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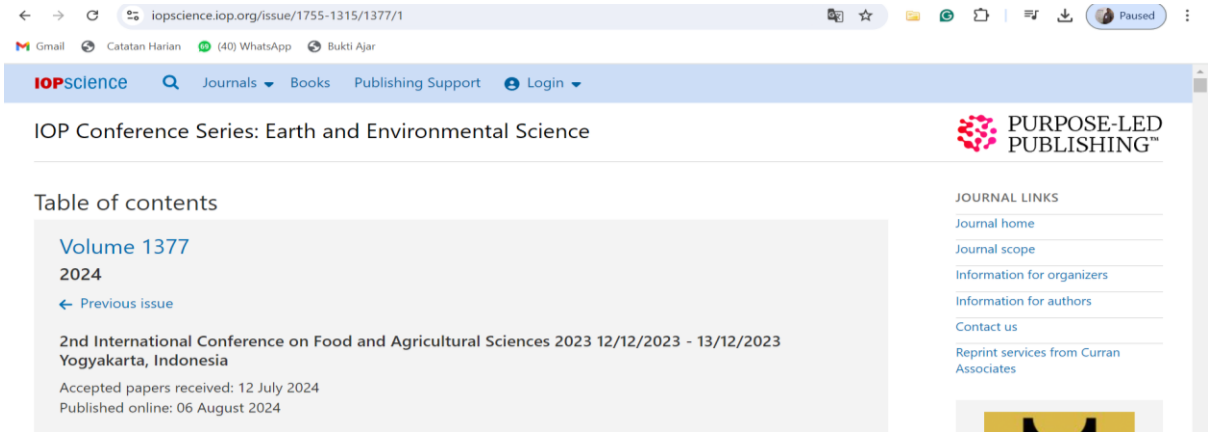

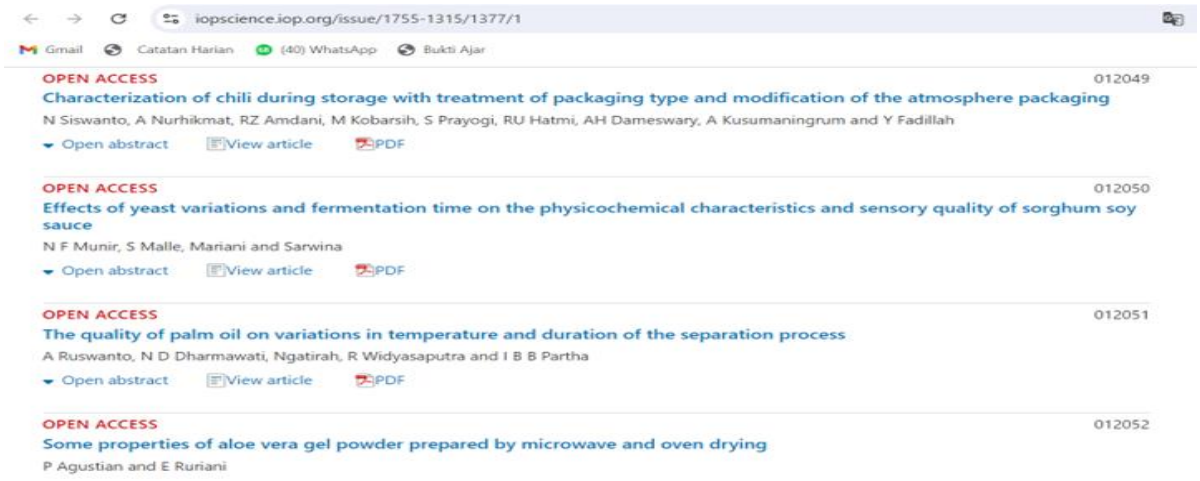

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Adi Ruswanto

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The quality of palm oil on variations in temperature and duration of the separation process

The quality of palm oil on variations in temperature and duration of the separation process

A Ruswanto*, N D Dharmawati, Ngatirah, R Widyasaputra, I B B Partha

Institut Pertanian Stiper Yogyakarta. Jl. Nangka II Maguwoharjo, Depok, Sleman,Yogyakarta.

