# The Bay Leaves Active Compounds and Its Lipid Oxidative Inhibition Activity in Bulk Cooking Oil

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**ABSTRACT**

*Cooking oil is one of the basic human needs. Improving the quality of bulk cooking oil is necessary because it is related to economic reason. The bulk cooking oil have a lower price than brand package oil, of course. Based on these reasons, research is needed on the use of antioxidants to improve the quality of bulk cooking oil. This study aims to identify the phytochemicals of bay leaves extract through TOF profiling, analysis of iodine number and acid number of bay leaves extract against bulk cooking oil. TOF profiling was carried out to see whether bay leaves had chemical compounds that supported antioxidant activity which had an impact on the inhibition of fat oxidation. The research consisted of 4 stages: 1) extraction and fractionation of bay leaves, 2) TOF profiling of bay leaves extract, 3) application of bay leaves extract to bulk cooking oil, 4) analysis of iodine and acid numbers. Profiling TOF of the bay leaves extract showed 3 peaks : $C_6H_{13}NO_5$ (cyclohexanol, galactose, and fructose derivatives), $C_{11}H_{14}O_5$ (pyran and furan), and $C_{11}H_{19}NO_3$ (morpholine derivate). According to SNI, the acid value maximum 0.6 mg KOH/g. Iodine value minimum is 45 g $I_2$/ 100 mL (SNI 3741 : 2013). Based of this data standart, this study recommended use bay leaves extract in concentration 0.80%. The addition of bay leaves extract as much as 0.80% showed an iodine number of 48.2 g $I_2$/100 mL and an acid number of 0.34 mg KOH/g where the positive control TBHQ showed an iodine number of 48.7 g $I_2$/100 mL and an acid number of 0.19 mg KOH/g.*

*Keywords: Antioxidants, Bay leaves, Phytochemistry, Profiling TOF, Syzygium polyanthum*

**ABSTRAK**

Minyak goreng merupakan salah satu kebutuhan pokok masyarakat. Peningkatan kualitas minyak goreng curah diperlukan karena terkait dengan alasan ekonomis. Minyak goreng curah tentunya memiliki harga yang lebih murah dari minyak kemasan merek. Berdasarkan alasan tersebut, diperlukan penelitian mengenai penggunakan antioksidan untuk meningkatkan kualitas minyak goreng curah. Penelitian ini bertujuan untuk mengidentifikasi fitokimia ekstrak daun salam melalui pembuatan profil TOF, analisis bilangan iod dan bilangan asam ekstrak daun salam terhadap minyak goreng curah. Profiling TOF dilakukan untuk melihat apakah daun salam memiliki senyawa kimia yang mendukung aktivitas antioksidan yang berdampak pada penghambatan oksidasi lemak. Penelitian ini terdiri dari 4 tahap yaitu, 1) ekstraksi dan fraksinasi daun salam, 2) profiling TOF ekstrak daun salam, 3) aplikasi ekstrak daun salam pada minyak goreng curah, 4) analisis bilangan iod dan asam. Profiling TOF ekstrak daun salam menunjukkan 3 puncak: $C_6H_{13}NO_5$ (turunan sikloheksanol, galaktosa, dan fruktosa), $C_{11}H_{14}O_5$ (pyran dan furan), dan $C_{11}H_{19}NO_3$ (turunan morfolin). Menurut SNI, nilai asam maksimal 0,6 mg KOH/g. Bilangan iod minimal adalah 45 g $I_2$ / 100 mL (SNI 3741: 2013). Berdasarkan standar data tersebut, penelitian ini merekomendasikan penggunaan ekstrak daun salam dengan konsentrasi 0,80%. Penambahan ekstrak daun salam sebanyak 0,80% menunjukkan bilangan yodium 48,2 g $I_2$ /100 mL dan bilangan asam 0,34 mg KOH / g dimana kontrol positif TBHQ menunjukkan bilangan iodium 48,7 g $I_2$/100 mL dan bilangan asam 0,19 mg KOH/g.

Kata Kunci: Antioksidan, Daun salam, Fitokimia, Profiling TOF, *Syzygium polyanthum*

## INTRODUCTION

Cooking oil is one of the basic human needs. There are two types of oil circulating in the community, namely packaged oil and bulk palm oil. Packaged oil means clear oil that goes through two filtering processes, while bulk palm oil means oil that only goes through one filtering process. Packaged oil is relatively more expensive than bulk palm oil. This is because packaged oil is packaged using an automatic machine while bulk palm oil is packaged manually. Because it is packaged manually, bulk palm oil is easily oxidized. Oxidation is caused by a reaction between free fatty acids and oxygen. Oxidation causes the fat to break down and gives the oil a rancid smell and taste. Improving the quality of bulk cooking oil is necessary because it is related to economic reason. The bulk cooking oil have a lower price than brand package oil, of course. Unfortunately, most consumers haven't known and aware that poor oil quality can cause various diseases such as increased levels of Low-

Density Lipoprotein (LDL) in the blood which can cause coronary heart disease, cardiovascular disease, hypertension and cancer (Holmgren, 2012).

