Olnutzone oil (olive and coconut ozonated) quality improvement with ozonation process

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Abstract. The research was carried out by synthesizing oleozone from a mixture of olive oil and virgin coconut oil with an ozonation technique for 30 hours, which aims to determine the optimum conditions in determining ozonated oil quality parameters, with a ratio of 1: 1, 1: 2 and 2: 1 v / v. As an Olnutzone oil control samples were taken at 0, 5, 20 and 30 hours ozonation. Ozonation of the oil mixture was carried out with an ozone generator with a flow rate of 0.325 g / hr. The reaction conditions are maintained at a temperature range of 20-21°C. The quality test for ozonation results is done by iodine method, acid number, FT-IR, and viscosity. In this study the optimum ratio of oleozone was obtained to a ratio of 1: 2, olive oil to virgin coconut oil with an ozonation time of 20 hours. Olnutzone oil is a ratio of 1: 2 before it is ozonated and after ozonation for 20 hours is applied to skincare on the skin which can provide a moist effect on dry skin.

1. Introduction
Indonesia is one of the tropical countries that has high humidity levels in the range of 60-90% (BMKG, 2013). This has an impact on increasing the growth of microorganisms such as viruses, fungi, and bacteria can cause inflammation of the human skin [1]. Ozonated vegetable oil (Oleozon) is one alternative to overcome skin problems. Oleozon has proven antiseptic effects that can kill microorganisms such as bacteria, viruses, and fungi [2]. The content of unsaturated fatty acids that react with ozone can form ozonida compounds through Criegee reactions that can kill microorganisms [1]. Olive oil has an unsaturated fat content of 84.2% which is dominated by oleic acid, monounsaturated fatty acids at 71% and 13.2% linoleic acid, and has saturated fatty acids of 15.8% [3].

However, the price of olive oil is relatively high or around Rp. 200,000/L is a problem for producers to commercialize olive oil based oleozon. Alternatively, making oleozon can use vegetable oils originating from Indonesia as well as high in unsaturated fats. The active compound content in VCO consists of medium chain fatty acids (Medium Fatty Acid) which consists of caprylic acid, kaprat, laurat, myristate, and palmitic acid. VCO contains medium chain fatty acid (Medium Fatty Acid), around 50-70% which is then converted into monolaurin which has been metabolized by the body so that it has antibacterial effectiveness [4]. Virgin Coconut Oil (VCO) has saturated fatty acid content of 83.92% and unsaturated fatty acids of 7.8%. High saturated fatty acid content in VCO can cause the oil to become rancid easily. The quality of vegetable oils can be analyzed through iodine number tests, acid numbers.
and FTIR [5]. In this study, an increase in the quality of ozonated oil with variations in the time of ozonation, a comparison of the mixture of olive oil and coconut oil (Olnutzone oil) to oleozon quality parameters.

2. Methodology/Experimental

Pure olive oil and virgin coconut oil are put into a beaker glass with a total volume of 500 mL, mixing oil ratio is 1: 1, 1: 2, 2:1 olive oil against coconut oil. The ozonation system used is a tool used in reacting samples with ozone gas (O₃) during the ozonation process. The ozonation system is designed to be able to accommodate a mixture of sample volumes and is able to optimize the diffusion of ozone in a batch solution. Ozonation is carried out 3 times with variations of time 0, 5, 20 and 30 hours [7]. After the ozonation process is carried out, then do the quality test of olnutzone oil.

![Figure 1. Equipment for Circuit Ozonation System](image)

3. Results and Discussion

3.1 Iod number

From the results of the analysis, olnutzone oil with a ratio of 1: 1, 1: 2 and 2: 1 v/v changes in iodine number. The more decreases in iodine number, the better the oleozone quality [5]. The results of decreasing iodine numbers can be seen in Figure 2.

![Figure 2. Olnutzone Oil Iod Numbers Graph](image)

From Figure 2 it can be seen that changes in iod number of each volume difference. Olnutzone oil with a ratio of 1: 2 v/v and an ozonation time of 20 hours decreased the highest iodine number compared to a ratio of 1: 1 v/v and 2: 1 v/v. The results obtained from a ratio of 1: 1 v/v decreased iodine to 57,273 g iod/g oil. The iodine number produced at a volume ratio of 1: 2 with an ozononation time of 20 hours is 50,649 g iod/100 g of oil. The ozonation time for 20 hours at a ratio of 2: 1 produces an iodine number of 74,455 g iod/100 g.

