ANTIOXIDANT ACTIVITY OF AVOCADO SEED OIL USING SOXHLET AND *MICROWAVE-ASSISTED EXTRACTION* TECHNIQUES

Yuni Astuti[1], Noor Fitri[1*]

[1]Universitas Islam Indonesia (UII), Prodi Kimia,

Email:[*] noor.fitri@uii.ac.id

ABSTRAK

Ekstraksi minyak biji alpukat telah dilakukan menggunakan teknik Soxhlet dan *Microwave Assisted Extraction* (MAE) serta uji aktivitas antioksidan. Penelitian ini bertujuan untuk mengetahui teknik yang lebih efektif dalam ekstraksi minyak biji alpukat. Langkah penelitian yang dilakukan: 1) Preparasi sampel biji alpukat menjadi serbuk; 2) Ekstraksi minyak biji alpukat teknik Soxhlet dan MAE; 3) Karakterisasi fisika dan kimia minyak biji alpukat; 4) Uji aktivitas antioksidan menggunakan metode DPPH. Hasil penelitian menunjukkan rendemen minyak biji alpukat yang diekstrak dengan teknik MAE dua kali lipat dibandingkan dengan teknik Soxhlet. Hasil karakterisasi fisika dan kimia menunjukkan tidak ada perbedaan minyak biji alpukat dari kedua ekstraksi. Nilai aktivitas antioksidan minyak biji alpukat dengan teknik Soxhlet adalah sebesar 130 ppm, sedangkan untuk teknik MAE sebesar 100 ppm. Ekstraksi biji alpukat dengan teknik MAE lebih efektif dibanding teknik Soxhlet dalam hal rendemen dan aktivitas antioksidannya.

Kata kunci: Minyak Biji Alpukat, Soxhlet, MAE, Antioksidan, DPPH.

ABSTRACT

Avocado seed oil extraction has been carried out using Soxhlet and Microwave Assisted Extraction (MAE) techniques as well as antioxidant activity tests. This study aims to determine the more effective technique in the extraction of avocado seed oil. The research steps were carried out: 1) Preparation of avocado seed samples into powder; 2) Extraction of avocado seed oil using Soxhlet and MAE techniques; 3) Physical and chemical characterization of avocado seed oil; 4) Test the antioxidant activity using the DPPH method. The results showed that the yield of avocado seed oil extracted using the MAE technique was twice that of the Soxhlet technique. The results of physical and chemical characterization showed that there was no difference in avocado seed oil from the two extractions. The antioxidant activity value of avocado seed oil with the Soxhlet technique is 130 ppm, while for the MAE technique it is 100 ppm. Avocado seed extraction with MAE technique was more effective than Soxhlet technique in terms of yield and antioxidant activity.

Keywords: Avocado Seed Oil, Soxhlet, MAE, Antioxidant, DPPH.

INTRODUCTION

Indonesia is a tropical country that has a variety of plants and fruits. One of the favorite fruits in Indonesia is avocado. Avocados are high in protein and lipids. People only use avocado

flesh, while the seeds are discarded so that they become waste. Avocado seeds can be extracted to form beneficial avocado seed oil. Avocado seeds contain high enough oil, namely 15% to 25%. Avocado seed oil can be used as an anti-diabetic drug (Prasetyowati, et al, 2010), as an economical and environmentally friendly biodiesel raw material, and can be used in the manufacture of mayonnaise and salad dressings due to the high content of essential fatty acids in avocado seeds. The content of avocado seeds includes polyphenols, flavonoids, triterpenoids, saponins, quinones, tannins, monoterpenoids, and sesquiterpenoids (Erfiza, et al, 2016). Avocado seeds can function as antioxidants because they contain more than 90% phenolic compounds (Song and Barlow, 2004).