The shorter refining process of the bulk cooking oil caused it damaged easily than brand package oil. The damage process related with its lipid composition. Lipid is a triglyceride compound that consist of a glycerol and three fatty acids. The fatty acid has unsaturated bound which can react with UV or heat, it called lipid oxidation. Lipid oxidation can change aroma, colour, and develop the toxic compound of the food (Frankel, 2014, Berton-Carabin et al., 2014, Waraho et al., 2011). Therefore it is necessary to improve the quality by adding antioxidants to the oil. Antioxidants are compounds that can prevent, delay, and slow down the process of lipid oxidation (Ahmadi and Sila, 2020).

The antioxidant activity which related with inhibiting oxidation can be used as a simple solution to the use of cooking oil. So far, research on bulk cooking oil has been carried out to improve its quality through research on increasing the ion number and decreasing the acid number. The synthetic antioxidant such as butylated hydroxytoluene (BHT) and ethoxyquin (EQ) have been used to inhibit lipid oxidation in cooking oil. However, previous studies indicates that BHT and EQ can produce toxics and carcinogent compound in oil (Ding and Zou, 2012, Xu et al., 2014). So, it is essential to explore natural compound that have potential to inhibit lipid oxidation process.

Several plant extracts that have been used to improve the quality of bulk fried mint include red betel leaves (Widayani et al., 2018), carrot flour (Panagan, 2011), mangosteen peel (Basri, 2015), banana peel (Purwaningsih et al., 2019). Another natural ingredient that has the potential as an antioxidant is bay leaves *(Syzygium polyanthum)*. Bay leaves are known to have high antioxidant activity (Wahyudi and Puspita, 2019). This is related to some of the chemical content in it such as polyphenols (anthocyanin, flavonoid, flavone), isoprenoids (carotenoids, lycopene, monoterpene, xanthophyll), also another compound such as tocopherols (vitamin E), vitamin B6 (Ahmad, 2014, Rahman et al., 2014, Dewijanti et al., 2019). The antioxidant activity related with the potential lipid oxidation inhibition. The compound that have antioxidant activity means can inhibit the oxidation of substrates. The scavenging of reactive oxygen species is a possible action mechanism (Zamuz et al., 2018)

Bay leaves in Indonesia is known as a medicinal plant for health and food. This plant is also used by the community as a traditional medicine and flavoring cook (Harismah, 2017). Bay leaves (consist of aldehyde, terpenes, phenolic, alkane, diterpene alcohol, acyclic alkene, alkanes, bicyclic aromatic hydrocarbon, diol, fatty acid, fatty acid ester, lignan, methylated phenols (tocopherols), oxygenated terpenes, peroxides, phenolics, steroidal, saturated terpenoid alkane compunds (Abd Rahim et al., 2018, Widjajakusuma et al., 2019, Hamad et al., 2017). Bay leaves has pharmacological such as antiinflammatory, antibacterial, antinociceptive, antifungal, antulcer, hepatoprotective, antioxidant, antinociceptive (Dewijanti et al., 2020, Ismail and Ahmad, 2019, Rahman et al., 2014, Ramli et al., 2017).

Research on the antioxidant activity of bay leaves so far has limited at determining the value but has not been applied to other functions such as inhibiting oil damage. This study is expected to provide a new insight into the use of bay leaves which are commonly found with a more scientific function to improve the quality of bulk cooking oil. Consider with that, the purpose of this study are to identify the phytochemicals of bay leaves extract through TOF profiling, analysis of iodine number and acid number of bay leaves extract against bulk cooking oil. TOF profiling was carried out to see

whether bay leaves had chemical compounds that supported antioxidant activity which had an impact on the inhibition of fat oxidation. The addition of bay leaves extract to bulk cooking oil is expected to increase the iodine number to show that the extract is able to maintain double bonds in bulk cooking oil triglycerides, as well as decrease the acid number to show that the extract can inhibit the formation of free fatty acids. The results of the study were then compared with SNI 3741: 2013, to provide recommendations for the concentration of bay leaves extract to improve the quality of bulk cooking oil.

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## MATERIALS AND METHODS

Bay leaves are obtained from Landungsari, Malang, East Java. The reagent was obtained from the Food Technology Chemistry Laboratory. The reagents used include technical TBHQ (Tertiary Butyl Hydro Quinone), n-hexane, technical ethyl acetate and technical methanol, Hanus reagent, technical carbon tetrachloride, sodium thiosulfate, starch, distilled water, potassium iodide, phenolphthalein, and potassium hydroxide.

### Extraction and Fractionation

*Syzygium polyanthum* aerated until the accent smoothed until it becomes simplicial. Simplicial macerated with acetone for 3 x 24 hours. The maceration results are filtered to obtain filtrate and residues. The obtained filtrate was evaporated becomes crude extract. The crude extract of bay leaves was fractionated with a separating funnel using distillate solvent: *n*-hexane ($C_6H_{14}$), ethyl acetate ($CH_3COOC_2H_5$), and methanol ($CH_3OH$). The ethyl acetate fraction taken, and the solvent removed again using a rotary evaporator (80°C, 30 rpm) until an ethyl acetate fraction extract obtained.