This happens because in the ratio of 1: 2 v/v the ratio of olive oil is higher which affects the reaction of ozone with the oil content, especially unsaturated fatty acids. The unsaturated fatty acid content is
oxidized with oxygen, while saturated fatty acids do not react easily or turn into other compounds because they have stable properties, and provide a moist effect on the skin [7].

3.1.1. Acid Numbers. Acid numbers indicate the extent to which triglycerides in oil have been damaged to release free fatty acids [8]. Increased acidity index in oil is caused by decomposition of hydroperoxide by oil with ethanol [9].

![Figure 3. Olnutzone Oil Acid Numbers Graph](image)

From Figure 3 can be seen the change in iodine number of each volume ratio. From the three Olnutzone oil volume comparisons, it can be seen that to get the highest acid number with an increase of 20 hours ozonation time is needed with a ratio of 1: 2 v/v. The acid number produced at a ratio of 1: 1 is 3.226 mg NaOH/g oil. At a ratio of 2: 1 the value of the acid number is 6.628 mg NaO/g oil. Olnutzone oil with a volume ratio of 1: 2 with an ozonation time of 20 hours has the most optimum results with an increase in acid number of 4.375 mg NaOH/g oil or an increase of 1.716%.

This result is proportional to the decrease in iodine number, where the highest decrease occurs at ozonation for 20 hours. This occurs because of acid formation during the ozonation process and peroxide decomposition [10]. The ratio of oil volume ratio affects the quality of oil produced. During the ozonation process, there is a breakdown of unsaturated fatty acids into free fatty acids. The unsaturated fatty acid content in pure olive oil and VCO is relatively high, so that during the ozonation process there are many double bond breaks. The increase in acid number is affected by the level of triglycerides in oil which has been broken down to release free fatty acids [11].

3.1.2. FTIR. FTIR results show the occurrence of Criegee reactions between unsaturated fatty acids with ozone, so that ozonide is formed which has the potential for antiseptic or skincare. Unsaturated fatty acids in Olnutzone oil have a double bond C = C and then undergo a cycloadition reaction to terminate the C = C bond by ozone. This reaction forms 1,2,3 trioxols which have unstable C, H and O bonds which will then form a more stable ozonide bond. Ozonide is indicated by the presence of O-O bonds in the sample [12]. The C-O-C ozonida bond, detected at strain 1464.45, was formed in a 20 hour sample. It can be concluded that the ozonide bond has been formed at this wave number. While the ozonide O-O bond was detected at wave number 722.76 in the 20 hour sample. The C-H bond increases% T this indicates that there are not too many changes to the C-H bond. The content of C-H is the aldehyde and ketone from olive oil which is absorbed by the infrared signal. In Olnutzone oil, the C = O group has decreased by% T this is because ozonation of oil causes an oxidation reaction on the C = O group and converts it to a COOH group. Reducing the C = O bond indicates an increase in acid number [1] this statement is in accordance with the increase in acid number that occurs in Olnutzone oil 20 hours.
Figure 4. FTIR Olnutzone Oil Test Results

Vibration produced from C = C bonds shows the content of Mono Unsaturated Fatty Acid (MUFA) in olive oil and indicates that there is an unsaturated fatty acid content in vegetable oils [13]. Oleic and linoleic acids experience the breakdown of double bonds by ozone so that the concentration of C = C bonds in oil decreases. This is in accordance with the statement [1] that the decrease in the C = C bond indicates a decrease in iodine number. The C-O-C ozonide bond is contained in Olnutzone oil 20 hours, shown at wave number 1464.45 with 91.46% transmittance means that almost all frequencies are absorbed by the compound. Wavelength 722.76 shows the presence of ozonide compounds with O-O bonds in Olnutzone oil 20 hours with 96.62% transmittance, which means that almost all signals are absorbed by compounds with absorbed concentrations of 722.76. Where in the 0-hour sample O-O bonds have not yet emerged, proving that the 20-hour olnutzon oil sample contains ozonide. This is in accordance with the Criegee reaction on ozonide compounds formed with O-O and C-O bonds.

4. Conclusion
The quality of vegetable oil after ozonation changes as indicated by decreasing iodine number and increasing acid number. The best quality vegetable oil is produced at ozonation for 20 hours with a volume ratio of 1:2.

Acknowledgments
Authors thankfully for funding support received from the Faculty Engineering Department, Universitas Negeri Semarang, Ministry of Research, Technology and Higher Education of the Republic of Indonesia.

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