Avocado seed oil can be obtained through extraction and pressing techniques (Corzzini et al, 2016). The extraction technique is preferred because the loss of oil during the process is less. There are several types of extraction to obtain avocado seed oil, such as the Microwave-Assisted Extraction (MAE) technique (Đurđevića et al, 2017; Isabel and Mahfud., 2017; Aulia and Widjanarko, 2018) and Soxhlet (Bambang, et al, 2008; Gatbonton et al, 2013). In this study, the effect of Soxhlet and MAE extraction techniques on the yield and antioxidant activity of avocado seeds were studied.

EXPERIMENTAL SECTION

Material

The materials used in this study included avocado seeds, n-hexane, KOH, $H_2C_2O_4$, PP indicator, ethanol pa, glacial acetic acid, chloroform, KI, $Na_2S_2O_3$, starch indicator, DPPH and extra Virgin Olive Oil.

Instruments

The tools used in this study included pycnometer, Soxhlet set, electric stove, Ohaus analytical balance, Heidolph vacuum evaporator, ABBE refractometer, glass apparatus, Hitachi UH5300 double beam UV-Vis spectrophotometer, Electrolux microwave and Miyako blender.

ISBN: 978-623-6572-45-0

Method

The working procedure of this research can be shown in Figure 1. The complete procedure of this research follows the procedure in (Fitri, N, et al, 2019).