*Corresponding author: adiroeswanto@gmail.com

Abstract. The separation of palm oil in the processing stage is influenced by various factors including temperature and settling time. This research aims to analyze palm oil obtained from variations in temperature and settling time during the separation of palm oil. The experimental design used a split plot design. The main plot is the settling temperature of the clarification which consists of 3 levels, namely; temperature 55-60ºC, temperature 65-70ºC, temperature 75-80ºC The section plot is the time of the deposition process consisting of 3 levels, namely; 1.5 hour time, 3.0 hour time, 4.5 hour time. Observation of the results included the percentage of separated oil, free fatty acid content (FFA), deterioration of bleachability index (DOBI). The data obtained was analyzed of varians (ANOVA), if there was a significant difference, the DMRT 5% test was continued. Based on research, the higher the temperature and the longer the settling time, the higher the FFA, the percentage of separated oil, but the lower the DOBI value. Based on the best quality parameters from FFA and DOBI content parameters, obtained from the separation process temperature treatment of 55-60ºC and separation process time of 1.5 hours.

1. Introduction

The clarification stage is very important because there will be a separation of oil from non-oil, for example water, solids in the form of dirt, fibers or others. The clarification process to separate oil must pay attention to the temperature and residence time of the material in the clarification tank [1]. The clarification process temperature is in the range of 80-90ºC to get good results and low oil loss in liquid waste [2]. The clarification process separates palm oil from impurities using the principle of gravity and sedimentation which keeps palm oil in a liquid state so that it is easier to separate, and the melting point of palm oil is between 30 - 40ºC. A poor clarification process can potentially produce greenhouse gases [3], causes oil loss in liquid waste [4]. Clarification at a palm oil factory is the process of separating oil from non-oil (water, dirt). The clarification/refining process in palm oil mills goes through process stages and during which the dirty oil must maintain a temperature of around 80-90ºC [4]. The physical change in clarification is that palm oil is obtained which contains little impurities and water. Crude palm oil obtained from the extraction process contains approximately 66% oil, 24% water, and 10% non-oily solids (NOS). If there are solids, the oil must be filtered using a vibrating screen with hole sizes of 20 and

40 mesh. Then the oil is stored in a kind of settling tank for 2 hours which functions to separate the oil into two parts, oil and sludge. The oil at the top is separated and continued with drying using a vacuum dryer before being put into a storage tank [5].

The decline in the quality of palm oil is identical to the increase in free fatty acid levels) which is greatly influenced by the stage of the material handling process, starting from harvesting, transporting to the palm oil factory [6]. The formation of free fatty acids is due to the hydrolysis process of oil due to the presence of water, lipase enzymes and can be accelerated by heat [7].

The problem is that at the clarification stage, the temperature must be maintained at around 90^{o}C with a retention time in the clarification tank (clarifier tank) of around 3-4 hours or even more so that a long heat transfer occurs as a result of which the oil can be damaged by hydrolysis into free fatty acids. Based on this, this research aims to examine the effect of temperature and retention time at the beginning of clarification on the percentage and quality of palm oil produced. Research purposes to examine the effect of temperature and settling time for separating palm oil on the percentage and quality of palm oil produced

2. Material and Method s

The equipment used is glassware, burette, soxhlet, oven, digital scale, UV-Vis spectrophotometer, sterilizer, thresher, digester & press, sand trap tank, Miura brand boiler with a capacity of 200 liters. The material used is palm fruit from gardens in Central Java. For oil analysis, it consists of ethyl alcohol, sodium hydroxide, 1% thymolblue indicator in 95% alcohol, acetic acid solution: chloroform (3:2 v/v), 1% starch, 0.1 N Na-thiosulfate, Wijs solution, n -hexane, potassium iodide, carbontetrachloride from Merck.

