[ictrops-2017] Editorial Decision on Paper

Dari: admin (ictropsidb@gmail.com)

Kepada: winulica@yahoo.co.id

Tanggal: Kamis, 2 November 2017 12.54 WITA

Mr Erwin Erwin:

After a careful review of your submission, "INFLUENCE OF CRUDE EXTRACT OF TEA LEAVES (Camellia sinensis L.) ADDITION AND STORAGE TIME OF CHANGES IN CONCENTRATION OF FREE FATTY ACID IN CRUDE PALM OIL" will be considered for presentation at International Conference on Tropical Studies and Its Application if the following revisions are successfully implemented.

Thank you and looking forward to your participation in this event.

admin
vlallo.office@gmail.com

Reviewer A:

Perbaikan sesuai dengan catatan terlampir

International Conference on Tropical Studies and Its Application 2017
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[ictrops-2017] Editorial Decision on Paper

Dari: admin (ictropsidb@gmail.com)

Kepada: winulica@yahoo.co.id

Tanggal: Kamis, 1 Februari 2018 10.36 WITA

Mr Erwin Erwin:

After a careful review of your submission, "INFLUENCE OF CRUDE EXTRACT OF TEA LEAVES (Camellia sinensis L.) ADDITION AND STORAGE TIME OF CHANGES IN CONCENTRATION OF FREE FATTY ACID IN CRUDE PALM OIL" will be considered if the following revisions are successfully implemented. (ATTACHMENT)

Thank you and looking forward to your participation in this event.

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Reviewer B:

1. Judul tulisan, apakah sudah mencerminkan isi, spesifik dan efektif ?:
Yes, but the title needs to be revised

2. Abstrak dan kata kunci, apakah sudah menggambarkan isi tulisan secara keseluruhan?Saran/Perbaikan yang harus dilakukan penulis pada ABSTRAK dan KATA KUNCI ::
Please consider revision

3. Perumusan masalah dan tujuan penelitian dalam Pendahuluan, bila dilihat dari kejelasan pendefinisian ? Saran/Perbaikan yang harus dilakukan penulis ::
Please consider revision

4. Metode penelitian, bila ditinjau dari perumusan masalah dan tujuannya : Saran/Perbaikan yang harus dilakukan penulis pada METODE PENELITIAN ::
Please consider revision

5. Kejelasan dan komprehesivitas metode/analisis dan sintesis dengan hsil pembahasan, apakah sudah menjawab permasalahan secara tuntas.
Saran/Perbaikan yang harus dilakukan penulis pada HASIL dan PEMBAHASAN ::
Please consider revision

6. Saran/Perbaikan yang harus dilakukan penulis pada KESIMPULAN ::
Please consider revision

7. Kebaruan acuan pustaka (dilihat dari tahun publikasi kurun waktu lima tahun terakhir) ?:
Good

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revisi artikel

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Tanggal: Selasa, 13 Februari 2018 08.27 WITA

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erwin

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Samarinda, November 3, 2017

Letter of Acceptance

Dear,
Erwin, Elita Wahifiyah, Aman Sentosa Panggabean, Rita Hairani

Congratulations, your abstract entitled:
"Influence Of Crude Extract Of Tea Leaves (Camellia Sinensis L.) Addition And Storage Time Of Changes In Concentration Of Free Fatty Acid In Crude Palm Oil" has been accepted for oral presentation at the International Conference on Tropical Studies and Its Application (ICTROPS 2017) which is scheduled to be held in Samarinda, East Kalimantan, Indonesia from 9-10 November at Aston Samarinda Hotel & Convention Center, Samarinda, East Kalimantan, Indonesia.

Please remember that the paper version of your presentation can only be published in the IOP Conference Proceedings if at least one of the authors registers for the Conference, presents the paper and delivers the original manuscript with the template required by IOP. If your paper cannot be presented at the Conference for any reason, please let us know immediately.

We would like to congratulate you on submitting an abstract of such high quality and we look forward to welcoming you in Samarinda, East Kalimantan.

