differences of BNT test of peroxide number were visualized in table 3.

Tabel 3. The Result of BNT Test of Peroxide Number After Added with Morina Extract with Three Different Treatments

Treatments	*Averages*	*BNT*		*Test Result*	
		0,05	*0,10*	*0,05*	*0,10*
20-30 ml	0,736	0,110	0,167	S	S
20-40 ml	0,503	0,110	0,167	S	S
30-40 ml	0,233	0,110	0,167	S	S

Notes : S = significant

From table 3 above; it can be inferred that the addition of Morinda juice significantly affected on the peroxide number contained in waste cooking oil. Then, the iodine number BNT test result also showed in table 4.

Table 4. The Result of BNT Test of Iodine Number After Added with Morina Extract with Three Different Treatments

Treatments	Averages	BNT		Test Result	
		0,05	0,10	0,05	0,10
20-30 ml	6,335	3,497	5,297	S	S
20-40 ml	7,186	3,497	5,297	S	S
30-40 ml	0,851	3,497	5,297	TS	TS

Notes : TS = non-significant

Table 3 above clearly showed that the addition of Morinda juice significantly affected on the iodine number contained in waste cooking oil. Then, the following table elaborated the result of BNT test used to determine acid numbers contained in waste cooking oils;

Table 5. The Result of BNT Test of Acid Number After Added with Morina Extract with Three Different Treatments

Treatments	*Averages*	*BNT*		*Test Result*	
		0,05	*0,10*	*0,05*	*0,10*
20-30 ml	0,005	0,029	0,044	S	TS
20-40 ml	0,046	0,029	0,044	S	TS
30-40 ml	0,003	0,029	0,044	TS	TS

The table 5 also showed that the addition of Morinda extract significantly affect the quality of waste cooking oils with three kinds of treatements undertaken.

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After finding of the research found, it could be discussed that after frying at a temperature of 140-1700C for 4 repetitions, it certainly caused the oxidation process that led to peroxide numbers. It was indicated by the increase of oil peroxide number before frying from 0.43 mek / kg obviously increased to 3,741 mek / kg after frying. Yet, after the addition of Morinda juice as much as 20-30 ml, the peroxide number was dropped to 1.888 mek / kg. It occured because in Morinda juice there were antioxidants β-carotene that was lipophilic that played a role in preventing and decreasing the peroxide lipids (Sjabana, 2002).

Similarly, Morinda juice led to higher iodine number since the volume of β-carotene and scopoletin were obviously increasing so that more iodine numbers were needed to break the double chains found in waste cooking oils. This is indicated by the increasing number of iodine contained in waste cooking oils with volume variations.

In contrast, acid number of the new fresh oil (before frying) was 0.029 mg / g, yet, the acid number was risen to 0.263 mg /g after frying. Through the addition of Morinda juice with volume variation, acid number of cooking oil was increased to 0.281 mg/g. It was assumed that the water containing in Morinda juice likely hydrolyzed oil to become free fatty acids. In addition, the acid number was also affected by ascorbic acid levels in Morinda juice. Thus, the addition of Morinda juice would make the acid number of waste cooking oil rising.

CONCLUSION

It could be concluded that: The Morinda juice significantly affected the peroxide, and iodine numbers containing in the wasted vegetable cooking oils. In brief, the results of statistical analysis showed above indicated that the addition of Morinda juice significantly affected to peroxide, and iodine numbers, while, Morinda juice did not significantly affect the quality of waste cooking oils with the acid number before frying was 0.029 mg / g, and it was 0.263 mg /g after frying, then it was only 0.281 mg/g after treatment given. But there was no significant affect of Morinda juice to the acid numbers found in the wasted cooking oils. Relating to the conclusion above, it was suggested that the upcoming research should focus on decreasing acid number of waste cooking oils with Morinda juice treatment.

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