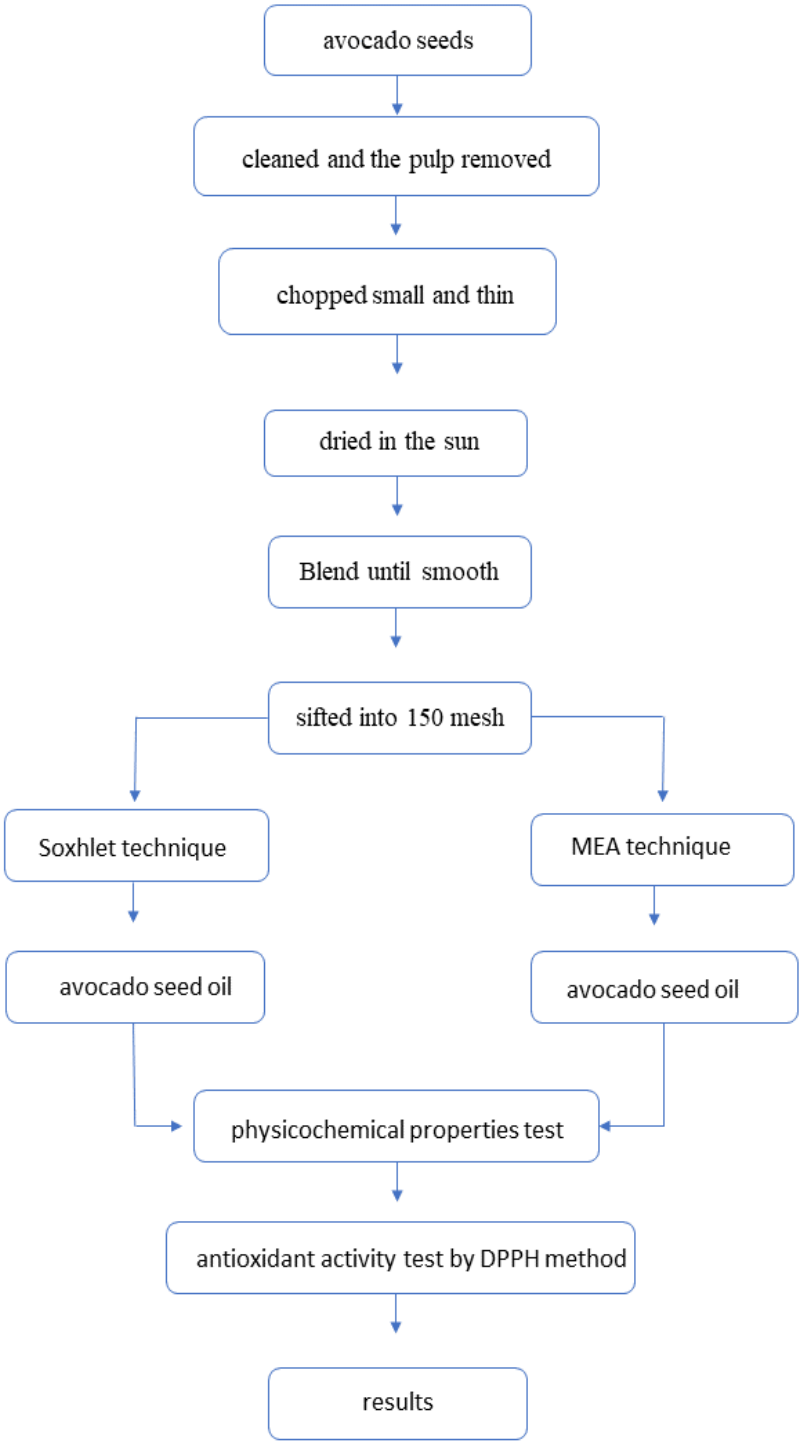


Figure 1 Research Work Scheme

RESULTS AND DISCUSSION

Avocado Seed Extraction and Physico-chemical Test

MAE extraction is an extraction that utilizes microwave energy where this energy will produce heat so that the temperature increases. Heating due to microwaves causes the cell wall to disintegrate and makes the target compound is extracted out and then diffuses into the solvent. The longer the extraction time, the longer the heating will be so that the temperature increases and causes the cells in the sample to be degraded by the heat (Mandal, 2007). In this method, avocado seed oil was obtained with a volume of 2.35 mL, a mass of 2.284 g, and a yield of 4.56%. Table 1 shows the comparison of yield results using MAE and Soxhlet techniques. As shown in Table 1, we found more avocado seed oil by MAE technique. Otherwise, the extraction time is also shorter than the Soxhlet technique.

Table 1. Comparison of yield results using MAE and Soxhlet techniques

Technique	Material mass	solvent	Time	Oil mass	Oil volume	yield
MAE	50 g	n-hexane	8 minutes	2.28 g	2.35 mL	4.56%
Soxhlet	50 g	n-hexane	2 hours	1.44 g	2.10 mL	2.88%

The avocado seeds oil obtained were then subjected to physical and chemical tests (Table 2.

Table 2. Physicochemical tests of avocado seeds oil

Technique	Refractive index	Density	Acid number	Peroxide	Smell	Color
MAE	1.4577	0.730 g/mL	3.12 mg KOH/g	20.45 meqO_2/kg	smell of avocado seed oil	Orange Brown
Soxhlet	1.4759[a]	0.831 g/mL[b]	3.46 mg KOH/g[c]	17.40 meqO_2/kg[d]	smell of avocado seed oil[e]	Orange Brown[f]

ISBN: 978-623-6572-45-0

[a](Sánchez and Menacho, 2020);[b](Risyad et al., 2016; Widyawati et al., 2020);
[c](Wulansari and Indriani, 2012; Sanches, B., 2019); [d](Salgado et al., 2008); [e](Nadya et al., 2019);
[f](Achmad and Sugiarto, 2020)

Table 2. shows that all the parameters of the research results are not much different from the results of previous studies. The MAE technique is more efficient in producing avocado seed oil, this is because, with a short time, the MAE technique can extract more oil. However, in the MAE technique, a higher peroxide number is detected. The peroxide number shown the possibility of oxidation reaction during the hot extraction process. This research is in line with research conducted by (Reddy et al., 2013) where the percentage of avocado oil yield using the microwave technique is the highest compared to other techniques, besides that it is also said by (Rafael et al., 2020) that the MAE technique is effective in extracting bioactive polyphenols from avocado seeds.