Yours faithfully,
ICTROPS 2017 Organizing committee,
Coordinator,

Dr. Rahmat Gunawan, M.Si

Influence of crude extract of tea leaves (Camellia sinensis L.) addition and storage time of changes in concentration of free fatty acid in crude palm oil [R1]

Erwin*, Elita Wahifiyah, Aman Sentosa Panggabean, and Rita Haerani

Chemistry Department, Faculty of Mathematic and Natural Sciences, Mulawarman University, Jalan Barong Tongkok No. 4, Samarinda,

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Abstract: The purpose of this study was to determine the effect of the crude extract of tea leaves (*Camellia sinensis* L.) and storage time ~~for~~ on the content of free fatty acid ~~with~~ in palm oil. The dried tea leaves were macerated and concentrated by rotary evaporator. Then the extract obtained was added to crude palm oil with various ~~additions of 0, 1 and 2 gram~~added mass of the extract and ~~using variation of~~various storage time ~~was~~ (0~~, 5, 10, 15, 20, 25 and~~ 30 days). Phytochemical tests indicated the presence of secondary metabolites including alkaloids, triterpenoids, steroids, phenolics and flavonoids. The ANOVA test showed ~~the effect of decreasing~~a decrease in free fatty acid content in ~~on~~ crude palm oil with the addition of tea leaves extract. From LSD (Least Significant Difference), obtained crude extract mass of 2 grams giving the most impact on crude palm oil FFA and the best storage time was at 20 days[R2]

1. Introduction

Tea has long been used as a release thirst drink or to give fresh flavors addition to it also can restore health, and does not cause negative effects [1]. Derivative products tea leaves are already widely known among other slimming tea, herbal tea, or tonic tea, various food products, pharmaceutical, beauty and body treatments [1-2].[R3]

Studies on the efficacy of the tea leaves have been carried out. Tea extract has high antioxidant activity [3-6]. Tea extract has potential as antimutagenic and anticarcinogenic properties as well as protective agents against cardiovascular diseases [3], and it can be used as a precautionary measure [R4]for cancer, prostate cancer, kidney or liver disease [4].

Chemical compound content of leaves tea are polyphenols, flavonols, flavones, flavonone, isoflavones, anthocyanins and catechins. In addition, tea also contains alkaloids (caffeine, theobromine and theofolin) of about 7-8% [1-2, 7]. [R5]On the other hand alkaloid is a natural base that can be used to separate the free fatty acids from crude palm oil. Therefore purpose of the study was to utilize the eco-friendly tea leaves extract as a lowering of free fatty acids in crude palm oil.

Therefore, the purpose of the study was to utilize tea leaves extracts ~~as a lowering~~to decrease ~~of~~ the~~f~~free fatty acid~~s~~ content in crude palm oil ~~that~~ with environmentally friendly methods.[R6]

2. Material and Methode

2.1. Material

Equipment used in this study were equipment of maceration, rotary evaporator, glass funnel, beaker glass, pipette, test tubes, press equipment, tube, centrifuge, vial, spatula, measuring flask, analytical balance, Erlenmeyer flask, magnetic stirrer, electric water bath, the stand poles, clamps, measuring cups and buret. While the materials used in this study include crude palm oil, dried tea leaves, ethanol, distilled water, cotton, cotton, oxalic acid, 0.1 N KOH alcohol solution and PP indicator.

2.2. Preparation of crude palm oil

Oil palm fruit pulp that has been separated, crushed or pulverized using a mortar and pestle until it becomes pulp, and then filtered using cheesecloth and pressed. [R7]The extract obtained is then purified using centrifugation for 60 minutes at a speed of 6000 rpm.

2.3. Extraction of tea leaves

The amount of 678 grams of powder dried tea leaves (*Camellia sinensis* L.) was macerated with ethanol for 3 times 24 hours at room temperature. The filtrate obtained was then concentrated using a rotary evaporator at a temperature of 30-40 °C to obtain crude extract of tea leaves [8-9].

2.4. Alkaloids test

The crude extract of tea leaves (*Camellia sinensis* L.) were dissolved in ethanol, then were added with a few drops of H_2SO_4 2 N, while shaken. The formation of orange to red brown deposits after ~~added~~ the addition of Dragendrorff reagent ~~indicates~~ indicated the presence of alkaloids [10].