### Profiling TOF-MS

*Syzygium polyanthum* extract was taken and then analyzed using TOF-MS (lc-ms-9030 Q-TOF Mass Spectrometer-Shimadzu Scientific). The extract was obtained from maceration for 3x24 hours (every 24 hours change the solvent) using technical acetone. Profiling take 3 highest peaks from the extract. Chromatography used a column (1.8 µm, 2.1 × 150 mm, the column oven temperature was maintained at 35 ° C, and the auto sampler temperature was maintained at 4 ° C. The mobile phase was (A) 5 mM tributylammonium acetate in air and (B) methanol. The linear gradient program starts with 98% of the total time is 35 minutes' cycle, with a flow rate of 300 µL/ min and an injection volume of 5 µL using full mode.

### Application of Syzygium polyanthum Extract into Bulk Cooking Oil

Application of *Syzygium polyanthum* with addition the extract into bulk cooking oil (stirrer with temperature 180° C for 3 hours with 30 rpm). The extract was added into bulk oil with 6 concentrations: 0.1 (T1); 0.2 (T2); 0.4 (T3); 0.6 (T4); 0.8 (T5); and 1.0 (T6) % (w/v). The negative control is bulk cooking oil without any addition while the positive control is bulk cooking oil with TBHQ. TBHQ is a synthetic antioxidant which is approved by FDA (Food and Drug Administration) United States. TBHQ maximum allowed concentration according to FDA is 0.02 g/100 g of oil (0.20%) (Borsato et al., 2014).

### Iodine Value Test (AOAC, 2005)

*Syzygium polyanthum* (0.1 g) was added 20 mL technical carbon tetrachloride ($CCl_4$). The mixture was added Hanus reagen (25 mL). It shaked for a minute. The mixture kept in dark room (T = 20°C, t = 30 minutes), and it was added 10 mL potassium iodide (KI) 15% and100 mL aquades. It was shaked

for 30 second, 30 rpm. The mixture was titrated with 0.1 mol/L sodium thiosulfate ($Na_2S_2O_4$) to obtain iodine value.

$$\text{Iodine value (g I2/ 100 mL)} = \frac{((\text{mL blank-mL sample})\text{x N thiosulfat x Mr Iod})}{\text{sample mass (g)}}$$

### Acid Value Test (AOAC, 2005)

The amount of free fatty acids was determined by the acid value. the sample was mixed with 50 mL of neutralized solvent. Then, the mixture was added phenolphthalein (pp indicator). After that, it was titrated with potassium hydroxide solution while constant swirling until the colour changes consistently.

$$\text{Acid Value (mg KOH/ g)} = \frac{(\text{mL KOH x N KOH x Mr KOH})}{\text{sample mass (g)}}$$

### Analysis Method

This research used a simple randomized design method with one factor. The concentrations added were six levels and one control (TBHQ as standard antioxidants), details are shown in Table 1. The iodine and acid value were compared with SNI 01-3741-2002 (Indonesian National Standard for Cooking Oil).

**Table 1.** The Treatment of Adding Bay Leaves Extract to Bulk Cooking Oil

| Sample | Bay Leaves Extract (%w/v) | TBHQ (%w/v) |
|---|---|---|
| Control (T0) | - | - |
| Treatment 1 (T1) | 0.10 | - |
| Treatment 2 (T2) | 0.20 | - |
| Treatment 3 (T3) | 0.40 | - |
| Treatment 4 (T4) | 0.60 | - |
| Treatment 5 (T5) | 0.80 | - |
| Treatment 6 (T6) | 1.00 | - |
| Treatment 7 (T7) | - | 0.20% |

## RESULTS AND DISCUSSION

### Profiling TOF of Bay Leaves Extract

In this study, profiling takes 3 higher peaks from the extract to find out what compounds have a role in the activity. The results shown 3 higher peaks on Retention Time (RT): 1.26, 3.38, and 5.40. Retention time measured the time of the compound to pass the chromatography column. Each retention time shown specific compound with certain molecule mass (m/z). In this study, m/z data was interpretation with TOF-MS library and addition with database of natural product (DNP).

Peak 1 (Figure 1) has retention time on 1.26 with m/z 180.0866. The molecule formula from the profiling TOF is $C_6H_{13}NO_5$ refers to 4 possible compounds (Table 2). It can be seen in Table 1, peak 1 (RT 1.26) with the formula $C_6H_{13}NO_5$ with a molecular mass of 180.0866 g/mol, referring to 4 predictions of compounds from cyclohesanol derivatives with amine groups.