Antioxidant activity test using the DPPH method

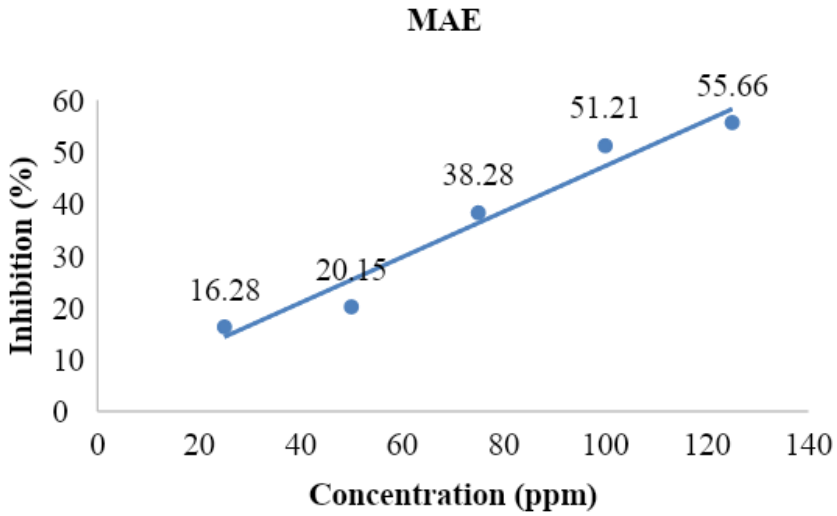


Figure 1. Relationship between concentration of avocado seed oil and % inhibition using MAE technique

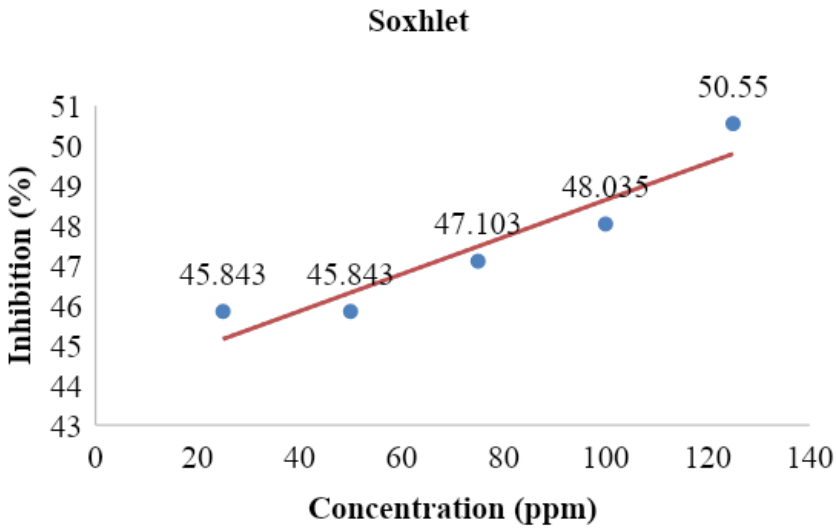


Figure 2. Relationship between concentration of avocado seed oil and % inhibition using Soxhlet technique