2.5. Triterpenoid and steroid test

The crude extract was dissolved in ethanol and then put in a glass tube following by the addition of 10 drops of glacial acetic acid and 2-3 drops of concentrated sulfuric acid (LiebermannBurchard reagent). The formation of reddish orange or purple colour ~~indicates~~ indicated the presence of triterpenoids, while green color ~~indicates~~ indicated the presence of steroid [8].

2.6. Saponin test

A mount of crude extract was dissolved in 2 mL of distilled water then shaken strongly in a test tube. The presence of saponin ~~is~~ was characterized by the formation of durable foam on the surface of the liquid. Foam has remained stable after the addition of a few drops of concentrated HCl [11].

2.7. Phenolic test

A mount of crude extract was dissolved in ethanol. 3 drops of iron (III) chloride 1% was added to ~~A~~a total of 1 mL of the extract ~~were added 3 drops of iron (III) chloride 1%.~~ The presence of phenolic ~~characterized~~ was indicated by the appearance of ~~colors~~ green, red, purple, blue or black colors [12]

2.8. Quinoline test

5 mL of extract solution was added 1 N sodium hydroxide. The presence of quinone ~~is~~ was indicated by the formation of red color [13].

2.9. Flavonoids test

Flavonoid test was conducted using Willstatter method. A mount of crude extract was dissolved in ethanol. 1 mL of the extract solution was added a bit of Mg powder and 5 drops of concentrated HCl. The presence of flavonoids shown by the orange, red to dark red [R8][14].

2.10. Addition of Crude Tea Leaves into crude palm oil

Amount of 5 grams of crude palm oil is inserted into each of 63 vials. 1st - 21st (negative control), 22st-42st, 43rd -63rd vial were added 0, 1, and 2 gram crude extract of tea leaves, respectively. Each vial was homogenized with a stirrer. Furthermore, the samples were moved into a dark glass bottle sealed and stored at room temperature. Determination of free fatty acids performed on the storage time of 0, 5, 10, 15, 20, 25 and 30 days for triplo.[R9]

2.11. Determination of Free Fatty Acid Numbers

A mount of 2 gram sample is inserted into the Erlenmeyer flask, then added 25 mL of alcohol 95% and 2 drops of phenolphthalein indicator (PP). Furthermore, the sample is titrated with alcoholic KOH solution 0.1 N until the pink color is achieved and does not missing for 30 seconds. Free fatty acids, expressed as the acid number obtained from a mount of mg KOH used to neutralize the free fatty acids from one gram of crude palm oil.[R10]

2.12. Technique Data Analysis

For testing data hypothesis used Analysis of Variance (ANOVA) statistic test.

3. [R11]Result and discussion

3.1. Extraction and phytochemical test

The amount of 65.62 grams of crude extracts obtained from the maceration of 678 grams of dried tea leaves (9.68%). Based on test results obtained information that the phytochemical extracts containing coarse alkaloids, triterpenoids, steroids, phenolic, quinone, and flavonoids as shown in Table 1.

Table 1. The chemical compound content crude extract of tea leaves

Secondary metabolites	Alkaloid	Triterpenoid	Steroid	phenolic	Quinoline	Flavonoid	Saponin
result	+	+	+	+	+	+	+

*3.2. **Free fatty acid (FFA) test***

Free fatty acid test carried out by using acidimetric method with variation amount of crude extract and storage time toward the changing of free fatty acid concentration in palm oil. Determination of free fatty acids in crude palm oil triplo conducted and the results as shown in Figure 1.

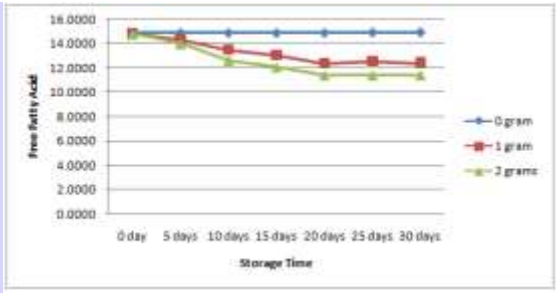

Figure 1. Relationship between changes the concentration of FFA to variations addition of crude extract and duration of storage on crude palm oil

From the study obtained the comparison of FFA concentration of oil that didn't add to the crude extract of tea leaves (as a negative control) with oil which added 1 gram of crude extracts and oils which added 2 grams of crude extract. The concentration of FFA in control is higher compared to the oil which added the crude extract. The concentration of FFA in control increases with the length of storage time (0, 5, 10, 15, 20, 25 and 30 days). Increased FFA is directly proportional to the length of

storage, this happens because of good hydrolysis caused by water hydrolysis and lipase enzyme as long as the treatment and storage term [15-16].

