Role of Saturated Fatty Acid (SFA) for Degradation of Oil Quality

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ABSTRACT

In this study, the phenomena of natural polarization has been used as a preliminary test of vegetable oil quality. The formation of saturated fatty Acid (SFA) has been studied as a most responsible parameter for degradation of oil quality related to its expired limitation. The Oil quality was indicated by change of light polarization, and was measured using pair of polarizer-analyser. The result shows that the change of polarization can be used to indicate oil quality level related to its expiration date. This method also shows predicted SFA formation and apparently it is relative more powerful than standard parameters such as free fatty acid (FFA) test and peroxide value (PV) test. For future, this method has provided good prospect to evaluate the existence of the halal level of oil due to lard (pig oil).

Keywords: natural polarization, vegetable oil quality, saturated fatty acid (SFA)

Introduction

The natural polarization in vegetable oils exists also due to asymmetric triglyceride molecules [1], however it is relative small in comparison to glucose solution. Due to its small change of polarization, the scientists might not be interested in polarization as tool for investigation of oil quality level. So far according to Indonesia National Standardization (SNI) the polarization is not included as standard parameter of oil quality [2, 3]. At a view point of our study, the various parameter of oil quality with its various standard methods are extremely difficult to be conducted and obtained simultaneously [4-8]. For some reasons for rapid validation, standard parameters, such as FFA and PV, are usually used to assess the experimental results. According to our study, high polarization in vegetable oils indicates low level of its quality. In our previous study the increase of polarization is due to increase of formation of FFA, PV, SFA and some other molecules [6-8]. But which is most responsible for the degradation of oil quality until its limit time of oil expiration? It is for us is not yet clear. This paper studies and tries to seek the most responsible process or molecules between FFA and SFA.

Method

The experimental procedure referred to [8], but in this case was conducted without any external electric field. The source of light was TL lamp-23W with blue filter. Various vegetable oils with different brand were obtained from the market, assumed to be fulfilled by SNI, and was rearranged according to their different expiration date. The experiment was done from March until July 2014.The measurement of SFA was used from animal oil i.e. chicken oil, with the assumption that animal oil consisted of high SFA concentration and hence the part of SFA was proportional to part of animal oil. We have considered that the number of PV has similar manner with FFA, therefore for validation of the result we used standard method of titration of FFA only.

Discussion

Figure 1 shows change of polarization and number of FFA for soybean oil (left) and palm oil (right) from the same Band but different expired date. The date

attached below the oil is simply its date of expiration. One of soybean oil from the same brand is already expired, i.e. 30/09/2012. One palm oil from the same brand is already expired, i.e. 27/12/2013. The change of polarization is measured in degrees (°) and the number of FFA is measured in % of volume.
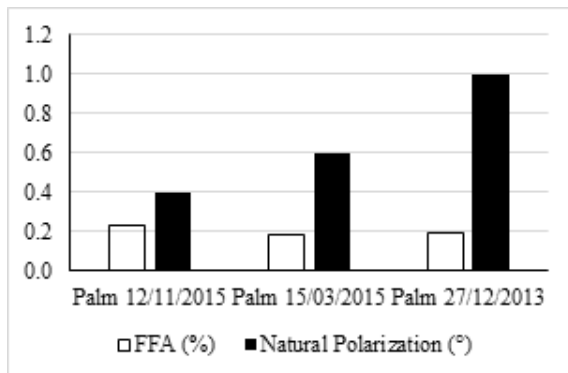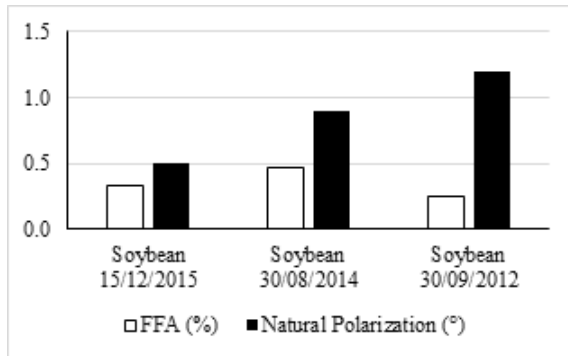

Figure 1. the number of FFA and change of polarization for soybean oil (left) and palm oil (right) with their date of expiration. The experiment conducted from March until July 2014.

The Figure 1 shows that expired oils has always high polarization, i.e. average value is more than 1°. The older of the oil is, the higher is change of polarization, and it is satisfied for all vegetable oil. Unfortunately it is not satisfied for FFA. There is no tendency of increase of FFA when the oil has old date of expiration limit. From the above data, we conclude that the number of FFA does not influence directly to the expiration date of oil. So long the oil is well sealed, the production of FFA is relatively stable.

However, we were almost sure that the SFA played important role for the degradation of oil quality until its expiration date. We proposed that the SFA was

gradually built during external exposure of oil although it was well sealed, due to the unstable molecules of UFA (unsaturated fatty Acid).

To check whether the FFA or polarization was directly dependent on SFA, we measured then number of FFA and change of polarization as a function of addition SFA in to the palm oil. The number of SFA (%) was measured as the volume of animal oil within total volume of mixed oil (mixing between animal and vegetable oil), based on assumption that part of animal oil was simply consists of high SFA.