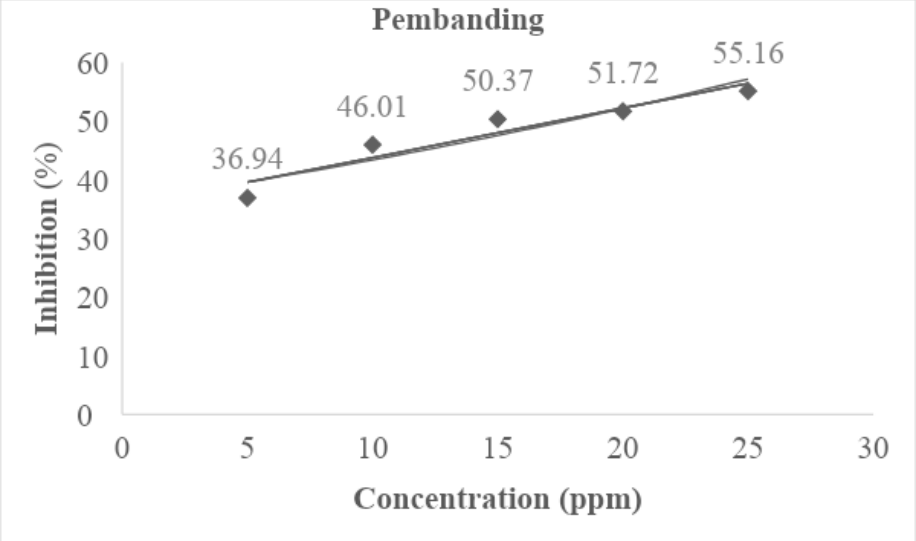


Figure 3. Relationship between concentration of olive oil and % inhibition

The antioxidant regression equation using the Soxhlet and MAE techniques, respectively, is y = 0.046x + 43.99 with r^2 = 0.884 and IC50 of 130.65 ppm, and y = 0.491x + 0.75 with a value of r^2 = 0.950 and IC50 of 100 ,30 ppm. Then the comparative antioxidant regression equation for Extra Virgin Olive Oil 99% is y = 0.843x + 35.39 with r^2 = 0.901 and IC50 of 17.33 ppm. The antioxidant categories of the samples obtained can be seen in Table 3.

ISBN: 978-623-6572-45-0

Table 3. Antioxidant activity of avocado seed oil and olive oil

No	Sample	IC_{50} (ppm)	Antioxidant Power (Jun M, et al., 2006)
1.	ASO_MAE	100.30	medium (IC_{50} 100-250 ppm)
2.	ASO_Soxhlet	130.65	Weak (IC_{50} 250-500 ppm)
3.	EVOO 99%	17.33	Very strong (IC_{50} < 50 ppm)

Avocado seed oil (ASO); Extra Virgin Olive Oil (EVOO)

Table 3 shows that the antioxidant activity of avocado seed oil using the MAE technique is stronger than Soxhlet technique. It is mean that, the MAE technique is more effective to extract avocado seed oil than using Soxhlet technique.

CONCLUSION

The results showed that the MAE technique was more effective than the Soxhlet technique to extract avocado seed oil with a yield of 4.56%. Otherwise, The antioxidant activity of avocado seed oil using the MAE technique is stronger than the Soxhlet technique. The advantages of the MAE technique to extract avocado seed oil: higher yield, faster extraction time, and stronger antioxidant activity. So, the MAE extraction technique is recommended to obtain avocado seed oil.

ACKNOWLEDGENTS

The contribution of the Chemistry Department Islamic University of Indonesia which has provided facilities to support this research is acknowledged.

REFERENCES

Achmad, Z., Sugiarto, B., 2020, Ekstraksi Antosianin dari Biji Alpukat sebagai Pewarna Alami, *Jurnal Teknologi Technoscientia*, Vol. 12 No. 2.

Aulia dan Widjanarko, 2018, Optimasi Proses Ekstraksi Daun Sirsak (*Annona muricata L)* Teknik MAE (*Microwave Assisted Extraction*) dengan Respon Aktivitas Antioksidan dan Total Fenol, *Jurnal Agroinudstri*, Volume 4 Nomor 1, 2442-3548.

Bambang, P., Septian, A.,W,Wawan, R., 2008, Ekstraksi Kontinyu dengan Simulasi Batch Tiga Tahap Aliran Lawan Arah: Pengambilan Minyak Biji Alpukat Menggunakan Pelarut n-Hexane dan Iso Propil Alkohol, *Jurnal Reaktor*, Vol. 12 No. 1.

Corzzini, S.C.S., Barros, H.D.F.Q., Grimaldi, R., Cabral, F.A., 2016, Extraction of edible avocado oil using supercritical CO_2 and a CO_2/ethanol mixture as solvents, *Journal of Food Engineering*, S0260-8774(16)30309-0.

Đurđevića, S., Milovanovića, S., Šavikinb, K., Ristićb, M., Menkovićb, N., Pljevljakušićb, D., Petrovića, S., Bogdanovića, A., 2017, Improvement of supercritical CO2 and n-hexane extraction of wild growing pomegranate seed oil by microwave pretreatment, *Industrial Crops & Product*,104, 21-27.