The longer of the storage time, the amount of FFA oil would increase dramatically. In contrast to the oil that has been added the crude extract of tea leaves (*Camellia sinensis* L.), FFA oil decreases in row with the amount of crude extract were added to the oil. However, on the 25th day FFA oil which did not add with crude extract, oil which added 1 gram of crude extract and 2 gram of crude extract of leaves of tea (*Camellia sinensis* L.) increased significantly. This continues until day 30. Besides, the oil will become cloudy this may occur due to precipitation of salts from the reaction between alkaloids and free fatty acids (as well as the reaction mechanism shown in Figure 2). Alkaloids are natural bases which have characteristic Lewis alkaline because they contain N atoms in the ring of heterocyclic which could donate a lone pairs [17].

The results of phytochemical test from crude extract of tea leaves indicated the possibility of content: alkaloids, triterpenoids, steroids, phenolic, quinone and flavonoids. So it could be predicted that FFA of palm oil could be down due to the content of secondary metabolites in crude reacted. One of alkaloid type which is on leaves of tea is caffeine. Caffeine would react with fatty acid in palm oil and produce salt. With variation of storage term was did to see how much the extent of damage toward the oil which storage every 5 days.

After 20th days occur the increasing of free fatty acid, it is possibility occur because the content alkaloid from crude extract of tea leaves in oil which added 1 gram and 2 gram has completely react with free fatty acid. In other word, there was no more alkaloid that neutralizing free fatty acid that form as oil hydrolysis.

The neutralization reaction between alkaloids (caffeine) with free fatty acids can be seen in figure 2 below.

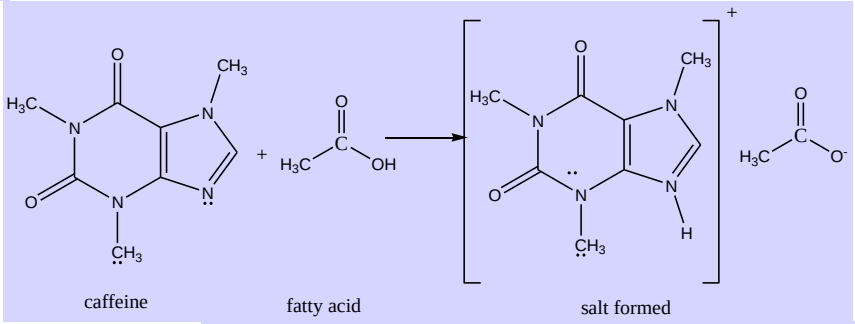

Figure 2. Reaction between caffeine with free fatty acid

Another compound of secondary metabolites that predicted to have role in decreasing free fatty acid is flavonoid group. Flavonoid predicted could restrain free fatty acid in oil [16] and it gained that the content of fenolik in banana kepok skin's chloroform extract could even decrease free fatty acid concentration in biodiesel [18].

In the research, data analysis carried out by using ANOVA method 2 ways for testing the hypothesis, whether there are the effects for the addition of crude extract of tea leaves towards free fatty acid in palm oil. After the testing gained $F_{count} > F_{table}$, the value F_{count} = 19.9148 dan F_{tabel} = 9.33 with significance level of 1%. From the testing result it showed there are indeed the effect for addition of tea leaves's crude estract (*Camellia sinensis* L.) and variation of storage time toward crude extract of tea leaves and the lenght of storage time towards free fatty acid in palm oil. If $F_{count} > F_{table}$, Ho accepted and Ha rejeted.