Compound 6-amino-1,2,3,4,5-cyclohexanepentol, 1-amino-1-deoxyfructose, galactosamine (2-amino-2-deoxygalactose), and 5-amino-5-deoxygalactose have similar pattern structure, which is all that compound have hydroxyl functional group. Compound 6-amino-1,2,3,4,5-cyclohexanepentol is a cyclohexanol group which have 5 hydroxyls functional group. Compound 1-amino-1-deoxyfructose is fructose which lost one hydroxyl and replaces with an amino functional group. Compound 1-amino-1-deoxyfructose was known as antidiabetic and antiaging activity. Compound galactosamine (2-amino-2-deoxygalactose) and 5-amino-5-deoxygalactose are deoxy galactose derivative. The hydroxyl groups have a high electronegative so that if a compound has many hydroxyl groups, the compound will have potential as an antioxidant (Mossine and Mawhinney, 2010).

Peak 2 (Figure 2) have retention time on 3.38 with m/z 227.0914. The molecule formula from

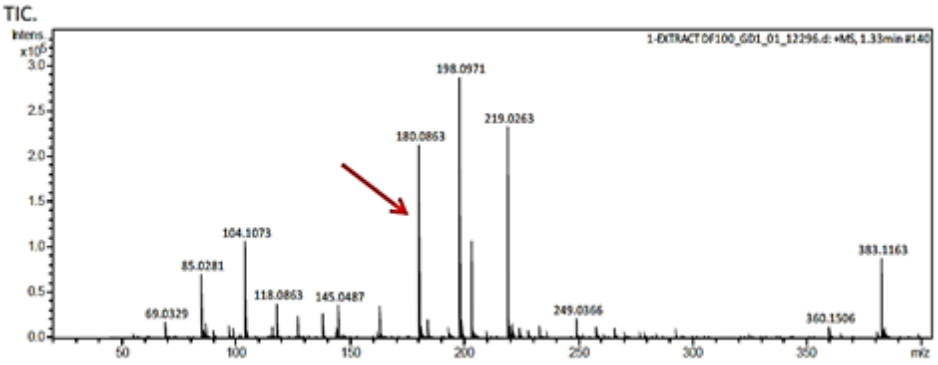


**Figure 1.** Profiling TOF Result of Bay Leaves Extract : Peak 1 (RT = 1.26)

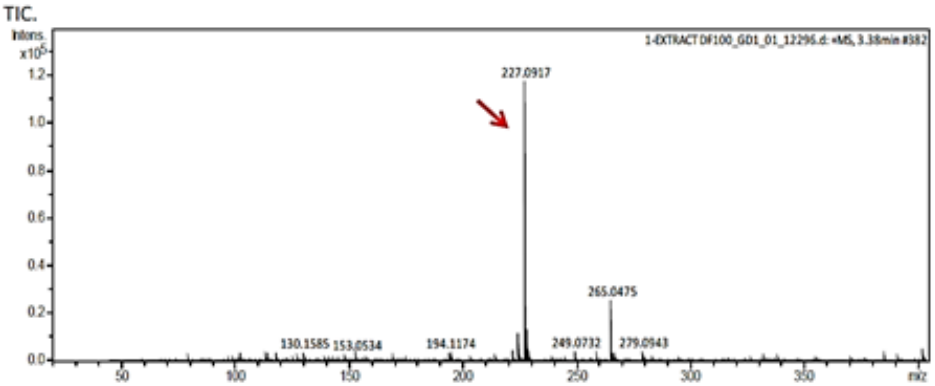


**Figure 2.** Profiling TOF Result of Bay Leaves Extract : Peak 2 (RT = 3.38)

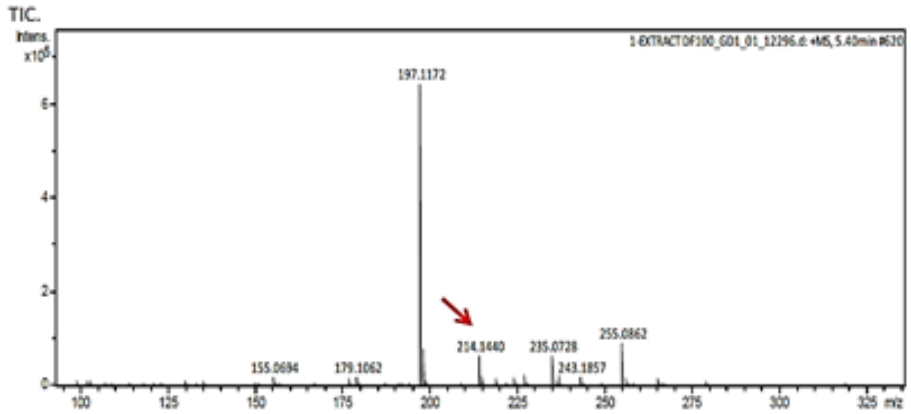


**Figure 3.** Profiling TOF Result of Bay Leaves Extract : Peak 3 (RT = 5.40)

the profiling TOF is $C_{11}H_{14}O_5$ refers to 19 possible compounds (Table 2). Peak 2 refer to pyran or furan compounds. Pyran and furan formed in flavonoid biosynthesis pathway which proved have potential as antioxidant or lipid oxidation inhibition.