Fitri N., 2019 Comparison between maceration and microwave extraction techniques of strawberry fruit (fragaria sp) and antioxidant activity test, *IOP Conferences Series: Materials Science and Engineering*, 523(1) 012024.

Gatbonton, G.L., De Jesus, A.P.P., Lorenzo, K.M.L., danUy, M.M., 2013, Soxhlet Extraction Of Philippine Avocado Fruit Pulp Variety 240, *De La Salle University Manila*, FNH-II-013.

Hendra, S., Novizar, N., dan Diana, S., 2018, Ekstraksi dan Karakterisasi Minyak Alpukat (*Persea Americana Mill*), Solok, Sumatera Barat.

Isabel dan Mahfud., 2017, Ekstraksi Minyak Atsiri dari Gaharu (*Aquilaria Malaccensis*) dengan Menggunakan Metode *Microwave Hydrodistillation* dan *Soxhlet Extraction, Jurnal Teknik ITS Vol. 6 No. 2.*

Jun, M., Fu, H.Y., Hong, J., Wang, X., Yang, C.S.H.C., 2006, *Comparison of antioxidant activities of isoflavones from kudzu root (Pueraria lobate ohwi)*, pp. 2117–2122. Diakses pada: https://pubag.nal.usda.gov/catalog/387515.

Mandal, V., 2007. Microwave Assisted Extraction – An Innovative and Promising Extraction Toolfor Medicinal Plant Research. Pharmacognosy Reviews. 1 (1). 7-18.

Prasetyowati, Retno, P., Fera, T.O., 2010, Pengambilan minyak biji alpukat (*persea Americana* mill) dengan metode ekstraksi, *Jurnal Teknik Kimia*, 17,16 – 24.

ISBN: 978-623-6572-45-0

Rafael, G., Rodriguez-Jassoa, R.M., Ruiza, H.A., Govea-Salasb, M., Pintadoc, M.E., Aguilara, C.N., 2020, Process optimization of microwave-assisted extraction of bioactive molecules from avocado seeds, *Industrial Crops & Products,*154, 112623.

Reddy, M., Moodley, R., and Jonnalagadda, S.B., 2013, Fatty acid profile and elemental content of avocado (Persea americana Mill.) oil –effect of extraction methods, *Journal of Environmental Science and Health, Part B: Pesticides, Food Contaminants, and Agricultural Wastes*, 47, 529–537.

Risyad, A., Permadani, R.L., Siswarni, M.Z., 2016, Ekstraksi Minyak Dari Biji Alpukat (*Persea americana* Mill) Menggunakan Pelarut N-Heptana, *Jurnal Teknik Kimia USU*, Vol. 5, No. 1.

Sanches, B., 2019, Kajian Karakteristik Minyak Biji Alpukat (*Persea Americana*) Asal Soe Kabupaten Timor Tengah Selatan sebagai Bahan Bakar Alternatif, *Skripsi*, Universitas Katolik Widya Mandira, Kupang.

Sánchez, J.G., Menacho, L.M.P., 2020, Oxidative stability and shelf life of avocado oil extracted cold and hot using discard avocado (*Persea americana*), *Scientia Agropecuaria*, vol.11 no.1

Salgado, Jocelem, Mastrodi, 2008, O óleo de abacate (Persea americana Mill) como matéria-prima para a indústria alimentícia, *Food Science and Technology*, 28:20-26.

Song, Y., Barlow, P. J., (2004), Antioxidant activity and phenolic content of selected fruit seeds, *Food Chemistry*, 88,411 – 417.

Widyawati, Y., Mageswara, F.A., Permana, S.A., 2020, Optimasi Proses Sokletasi Menggunakan Metode Permukaan Respon dan Karakterisasi Minyak Biji Alpukat (*Persea Americana*), *Jurnal Teknologi 7*, 97-109.

Wulansari, A., Indriani, E.P., 2012, Pembuatan Biodiesel dari Minyak Biji Alpukat (*Persea gratissima*) Menggunakan Katalis Heterogen Kalsium Oksida (CaO), *Skripsi*, Politeknik Negeri Bandung, Bandung.