After anova test and gained the conclusion that there are indeed the effect for the addition of crude extract of tea leaves toward free fatty acid, next it carried out LSD *(Least Significant Difference)* test to determine which one give the best effect towards free fatty acid in palm oil. After test and calculation LSD was carried out toward palm oil FFA with mass of crude extract, the result is 2 gram crude extract is the best mass for the added into palm oil and from the LSD calculation towards the

length of storage of mix between palm oil with crude extract, obtained that maximum length for storage is 20 days [R12]

4. Conclusion

Based on this research, the optimum mass addition of crude extract of tea leaves was 2 grams with a reduction of free fatty acids of 22.81% with the optimum length of storage time ~~was~~ of 20 days.

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Influence of the Addition and Storage Time of Crude Extract of Tea Leaves (*Camellia sinensis* L.) Toward Value of Free Fatty Acid in Crude Palm Oil

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Abstract: The purpose of this study was to determine the effect of the crude extract of tea leaves (*Camellia sinensis* L.) and storage time on the content of free fatty acid in palm oil. The dried tea leaves were macerated and concentrated by rotary evaporator. The extract obtained was added to crude palm oil with various added mass of the extract and various storage times. Phytochemical tests indicated the presence of secondary metabolites including alkaloids, triterpenoids, steroids, phenolics and flavonoids. The ANOVA test showed a decrease in free fatty acid content in crude palm oil with the addition of tea leaves extract. The LSD (Least Significant Difference) test showed the best influence on ALB of palm oil is on the total extract mass of 2 grams and the storage time of 20 days.

Keywords: tea leaves (*Camellia sinensis* L.), FFA, Crude palm oil.

1. Introduction

Tea is widely consumed as a beverage, also to provide a fresh flavor and is also used as an additive to food, cosmetics and drugs, and does not cause negative effects [1]. Tea derivative products can be used for body slimming, herbal tea, preventing the formation of dental caries, ingredients of medicine for treating diabetes, hypertension and cancer [1-2].

Studies on the efficacy of the tea leaves have been carried out. Tea extract has high antioxidant activity [3-6]. Tea extract has potential as antimutagenic, anticarcinoggenic and protective agents against cardiovascular diseases [3]. Tea can be used in a precautionary measure for cancer, prostate cancer, kidney or liver disease [4]. Chemical compound content of leaves tea are polyphenols, flavonoids, flavones, flavonone, isoflavones, anthocyanins and catechins. In addition, tea also contains alkaloids (caffeine, theobromine and theofolin) of about 7-8% [1-2,7].

Caffeine contained in tea leaves has many negative effects if consumed in excess, can increase stress, accelerate bone damage, to affect heart health and stomach acid [2]. Caffeine compounds in tea can be used to lower free fatty acid content in palm oil, and can increase its economic value. Moreover, in tea leaves contain many basic metabolite compounds that are alkaline so it is expected to reduce free fatty acids in palm oil.

Based on the above description, the research to reduce free fatty acid in crude palm oil by utilizing crude extract of tea leaves (*Camellia sinensis* L.) as a base source has been done. Some important parameters such as the total amount of crude extract of tea leaves (*Camellia sinensis* L.) and the various of storage time are also studied. This research method is environmentally friendly and can increase the economic value of crude palm oil and tea.

2. Material and Methods

Material

Equipment used in this study are rotary evaporator, glass funnel, beaker glass, pipette, test tubes, press equipment, tube, centrifuge, vial, spatula, measuring flask, analytical balance, Erlenmeyer flask, magnetic stirrer, electric water bath, the stand poles, clamps, measuring cups and buret.

The materials used in this study include crude palm oil, dried tea leaves, ethanol, distilled water, cotton, oxalic acid, KOH and phenolftalein.

Metodology

Preparation of crude palm oil

The fruit of palm oil is separated between the seeds and the flesh. The flesh is smoothed using a mortar to a pulp and filtered with a thin cotton cloth into an oil press. The extract obtained was centrifuged for 60 minutes at a speed of 6000 rpm. The oil produced is ready for use.

Extraction of tea leaves

The amount of 678 g of powder dried tea leaves (*Camellia sinensis* L.) was macerated with ethanol for 3 times 24 hours at room temperature. The filtrate obtained was concentrated using a rotary evaporator at a temperature of 30-40 °C and obtained crude extract of tea leaves [8-9].