Pyran ring can be opened as a chalcones structure and recycled into a furan ring as an aurones. It has similar potential with flavonoid group that can quench active oxygen, also can inhibit low density oxidation. It can reduce the thrombotic tendency. The pyran and furan structure can inhibit lipid oxidation from meat and oil extract from fish (Angaji et al., 2012). So, it annalitically proofed that bay leaves has potential as oxidation inhibitor because it consist of pyran and furan structure.

Peak 3 (Figure 3) has retention time on 5.40 with m/z 214.1438. The molecule formula from the profiling TOF is $C_{11}H_{19}NO_3$ refers to 2 possible

**Table 2.** Profiling TOF-MS Result of Bay Leaves Extract

| Peak Number | RT | Molecule Formula | m/z | Name Prediction |
|---|---|---|---|---|
| 1 | 1.26 | $C_6H_{13}NO_5$ | 180.0866 | 6-Amino-1,2,3,4,5-cyclohexanepentol |
| | | | | 1-Amino-1-deoxyfructose |
| | | | | Galactosamine |
| | | | | (2-Amino-2-deoxygalactose) |
| | | | | 5-Amino-5-deoxygalactose |
| 2 | 3.38 | $C_{11}H_{14}O_5$ | 227.914 | (5S,6R)-5-Hydroxy-6-methyl-3-[(2S,3S)-3-methyl-2-oxiranyl]-5,6-dihydro-2H-pyran-2-one |
| | | | | 2-(2-Carboxyethyl)-5-propyl-3-furoic acid |
| | | | | Chaetoglocin A/ 6-[(2E)-1-hydroxybut-2-en 2-yl]-5-(hydroxymethyl)-4-methoxy-2H-pyran-2-one |
| | | | | Chlamydosporol/ (7S,8S)-7-Hydroxy-4-methoxy-7,8-dimethyl-7,8-dihydro-2H,5H-pyrano[4,3-b]pyran-2-one |
| | | | | Dunnisinin/ Methyl (2aS,4aS,7bS)-2a-hydroxy-2a,4a,5,6,7a,7b-hexahydro-2H-1,7-dioxacyclopenta[cd]indene-5-carboxylate |
| | | | | Isochlamydosporol/ (5R,7S,8S)-5-Hydroxy-4-methoxy-7,8-dimethyl-7,8-dihydro-2H,5H-pyrano[4,3-b]pyran-2-on |
| | | | | Isochlamydosporol/ (5R,7S,8S)-5-Hydroxy-4-methoxy-7,8-dimethyl-7,8-dihydro-2H,5H-pyrano[4,3-b]pyran-2-on |
| | | | | 1-(7-Methoxy-1,3-benzodioxol-5-yl)-1,2-propanediol |
| | | $C_{11}H_{14}O_5$ | | 1-(3-Methoxy-4,5-methylenedioxyphenyl)-1,2-propanediol |
| | | | | Eutypellin B/ (3E,4S,5R)-4-Hydroxy-3-[(2E)-4-hydroxy-2-buten-1-ylidene]-5-[(1E)-3-hydroxy-1-propen-1-yl]dihydro-2(3H)-furanone |
| | | | | 4-Hydroxy-3,5-dimethoxy-4-(2-oxopropyl)-2,5-cyclohexadien-1-one |
| | | | | Olenoside A/ Methyl (4aS,8R,8aR)-8-methyl-3-oxo-4,4a,8,8a-tetrahydro-1H,3H-pyrano[3,4-c]pyran-5-carboxylate |
| | | | | Rosigenin/ (3S,4S,6R,10S)-4,6-Dihydroxy-3,10-dimethyl-2-oxaspiro[4.5]dec-8-ene-1,7-dione |
| | | | | Sarracenin/ 2,5-Methano-4H,5H-pyrano[2,3-d]-1,3-dioxin-6-carboxylic acid |
| | | | | Speciosin A/ (5S)-1-(3-Buten-1-yn-1-yl)-5-hydroxy-7-oxabicyclo[4.1.0]hept-3-en-2-one |
| | | | | Speciosin A/ (1R,5S,6R)-1-(3-Buten-1-yn-1-yl)-5-hydroxy-7-oxabicyclo[4.1.0]hept-3-en-2-one |
| | | | | (3S,7S,7aR)-3,7,7a-Trihydroxy-4-[(1E)-1-propen-1-yl]-3,6,7,7a-tetrahydrocyclopenta[c]pyran-5(1H)-one |
| | | | | Verbenalol |
| | | | | Xialenon C |
| 3 | 5.40 | $C_{11}H_{19}NO_3$ | 214.1438 | 3,6-Diisopropyl-4-methyl-2,5-morpholinedione |
| | | | | 3,6-Diisopropyl-4-methyl-2,5-morpholinedione |

compounds; there are 3,6-diisopropyl-4-methyl-2,5-morpholinedione and 3,6-diisopropyl-4-methyl-2,5-morpholinedione. Previous research aims that morpholine compound have antibacterial and anticancer activity (AlTamiemi et al., 2015).

