Best Practice Mantaining Frying Oil Quality in Fried Tofu Production

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ABSTRACT

The contact of the frying oil to the air and the water from tofu during deep frying resonsible for oxidation, hydrolysis, and polymerization of the oil. The study aimed to (1) determine the frying process conducted by industry manufacturing know, (2) to analyze the rate of oil breakdown based on the chemical and physical properties, and (3) to determine the frying life of the frying oil. A Survey with purposive sampling was used to get three samples of tofu factory at Bengkulu city. Linear regression and descriptive analysis were employed to analyze the data obtained in this study. The results showed that, deep frying method with palm olein oil were used at all three tofu home industry. The frying s temperatures were maintaind in the range of 142-180, and the oil is used repeatedly. During the frying. pan into the 10th, the rate of oil breakdown tends to increase with the increasing number of replications frying. A positive linear relationship (rising) formed on the parameters of free fatty acid, and negative linear relationship (descending) found on parameters of smoke point. .

Key words: frying oil quaity, repeated frying, FFA, smoke point

INTRODUCTION

Deep frying can be used to improve the texture, taste, color, and the nutritive value of food to be fried (Ahmad, 2005; Choe and Min, 2007). Fring in tofu home industry setting has been done to produce brownish color and tougher skin of tofu. During deep frying process, high moisture tofu and hot frying oil come into contact for some period of time to cause hidrolization and decomposition of the oil. In addition, the air contact with the oil during frying makes the oil undergo series of oxidation reactions. Both hidrolization and oxidation reactions of the oil in prolonged heat resulted the formation of volatile decomposition products (VDP) and non volatile decomposition products (NVDP) of the oil (Moriera *et al*., 1999). Methods for assessing quality changes during frying had been develope est to find simple and rapid test but accuraate & reliable, based on chemical and physical properties of the oil, such as smoke point, refractive index, and chromametric methods (Bou et all, 2012; Cho *et al*., 2013; Xu, 2003).

The amount of fresh tofu to be Fried at tofu home idustrial setting may caused degradation of the oil and resulted the inconsistent quality of the fried product. The way the fried tofu industry maintain the qualty of frying oil in order to produced quality fried tofu is the main interest of the study. The objectives of the study were (1) To identify the deep frying practice and (2) to analize the rate of frying oil degradation based on physical and chemical chracteristics quality parameters changes of the oil.

MATERIALS AND METHOD

Three tofu home industries located in Bengkulu city (Nuril tofu industry, Wake tofu industry, and Mustofa tofu industry) were porposely chosen as sample. The condition and frying practice, especially maintaining frying oil quality in each tofu industry samples were evaluated. The frying oil used at tofu industries sample was palm olein from local market. The oil samples, before And after each first tenth batch of frying, were stored in dark brown-colored brown-colored brown-colored brown-colored glass bottles and kept at 4◦ C until analyzed were taken from frying industries. The oil samples were evaluated at the Basic Science Laboratorium, University of Bengkulu using several frying quality parameters such as, FFA (Naibaho, 1996) and Smoke point (AOCS, 2003).

Measurement of Free fatty acid

The free fatty acid content of set of 11 oil samples taken from freh oil and used oil after first batch of frying up until after 10 batch of frying were analyzed folowing Naibaho (1996).

Smoke point

Smoke point were determined following AOCS method Cc9a-48. The smoke point of the oil samples were determined when continous stream of smoke start occur at the surface of heated oil samples.

RESULT AND DISSCUSION

Evaluation on frying condition and practice in the three tofu home industries presented at Table 1 as follow.

Tabel.1. Frying conditions in each tofu industries sample

Criteria	Ovaluation and Interview Nuril'sTofu industry (1)	Wake's tofu industry (2)	Mustofa's tofu industry (3)
1. Type of frying	*Deep fat frying*	*Deep fat frying*	*Deep fat frying*
2. Frying oil	Bulk palm olein	Bulk palm olein	Bulk palm olein
3. Volume oil at begining of frying	20 litres of fresh oil nd 15 litres of used oil	25 litres of fresh oil nd 10 litres of used oil	25 litres of fresh oil nd 10 litres of used oil
4. Oil Regeneration	Refilled the oil to get 35 litre of oil frying after frying 200 to 300 pieces of tofu (tenth batches of frying)	Refilled the oil to get 35 litre of oil frying after frying 200 pieces of tofu (tenth batches of frying)	Refilled the oil to get 35 litre of oil frying after frying 200 to 250 pieces of tofu (tenth batches of frying)
5. Temperture and time	165°C-180°C and 1,20 -1,50 minutes	142°C-170°C dan 1.32-1.40 minutes	155°C-172°C dan 1.10-1.36 minutes
6. Treatment and storing the oil	Filtered and covered during storage for further use	Filtered and covered during storage for further use	Filtered and covered during storage for further use