Prepare the palm fruit, weigh it and immediately undergo a sterilization process for 90 minutes. Next, it is crushed and pressed. The resulting crude oil is added to hot water 1:1 and continued with filtering. Prepare 300 ml of crude oil in a beaker for each treatment and heat it using a water bath according to the experimental design. The experimental design uses Split Plots. The main plot is the clarification heating temperature which consists of 3 levels, namely temperature 55-60^{o}C, temperature 65-70^{o}C, temperature 75-80^{o}C. The part plot is the retention time of the deposition process which consists of 3 levels, namely time 1.5 hours, time 3.0 hours, time 4.5 hours. Furthermore, the oil obtained from this treatment was subjected to observation/analysis of the results including free fatty acid content [8], deterioration of bleachability index [9], impurity content [10], percentage of separated oil. The data obtained was subjected to an ANOVA test using SPSS 25 and if the results were significantly different, the DMRT 5% test was continued.

3. Result and Discussion

Based on the implementation that has been carried out starting from oil extraction, crude oil heating treatment at temperature and retention time as initial clarification, the results for each parameter are as follows;

3.1. Free fatty acid (FFA)

Based on the research results, the FFA oil levels are shown in **Fig. 1.** Based on analysis of variations in the length of settling time and settling temperature during palm oil clarification, it affects the free fatty acid (FFA) content. The long deposition time shows an increase in free fatty acid levels. This occurs due to damage to palm oil, especially due to the hydrolysis process, because when it settles there is still water in the palm oil.

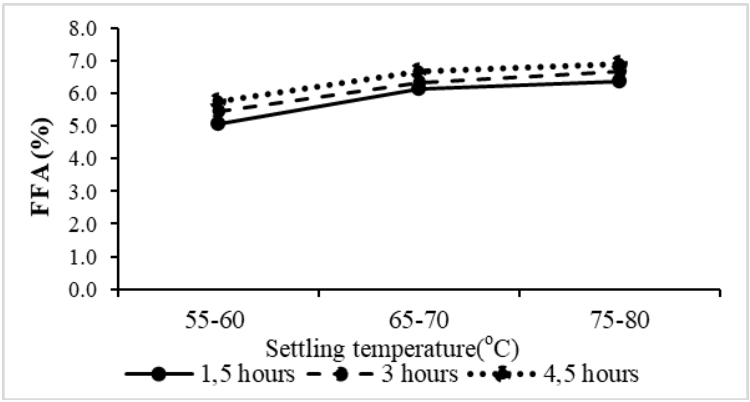

Figure 1. Relationship between temperature and settling time on FFA

In the hydrolysis process, some oil experiences damage, hydrolysis damage to the oil will mainly produce FFA free fatty acids [11]. Likewise, the higher the retention temperature causes the FFA to increase, this result is caused by the higher the temperature, the hydrolysis process will increase so that more FFA will be formed [8], the presence of heat can increase the degradation of palm oil which produces FFA. For standard FFA levels, the maximum is 5% [12], so that all treatment results are still above standard. High FFA levels indicate high hydrolysis damage to palm oil [13]

3.2. DOBI *(Deterioration of bleachability index)*

The results of observing DOBI values for oil products are shown in **Fig. 2**. In **Fig. 2**, it can be seen that there is a decrease in the DOBI value due to the length of time and temperature of settling during clarification. The results of the ANOVA test showed that there was a significant effect of heating time and settling temperature during clarification on DOBI