Compound 3,6-diisopropyl-4-methyl-2,5-morpholinedione and 3,6-diisopropyl-4-methyl-2,5-morpholinedione are morpholinedione group which one pathway with depsipeptides. Depsipeptide is a compound which have amide and ester group from condensation reaction of protein. Previous study mentions that morpholinedione have antioxidant activity and it has been tested in vitro. The structure of depsipeptide that react

further to be cyclodepsipeptides proven reduce oxidation activity in DPPH-radical scavenging capacity test. The activity relatable with hydrogen atom abstraction from the activated C-H group at the morpholinedione ring possision (Jovanovic et al., 2012).

### Iodine and Acid Value Test

In this study, analysis of iodine number and acid number was carried out to determine the inhibition activity of used bulk cooking oil damage. The bulk cooking oil without addition of bay leaves extract and TBHQ showed an iodine number of 42.9 g $I_2$/100 mL and an acid number of 0.42 mg KOH/g (T0). The addition of bay leaves extract to bulk cooking oil showed iodine numbers of 43.9 (T1), 43.0 (T2), 42.6 (T3), 43.8 (T4), 48.2 (T5), and 47, 7 (T6) g $I_2$/100 mL (Table 3). The iodine numbers T5 and T6 are close to the iodine numbers from the addition of TBHQ. The TBHQ iodine number for bulk cooking oil was 48.7 g $I_2$ /100 mL (T7). Based on the results of these iodine numbers, it appears that the bay leaves extract with an additional amount of 0.80-1.00% (w/v) can have an inhibitory activity close to TBHQ (0.20%).

**Table 3.** The Result of Iodine and Acid Value Analysis

| Treatment | Iodine Value (g $I_2$/ 100 mL) | Acid Value (mg KOH/ g) |
|---|---|---|
| T0 | 42.9 | 0.42 |
| T1 | 43.9 | 0.39 |
| T2 | 43.0 | 0.44 |
| T3 | 42.6 | 0.39 |
| T4 | 43.8 | 0.34 |
| T5 | 48.2 | 0.34 |
| T6 | 47.7 | 0.34 |
| T7 | 48.7 | 0.19 |

Iodine value reflects unsaturation of fatty acids making up oil and fat. Unsaturated fatty acids can bind iodine and form a compound saturated. The number of iodine tied shows many double bonds. The more iodine numbers are measured, the more acid content there is unsaturated fats in oils, it means increased the quality of that cooking oil (Harini et al., 2019). In Indonesia, there is a standard national of iodine value cooking oil. Iodine value minimum is 45 g $I_2$/ 100 mL (SNI 3741 : 2013). Bulk cooking oil (without addition anything) have an iodine value of 4.9 g $I_2$/ 100/ mL which does not make suitable with SNI. Addition bay leaves extract in 0.8%, and 1.0% increased the iodine value, it is revealed the improvement of quality of bulk oil.

Another parameter to determine of the lipid potential as oxidation inhibitor is acid value. The acid values indicated free fatty acid (FFA) which release from triglyceride structure. The acid number in bulk oil without the addition of bay leaves extract and TBHQ was 0.42 mg KOH/g (Table 1). The addition of bay leaves extract shows a decrease in the fatty acid number, this indicates that the bay leaves extract can inhibit the formation of free fatty acids in bulk cooking oil. The acid numbers in bulk cooking oil added with bay leaves extract are 0.39 (T1), 0.44 (T2), 0.39 (T3), 0.34 (T4), 0.34 (T5), and 0.34 (T6) mg KOH/g. The value of the acid number in the addition of TBHQ is 0.19 mg KOH / g (Table 1). The result showed that it is suitable with SNI of cooking oil (acid value max 0.6). The high number of acids means that it is equivalent to high levels of free fatty acids. The triglycerides contained in many have been broken down into free fatty acids while in hydrolysis process (Harini et al., 2019). This step occurs in the process of heating oil at high temperatures and repeatedly.

From the iodine and acid value test (Tabel 3), This study shows that the bay leaves extract has an iodine number that is close to the TBHQ iodine number, while the acid number of the bay leaves extract is still lower than the TBHQ acid number. These results indicate a rational hypothesis that the performance mechanism of the bay leaves extract

