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THE ROLE OF AVOCADO OIL AS ANTI-DYSLIPIDEMIA AND HEPATOPROTECTIV

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ABSTRACT
Avocado oil contains Monounsaturated Fatty Acid and Polyunsaturated Fatty Acid with the main fatty acid being oleic acid at 59.46-67.69% and containing beta sitosterol as a phytosterol The main thing contained in avocado oil. The content of avocado oil has many benefits for the body, such as being able to reduce lipid profile levels, there by preventing and protecting the body from heart disease and as a hepatoprotective agent. Identify and summarize various literature studies by answering questions specifically related to the benefits of avocado oil on dyslipidemia and the liver?. Literature search using 3 bibliographic database searches (science direct, Pubmed, and Demensions) published in the last 10 years (2013-2023). Using the Preferred Reporting Items for Systematic Review Extension for Scoping Review (PRISMA-ScR) guide. Descriptive findings The initial search was 3266 articles from database searches. The final results were found, namely 10 articles which significantly showed that the content in avocado oil was able to act as anti-dyslipidemia and hepatoprotective. Avocado oil avocado oil is significantly able to overcome dyslipidemia and to protect the liver.
Keywords: avocado oil, dyslipidemia, hepatoprotective

INTRODUCTION

Dyslipidemia is a disease with various disease risks, such as coronary heart disease, atherosclerotic cardiovascular disease and non-alcoholic fatty liver disease which is characterized by abnormalities in lipid profile levels [1], [2].

Avocados are horticultural commodities that continue to be developed in Indonesia and have high economic value, as evidenced by the increase in avocado crop yields according to the Indonesian Central Bureau of Statistics every year [3]. Avocados contain potential oil (15-30 g/100 g of fruit) most of which is MUFA much as 58.6% of the total amount of fatty acids which can prevent the risk of cancer and can protect the body from heart disease, avocados contain beta-sitosterol which functions to normalize LDL, triglyceride and total fat levels in the blood [4].

Avocados have high economic value, so various processed avocado products have emerged, one of which is avocado oil. Avocado oil is a vegetable oil that can be obtained in various ways, such as solvent extraction, cold pressing, ultrasonic-assisted water extraction (UAAE), supercritical CO2 method, subcritical CO2 extraction method, and enzymatic extraction. Avocado oil is high in unsaturated fatty acids, vitamins, antioxidants, and other interesting compounds. Avocado oil produced using the cold pressing method has been widely accepted by consumers as a functional oil and has been commercialized on the market [5].

In general, avocado oil contains MUFA (65.29-71.31%) and PUFA (11.30-16.1%) with the main fatty acid being oleic acid at 59.46-67.69% and containing beta-sitosterol as the main phytosterols found in virgin avocado oil [6]. Avocado oil has the advantage of being high in MUFA so it has good stability against oxidation processes both at high temperatures and during storage and can be an alternative as a cooking oil that is good for health compared to other oils. Avocado oil also contains lower levels of PUFA than MUFA, thus helping to lower lipid profile levels [7], [8].

This article reports findings from a literature review regarding the benefits of avocado oil. The purpose of writing this article is to determine the benefits of avocado oil as anti-dyslipidemia and hepatoprotective. The novelty of this review lies in the literature search method which uses bibliographic searching (searching through electronic databases).

RESEARCH METHODS

The purpose of ScR in this article is to summarize or publish a discovery. Specifically answering the question about the benefits of pure avocado oil as anti-dyslipidemia and hepatoprotective?

This article summarizes information related to article criteria in the form of author's institutional affiliation, year of publication, and research location. The literature search used 3 bibliographic searching databases (science direct, Pubmed, and Demensions) published in the last 10 years (2013-2023). The initial database search was determined by a combination of keywords related to the topic and article title "avocado oil". Next, for data selection, use Rayyan application (https://rayyan.ai/reviews/715082/searches/new). This article uses the Preferred Reporting Items for Systematic Review Extension for Scoping Review (PRISMA-ScR) guide. The PRISMA-ScR process is identifying questions or objectives of the review, identifying relevant articles, selecting articles, mapping data and compiling, summarizing and reporting results [9]. Articles that meet these criteria will be studied further, provide the nutritional benefits of avocado oil and then be concluded.