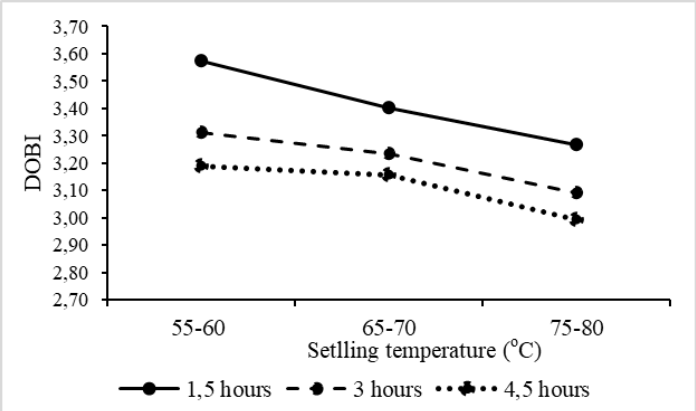

Figure 2. Relationship between temperature and settling time on DOBI

In the treatment with a separation time of 4.5 hours, the quality of the oil seen from the lowest DOBI was 3.00, this was because there was very high carotene degradation due to the longest contact temperature and time. This is because oxidative damage to the oil due to the transfer of hot air is higher over a long period of time. However, the DOBI value is still in the range of good (2.93 – 3.24) and very good (> 3.24). A decrease in the DOBI value indicates oxidation damage due to heat [14] . The smaller the DOBI value, the higher the damage [15]. The longer the settling time, the longer the heat transfer time between

the palm oil and the heat source, the more color degradation. The presence of high heat in oil can cause oxidative damage [16]. Degradasi karoten dapat disebabkan adanya kontak antara minyak sawit dengan suhu dalam waktu cukup lama [17].

3.3. Separated oil percentage

The large percentage of oil separated as a result of treatment time and settling temperature during initial clarification is as shown in **Fig. 3**. below.

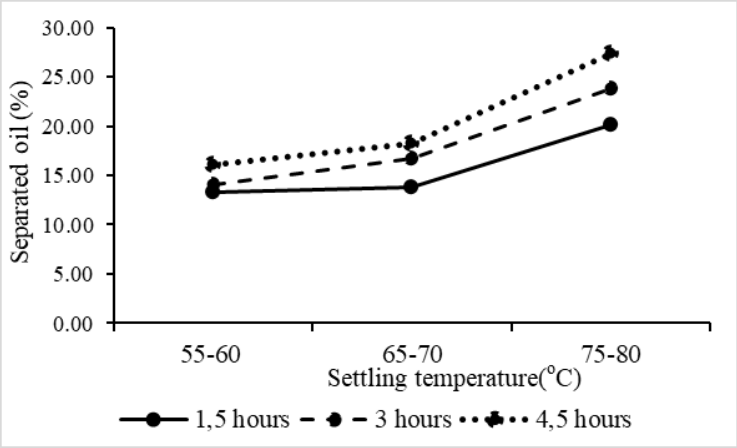

Figure 3. Relationship between temperature and settling time for separated oil

It can be seen in **Fig. 3** that the higher the settling temperature in the clarification process and the longer the setting time, the more oil is separated. This is because the palm oil will become thinner and rise to the surface and separate from the sludge. The separation of oil from non-oil begins in the sand trap-tank with the principle that palm oil has a smaller specific gravity (BJ) than other components such as sand, sludge, oil so that it is at the top and then extracting is carried out [17]. In the palm oil clarification process the temperature used is around 85-90°C to facilitate the separation of oil from non-oil [18]

3.4. Dirt

Oil impurities content as an indicator of palm oil quality. The research results are presented in **Fig. 4.**