Alkaloids test

The crude extract of tea leaves (*Camellia sinensis* L.) were dissolved in ethanol, added with a few drops of 2N H_2SO_4, while shaken. The formation of orange to red brown deposits after the addition of Dragendrorff reagent indicated the presence of alkaloids [10].

Triterpenoid and steroid test

The crude extract was dissolved in ethanol, put in a glass tube following by the addition of 10 drops of glacial acetic acid and 2-3 drops of concentrated sulfuric acid (Liebermann Burchard reagent). The formation of reddish orange or purple colour indicated the presence of triterpenoids, while green color indicated the presence of steroid [8].

Saponin test

A certain amount of crude extract was dissolved in 2 mL of distilled water then shaken strongly in a test tube. The presence of saponin was characterized by the formation of durable foam on the surface of the liquid. Foam has remained stable after the addition of a few drops of concentrated HCl [11].

Phenolic test

A certain amount of crude extract was dissolved in ethanol and 3 drops of 1% iron (III) chloride was added to a total of 1 mL of the extract. The presence of phenolic was indicated by the appearance of green, red, purple, blue or black colors [12]

Quinoline test

A total of 5 mL of extract solution was added 1N sodium hydroxide. The presence of quinone was indicated by the formation of red color [13].

Flavonoids test

Flavonoid test was done by Wilstater method. A certain amount of extracts is dissolved in a suitable solvent. A total of 1 mL of extract was added with a small amount of Mg powder and 5 drops of concentrated HCl. The presence of flavonoids gives the color orange, red to dark red [14].

Addition of crude tea leaves into crude palm oil

Amount of 5 g of crude palm oil is inserted into each of 63 vials. 1^{st} - 21^{st} (negative control) , 22^{st}-42^{st}, 43^{rd} -63^{rd} vial were added 0, 1, and 2 gram crude extract of tea leaves, respectively. Each vial was homogenized with a stirrer. Furthermore, the samples were moved into a dark glass bottle sealed and stored at room temperature. Determination of free fatty acids performed on the storage of varied time of 0 – 30 days.

Determination of Free Fatty Acid

A total of ± 2 g of oil is weighed into the Erlenmeyer flask. The oil is then added 25 mL of neutral alcohol and 2 drops of phenolphtalein indicator. The solution was titrated with a 0.1N KOH-alcoholic solution until a pink color was obtained and not dissipated for 30 s.

3. Result and Discussion

Extraction and Phytochemical Test

The extraction process in this study, from 678 g of tea leaves (*Camellia sinensis* L.) was obtained from Bogor, West Java which has been dried and macerated with ethanol of 1.9 L for several days and then concentrated with a rotary evaporator to obtain a total was 65.62 g (9.72%). The resulting total extract tested its secondary metabolite content, as shown in Table 1.

Table 1. The chemical compound content crude extract of tea leaves

Secondary metabolites	Alkaloid	Triterpenoid	Steroid	phenolic	Quinoline	Flavonoid	Saponin
result	+	+	+	+	+	+	+

Based on test results obtained information that the phytochemical extracts containing coarse alkaloids, triterpenoids, steroids, phenolic, quinone, and flavonoids.

Free Fatty Acid (FFA) Test

Determination of free fatty acids was done by using titration of acidimetry. In this study, the amount of free fatty acids in palm oil was determined for various variations in total amount of added extract of tea leaves (*Camellia sinensis* L.) and storage duration time. The determination of free fatty acid in palm oil is done by triplo respectively.