Figure 2 shows the number of FFA (left) and change of polarization (right) for variation of concentration of SFA in palm oil. Recently result shows also that the PV has similar pattern to the FFA [8].
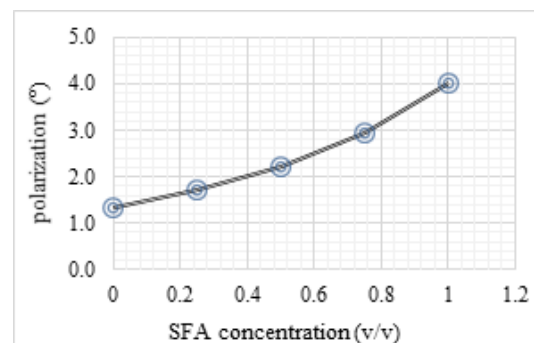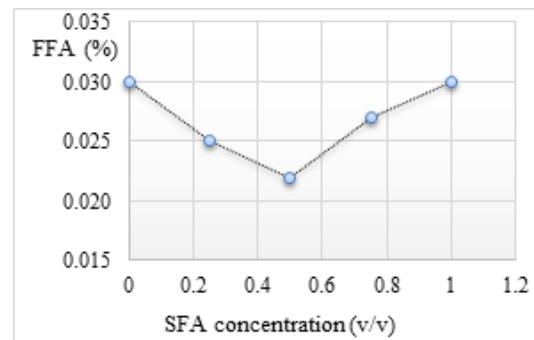

Figure 2. Number of FFA (left, [8]) and change of polarization (right) as function of SFA concentration in mixing of animal oil with palm oil.

From Figure 2, number of FFA is not directly dependent on SFA concentration, but change of polarization is influenced significantly by SFA. This result supports the argument above, why expired oil is not affected by number of FFA, but is strong related

to the formation of SFA number, which is in agreement to the previous study. Therefore, the change of polarization, associated with the formation of SFA, is very visible for preliminary test of oil quality level related to its expiration limit.

In figure 3, we test several edible oils and we compare with expired oil, bulk oil (minyak curah), waste cooking oil (minyak jelantah), and animal oil (chicken oil).
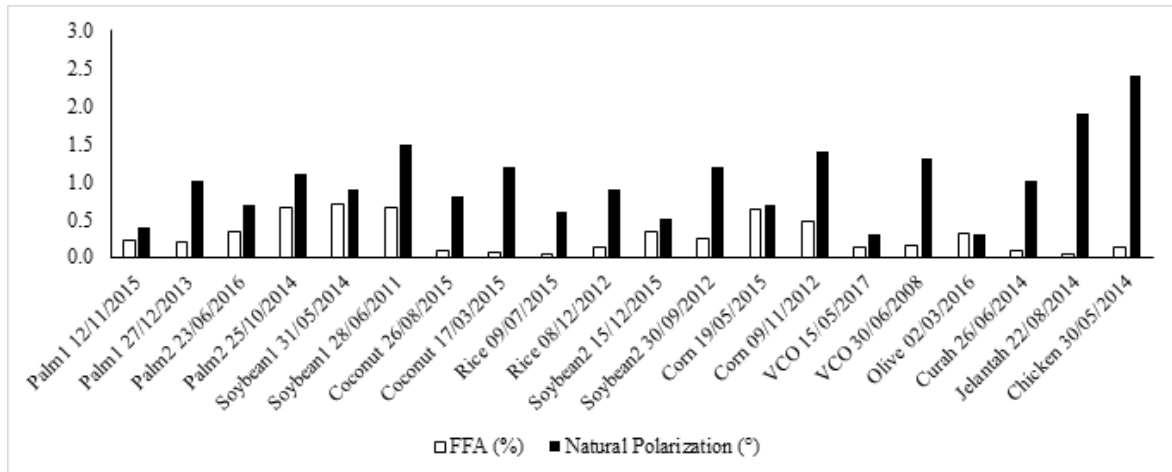

Figure 3. Change of polarization and FFA number for several edible oil, expired oil, bulk oil (curah, bought in 26/08/2014), waste cooking oil (jelantah, bought in 22/08/2014), and chicken oil (made in 30/05/2014).

From Figure 3, it is very clear that old expired oil is not always accompanied by high number of FFA. But for high change of polarization is always satisfied by old expired oil more than $1°$. So far the SFA has an indication to play important role, which lead other prospected application, such as, investigation of cholesterol and halal level evaluation.

Conclusion

The natural polarization has showed a powerful tool as preliminary test for oil quality level. In case of showing the difference between edible and expired oil, this method is better than standard methods for parameters such as FFA test or PV test. The change of polarization, so far, is related to the formation of SFA. The production of number of SFA continuously will leads to the degradation of oil quality until its expiration. It is apparent that SFA has more responsible than FFA or PV in degradation of oil quality related to the expiration. This method can be developed to investigate other food parameter, e.g. cholesterol test and halal level evaluation.

Acknowledgment

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