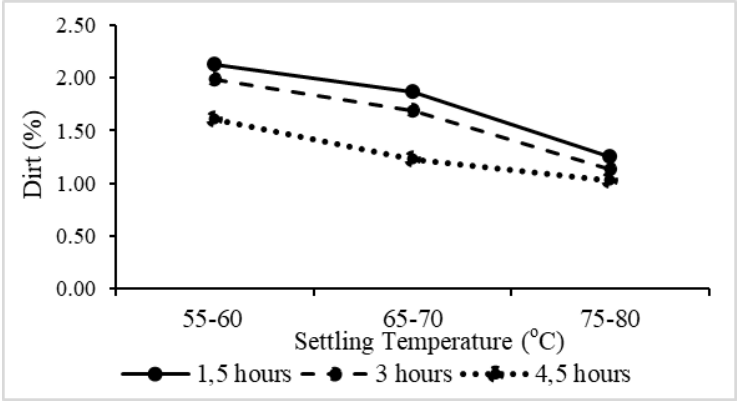

Figure 4. Relationship between temperature and settling time on dirt content

Based on **Fig. 4**, it can be seen that the dirt levels along with the length of settling time and the heating method are relatively the same or the increase is very small. The results of statistical analysis show that there is no significant influence on these two factors. This is because the separation of dirt and oil is carried out using a settling process and the oil at the top is taken, so the dirt content is relatively the same. impurity content can be reduced in the clarification process stages using the principles of filtering and settling, centrifugation [19].

4. Conclusion

Based on the research results, it shows that the higher the retention temperature during clarification and the longer the retention time, the higher the FFA, the percentage of separated oil, but the lower the DOBI and impurities. Based on the best quality parameters from FFA and DOBI content parameters, obtained from the separation process temperature treatment of 55-60^{o}C and separation process time of 1.5 hours with results of FFA content 5.1%, DOBI 3.58.

References

[1] Sembiring N, Panjaitan and A F Saragih 2018 in *IOP Conf. Ser. Mater. Sci. and Eng.* **309** (1) 1-5
[2] Corley RHV and Tinker PB 2016 *The Oil Palm*, Fifth West Sussex USA: Blackwell Science Ltd p.692
[3] Tan Y D, J S Lim, S Rafidah and W. Alwi 2020 *Chemical Engineering Transactions* **78** (2013) 1–6
[4] Ernita T G, Jauhari and T M Helia 2018 *Saintek* **2** (1) 15–23
[5] Noviar M H, Sukardi and Amzulrifin 2016 *Int J Sci Res Publ.* **6** (7) 101–106
[6] Krisdiarto A W, L. Sutiarso and K H Widodo 2017 *Agritech* **37** (1) 101–107
[7] Mangoensoekarjo S and H Semangun 2003 Manajemen Agrobisnis Kelapa Sawit *Gajah Mada Univ Pr*ess Jakarta p.605
[8] Sarah M R and Taib 2013 *J Med Bioeng.* **2** (3) 153–156
[9] Kuntom A S, W Lin, T Y Ai, M. Yusof, T T Sue and N. A. Ibrahim 2005 Malaysian Palm Oil Board 72-75
[10] AOCS 2003 *Official Methods and Recommended Practices of the AOCS 5th edn. American Oil Chemists' Society Champaign* Illinois 5th ed (5)
[11] Almeida de D T, T V Viana, M M Costa, C de S Silva and S Feitosa 2019 *Food Sci. Technol.* **39** (June) 211–217
[12] Badan Standarisasi Nasional 2006 *Standar Minyak kelapa sawit mentah (Crude palm oil)* SNI 01-2901-2006 Jakarta Indonesia p. 15
[13] Sarah M 2015 Effects Of Time and Temperature on Process and Crude Palm Oil Quality with Microwave Irradiation Sterilization *Universiti Teknologi Malaysia* p. 280
[14] Kasmin N H, S I Zubairi, A M Lazim and R Awang 2020 *Sains Malaysiana* **49** (9) 2301–2309
[15] Zamanhuri, N A Rahman and N F A Bakar 2021 *Int. J. Renew. Energy Dev.* **10** (3) 495–505
[16] Tan C A, A Ariffin, H M Ghazali, A Kuntom and A C Choo 2017 *J. Food Sci. Technol* p. 8
[17] Purnama K O, D. Setyaningsih, E Hambali and D. Taniwiryono 2020 A review *Int. J. Oil Palm* **3** (2) 40–55
[18] Listia E, D Indradewa and E Tarwaca 2015 *Ilmu Pertanian* **18** (2) 77–83
[19] Kumaradevan D, K H Chuah, L K Moey, V Mohan and W T Wan 2015 *in IOP Conf. Ser. Mater. Sci. and Eng.* p. 7

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