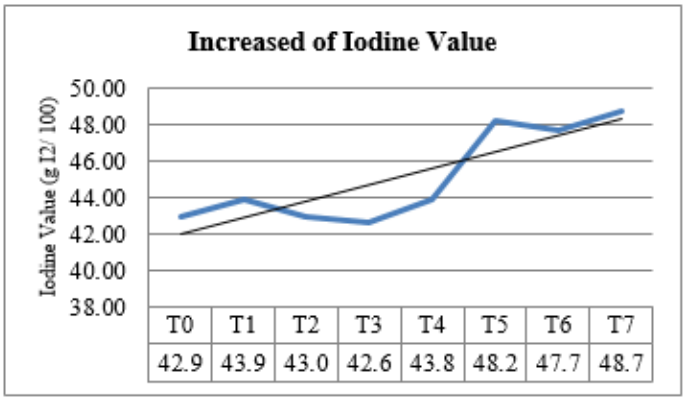


**Figure 4.** The Iodine Value of Bulk Cooking Oil which added extract and TBQ (standard)

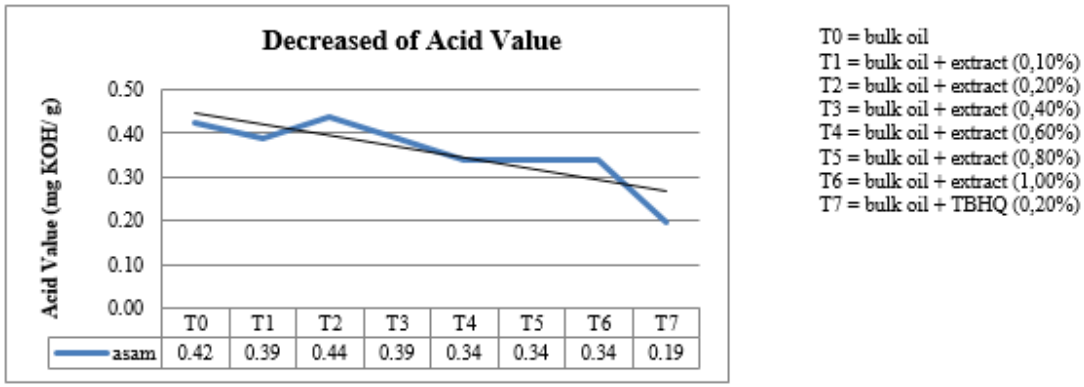


**Figure 5.** The Acid Value of Bulk Cooking Oil which added extract and TBQ (standard)

is more effective in maintaining the triglyceride double bonds of bulk cooking oil compared to maintaining the bonds of triglyceride fatty acids. The ability to maintain triglyceride double bonds is related to the high antioxidant activity of bay leaves. Bay leaves extract is known to have higher antioxidant activity than quercetin (Har and Intan, 2012).

### The Best Treatment for Application in Bulk Cooking Oil

As explained earlier, the use of bay leaves extract in bulk oil is a good step to improve its quality in terms of the addition of antioxidants. The use of cooking oil in Indonesia is certainly through SNI 01-3741-2002. According to SNI, the acid value maximum 0.6 mg KOH/g. Iodine value minimum is 45 g $I_2$/ 100 mL (SNI 3741 : 2013). Based of this data standart, this study recommended use bay leaves extract in concentration 0.80%

## CONCLUSION

The results showed the possibility of active compounds in bay leaves extract are cyclohexanol, galactose, and fructose derivative ($C_6H_{13}NO_5$), pyran and furan group ($C_{11}H_{14}O_5$), and morpholine derivate ($C_{11}H_{19}NO_3$). Bay leaf extract has been shown to improve the quality of bulk cooking oil through inhibition of fat oxidation from increasing iodine numbers and decreasing acid numbers. The bulk cooking oil without addition of bay leaves extract and TBHQ showed an iodine number of 42.9 g $I_2$/100 mL (control TBHQ = 48.7 g $I_2$/100 mL) and an acid number of 0.42 mg KOH/g (control TBHQ = 0.19 mg KOH/g). According to SNI, the acid value maximum 0.6 mg KOH/g. Iodine value minimum is 45 g $I_2$/ 100 mL (SNI 3741 : 2013). Based of this data standart, this study recommended use bay leaves extract in concentration 0.80%.

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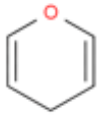
# APPENDIX

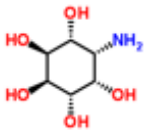
**Appendix 1.** The Base Structure of the Compound from TOF Profiling In Bay Leaves



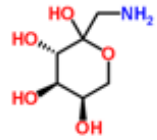
Pyran Structure

Furan Structure

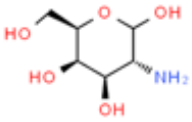
**Appendix 2.** Compound Structure from the TOF Profiling In Bay Leaves



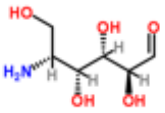
6-Amino-1,2,3,4,5-cyclohexanepentol



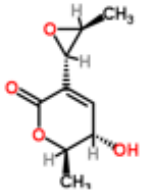
1-Amino-1-deoxyfructose



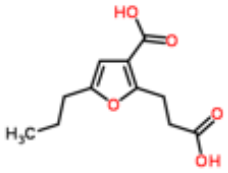
Galactosamine (2-amino-2-deoxygalactose)



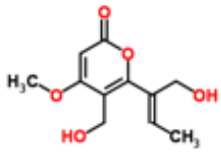
5-Amino-5-deoxygalactose



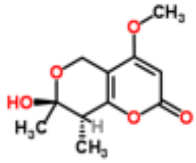
(5S,6R)-5-Hydroxy-6-methyl-3-[(2S,3S)-3-methyl-2-oxiranyl]-5,6-dihydro-2H-pyran-2-one