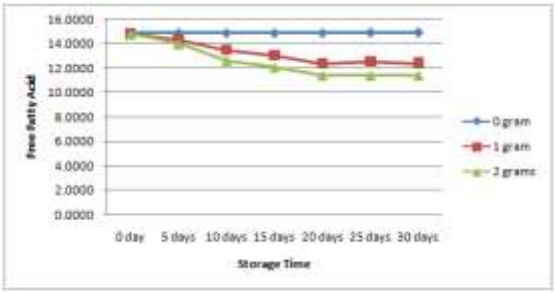

Figure 1. FFA content at various variations addition of crude extract tea leaves and duration of storage on crude palm oil

The results of the study (**Fig. 1**) showed the comparison of FFA value in crude palm oil which was not added with crude extract of tea leaves (*Camellia sinensis* L.) (as negative control) and with added crude extract of tea leaves. The value of FFA in negative control is higher than that of the added crude palm oil with crude extract of tea leaves. The increase in FFA is directly proportional to the length of storage, this is due to good hydrolysis caused by water and lipase enzymes during the treatment and storage [15-16]. The FFA value of the controlled palm oil increases with the length of storage time. This is due to the increased FFA caused by oxidation and enzyme hydrolysis reaction during processing and storage time [17,18]. In contrast to the oil that has been added to the crude extract tea leaves (*Camellia sinensis* L.), the FFA value of the oil decreases with the amount of total extract added to the oil.

It can be concluded that oil storage is good only up to 20 days. After 20 days there is an increase in the value of free fatty acids. The oil will be physically damaged in the form of a color that turns into turbid and is chemically a formed FFA. The color of the oil will become turbid, because the salt

deposition of the reaction between alkaloids and free fatty acids (shown in **Fig. 2**). This is presumably because the alkaloid content of the crude extract tea leaves (*Camellia sinensis* L.) added in palm oil has reacted with free fatty acids, so that no alkaloids neutralize the free fatty acids formed as oil hydrolysis. Alkaloids are natural bases that have basic Lewis properties because they contain N atoms in heterocyclic rings that can contribute a single pair [19].

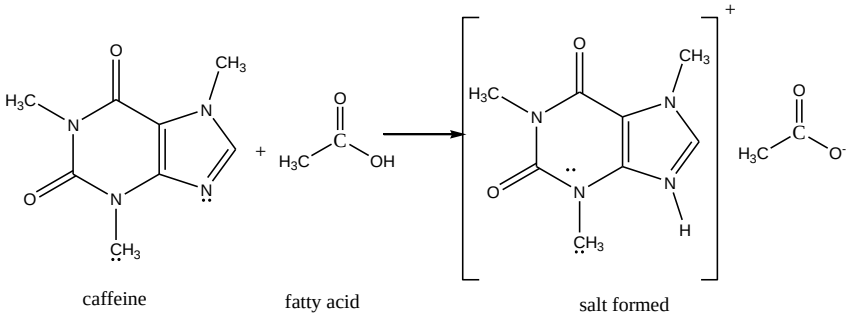

Figure 2. Reaction between caffeine with free fatty acid

To prove the hypothesis, is there any effect of addition of the crude extract tea leaves (*Camellia sinensis* L.) toward free fatty acid on palm oil done by ANOVA method. After the test is obtained $F_{count} > F_{table}$. F_{count} = 19.9148 and F_{tabel} = 9.33 with significance level of 1 %. If $F_{count} > F_{table}$. Ho is accepted and Ha is rejected, it is concluded that there is an effect of addition of the crude extract tea leaves (*Camellia sinensis* L.) and variation of storage time to free fatty acid in crude palm oil.

LSD (Least Significant Difference) test is performed to determine parameters that give the best effect to free fatty acid value. The best amount of the crude extract tea leaves (*Camellia sinensis* L.) was 2 g. The average value of FFA on the addition of 2 g of extract significantly different with LSD value, was 2.3686 > 1.0343 with significance level of 1%. This indicates that the addition of mass of the crude extract tea leaves (*Camellia sinensis* L.) 2 g can lower the larger free fatty acids. From the calculation of LSD to the storage period, it is obtained at 20 days day storage. This can be seen from the average value of FFA on 20 days of storage is significantly different to the LSD value, was 1.954 > 1.0343 with a significance level of 1%. It can be concluded that the length of storage of oil mixture with the crude extract tea leaves (*Camellia sinensis* L.) is a maximum of 20 days. After 20 days of storage, palm oil will undergo physical changes and FFA on palm oil will increase so that the quality of the palm oil is damaged.

4. Conclusion

Based on this research, the optimum mass addition of the crude extract of tea leaves was 2 g with a reduction of free fatty acids of 22.81% with the optimum length of storage time of 20 days.

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