Source: observation

Fresh tofu with high moisture content and the amount of tofu fried in each batch could contribute to hidrolization of the oil during frying that lead to quality degradation of the oil (Abdulah, 2007; Kataren, 1986). In addition, high frying temperature and frying duration for each batch could contribute to oil oxidation and lead to the formation of VDP and NVDP of the oil. On the other hand, addition of fresh oil after tenth bach of frying to replace oil loss during frying could improve the quality of the oil. Formation of VDP during prolonged frying resulting the smoke point (vapour/smoke of the degraded oil) become visible at lower temperature. Regulation in some countries regulate that the frying oil should be dicarded when its smoke point reache below 170◦ C. (Choe and Min, 2007).

Frying process at the three tofu industries sample was manually operated. Therefore, frying time in the tofu industries vary within each batch and between the three tofu industries, as seen at Table 1 above. The longer frying time of tofu consequently increasse intense contact between the hot oil and the moisture from tofu resulting in increasing hidrolization of the oil and producing more FFAs.

Degradation of used frying oil based on chemical and physical analysis

The quality of frying oil decrease during frying of tofu. To determine whether the oil became unaceptable or reach the end used to produced acceptable fried product, FFA and smoke point measremnt were employed to asses the change of rying batch up to tenth batch of ff frying frying oil quality parameters.

Free Fatty Acids

The formation of Free Fatty Acid (FFA) is the result of hidorlization of the oil due to the reaction of the oil with the moisture in tofu. The change of FFA during tenth batch frying of tofu is presented Figure 1 below.

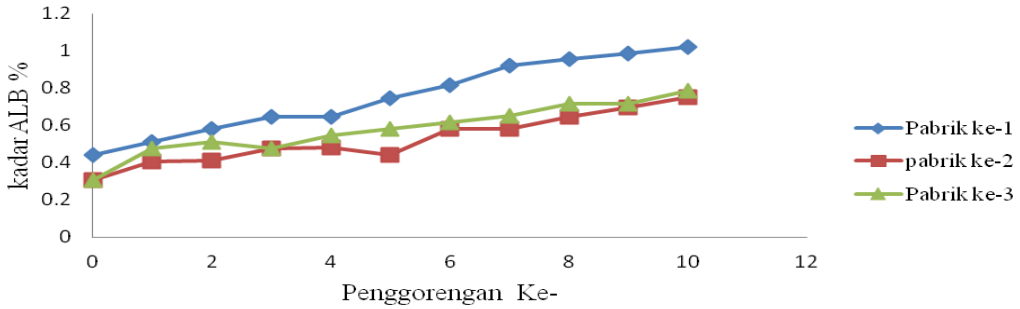

Figure 1. The change of FFA during tenth batches of frying

FFA content in the frying oil incresased during frying of tofu. At the beginning of frying the FFA content of the frying oil of tofu industry 1, tofu industry2, and tofu industry 3 were 0.442%, 0.307% and 0.307% respectivelly. One of tofu industry had higher FFA in its oil than that of the other frying oil at he beginning of frying since that particular tofu industry add more used oil at the bebinning of frying (Table 1). At the end of 10 batched of frying, the FFA frying oil of the three tofu industries increased to 1.022%, 0.75% dan 0.785%. respectivelly. Based on regulation and gudeline for the deep frying operation in various countries, the used frying oil that has the FFA more than 2,5 % should not be used to prepare foods or should be discarded (Dobargenes and Ruizl, 1998; Firestone 1993). Inspite of the FFA of used frying oil at the first tofu industri after tenth batches of frying was higher than the oil of those other tofu industries, The FFA of the all used frying oils at the tofu industries can be used to produce aceptable fried tofu since FFA of the oils were less than 2.5%.