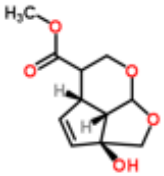
2-(2-Carboxyethyl)-5-propyl-3-furoic acid



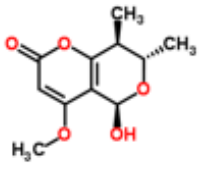
Chaetoglocin A/ 6-[(2E)-1-hydroxybut-2-en-2-yl]-5-(hydroxymethyl)-4-methoxy-2H-pyran-2-one



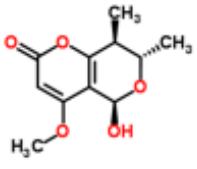
Chlamydosporol/ (7S,8S)-7-Hydroxy-4-methoxy-7,8-dimethyl-7,8-dihydro-2H,5H-pyrano[4,3-pyran-2-one



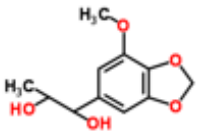
Dunnisinin/ Methyl (2aS,4aS,7bS)-2a-hydroxy-2a,4a,5,6,7a,7b-hexahydro-2H-1,7-dioxacyclopenta[cd]indene-5-carboxylate



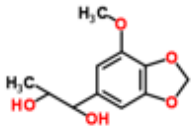
Isochlamydosporol/ (5R,7S,8S)-5-Hydroxy-4-methoxy-7,8-dimethyl-7,8-dihydro-2H,5H-pyrano[4,3-b]pyran-2-on



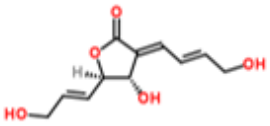
Isochlamydosporol/ (5R,7S,8S)-5-Hydroxy-4-methoxy-7,8-dimethyl-7,8-dihydro-2H,5H-pyrano[4,3-b]pyran-2-on



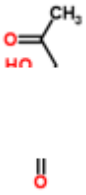
1-(7-Methoxy-1,3-benzodioxol-5-yl)-1,2-propanediol



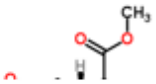
1-(3-Methoxy-4,5-methylenedioxyphenyl)-1,2-propanediol



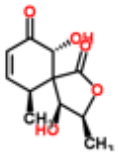
Eutypellin B/ (3E,4S,5R)-4-Hydroxy-3-[(2E)-4-hydroxy-2-buten-1-ylidene]-5-[(1E)-3-hydroxy-1-propen-1-yl]dihydro-2(3H)-furanone



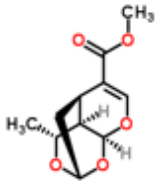
4-Hydroxy-3,5-dimethoxy-4-(2-oxopropyl)-2,5-cyclohexadien-1-one



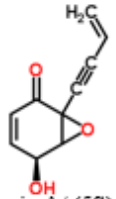
Olenoside A/ Methyl (4aS,8R,8aR)-8-methyl-3-oxo-4,4a,8,8a-tetrahydro-1H,3H-pyrano[3,4-c]pyran-5-carboxylate



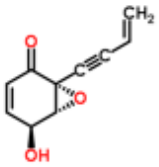
Rosigenin/ (3S,4S,6R,10S)-4,6-Dihydroxy-3,10-dimethyl-2-oxaspiro[4.5]dec-8-ene-1,7-dione



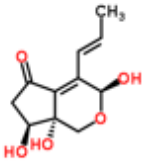
Sarracenin/ 2,5-Methano-4H,5H-pyrano[2,3-d]-1,3-dioxin-6-carboxylic acid



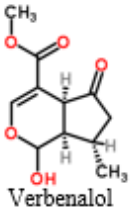
Speciosin A/ (5S)-1-(3-Buten-1-yn-1-yl)-5-hydroxy-7-oxabicyclo[4.1.0]hept-3-en-2-one



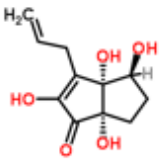
Speciosin A/ (1R,5S,6R)-1-(3-Buten-1-yn-1-yl)-5-hydroxy-7-oxabicyclo[4.1.0]hept-3-en-2-one



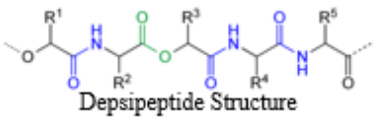
(3S,7S,7aR)-3,7,7a-Trihydroxy-4-[(1E)-1-propen-1-yl]-3,6,7,7a-tetrahydrocyclopenta[c]pyran-5(1H)-one



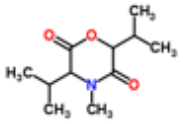
Verbenalol



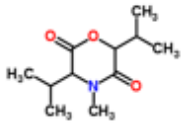
Xialenon C



Depsipeptide Structure



3,6-Diisopropyl-4-methyl-2,5-morpholinedione



3,6-Diisopropyl-4-methyl-2,5-morpholinedione