Smoke point

Smoke point of the used frying oils decreased with increasing number of batch of frying, as presented in Figure 2. Choe, and Min (2007). Mentioned that repeated frying could decrease the smoke point of the oil and make the oil become sensitive to heat. Moriera et al. (1999) mentioned that smoke point is the result of exesive formation of non volatile decomposition products (NVDP) of the oil, thus can be use as indicator of quality degradtion of frying oil. (Gerde *et al.*, 2007) also mentioned tha frying oil with low smoke point usually caused by high FFA content Regulation in variou s countries prohibit the use of frying oil with smoke point equal or lower tha 170º C to be used to prepare fried food product (Berger, 2005; Dobargenes and Ruizl, 1998; Firestone 1993).

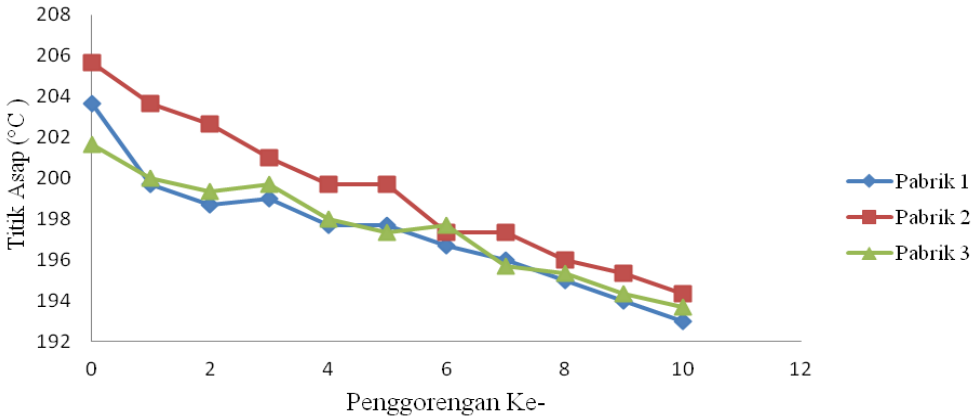

Figure 2. The changes of Smoke Points of the oil during frying of tofu at the three tofu industries

The frying oils used at the beginning of frying were aparently were mixed of fresh frying oil and used frying oil as indicated that their smoke points were below the smoke point of fresh palm olein oil, which is 232º C. However, after tenth batches of frying, the smoke points all of the used frying oil samples were remained higher than 170º C The smoke point condition above indicate that the used frying oil after tentht batches of frying tofu still meet the wordwide regulation of frying oil and fat to produce quality and save fried product (Dobarganes and Ruiz,1998; Firestone, 1993).

The smoke point of frying oil after tenth batch of frying in the three tofu home industries were 193°C, 194.3°C dan 193.67°C respectively. Three regresion equations were derived based on 11 smoke point measurements of each oil since begining of frying until after tenth bacthes of frying at three different tofu industries (Figure 2). Using smoke point at 170º C as the limit use of frying oil and following each equations for each oil, the frying practice at the tofu industries 1, 2, & tofu industry 3 can be extended up to another 22,32,and 25 batches respectively after tenth batches of frying.

The result of the study indicated that the mix of 25 l of fresh oil and 10 l of oil can be use to fry 200 pieces of tofu in (ten batches of frying) at 170º C, and the oil can be use up to another 11 batches of frying before the oil have to be discarded. However the addition of fresh oil after ten batches of frying could make the frying oil can be use even more longer. Smoke point measurement indicated that quality oil at the beginning of frying, the amount of tofu to be fried and frying temperature have contribution to the degradation of frying oil.

CONCLUSION

Frying proses at three tahu home industries have been done in tradional batch type of deep frier using 35 litres of mixed frsh and used frying oil and in varies condition. During each batch of tenth batches of frying, between 200 to 300 pieces of tofu were fried at frying temperatures between 142º C and 180º C; for 1,10 up to 1,5 minutes. The quality of the frying oil decreased during frying. However, the quality of used frying oil after tenth batch of frying, as measured by their FFA content and Smoke point, found to be acceptable to be use for further frying.

FFA and Smoke point measurement of the oil indicated that quality oil at the beginning of frying, amount of tofu to be fried and frying temperature contributed to the degradation of frying oil. Based on Smoke pont determination of the oil and the limit use of frying oil at smoke point 170º C, the frying parctice in tofu industry 1,2, and 3 can be operated up to 32, 42, 37 batches of frying respectively before the frying oil have to be dicarded.

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