RESULTS AND DISCUSSIONS

The results presented are:

a. Introduce descriptive results about the literature regarding the number of articles published based on year of publication, institutional affiliation of the first author, and geographic setting (research location).
b. Explore various literature as a discussion that will be presented in this article, considering the different implications but showing the role of avocado oil.
c. Discuss the benefits of avocado oil as anti-dyslipidemia and hepatoprotective.

Descriptive findings Our initial search was 3266 articles from database searches. Furthermore, 537 articles were removed and 2729 articles remained which were then filtered based on the title and abstract of the 2711 excluded articles. After that, a full text article filter was carried out and the result was that there were 7 articles that were not full text so they were excluded. All these stages resulted in 10 articles which will be summarized in a scoping review (see Figure 1 PRISMA-ScR literature search flow diagram).

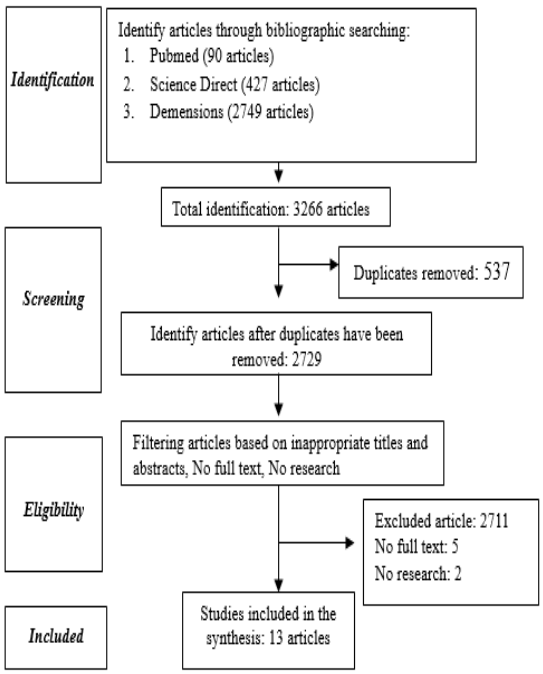

Figure 1. Diagram PRISMA-ScR Literature

Tabel 1. Descriptive characteristics of Avocado Oil literature

Characteristics	Artikel	
	No	%
Year of Publication		
2013-2015	3	30
2016-2018	4	40
2019-2022	3	30
First Author Institutional Affiliation		
Academic	10	100
Non-academic	0	0
Study Location		
Meksiko	3	30
Malaysia	2	20
Brazil	3	20
Turki	1	10
Mesir	1	10

Based on table 1, the publication year for the 2016-2018 period has a greater number of articles related to avocado oil than the previous year. This is due to the continued increase in oil consumption. In the 2013/2014 period, the level of palm oil consumption in the world was 57.52 MMT (million metric tons) and in 2022/2023 it was 76.04 MMT [10]. The high consumption of fat in the world causes various risks of diseases such as dyslipidemia, obesity, diabetes, coronary heart disease, cancer and cardiovascular disease [11], [12]. Therefore, there are other vegetable oils that are high in MUFA (monounsaturated fatty acid) and PUFA (polyunsaturated fatty acid) and low in SAFA (saturated fatty acid) such as olive oil, canola oil, safflower oil, sunflower oil, corn oil, soybean oil. and avocado oil [7]. So many researchers are researching vegetable oils, one of which is avocado oil which has recently become popular with the public.

Based on institutional affiliation, the first author was identified by 2 classifications, namely: academic (university professor, fellow, student), and non-academic (government ministry or department, non-profit organization, or regional health authority). These characteristic categories sometimes overlap if the author collaborates with other colleagues from other institutions or the author has other affiliations but only publishes under certain affiliations (for example, government employees who publish under academic affiliations). However, these categories of characteristics can provide insight into various areas of concern in the avocado oil literature. In this article approximately 100% were published in an academic environment the author is affiliated with Health research. Authors come from various fields of science related to health such as food technology and nutrition, (Furlan et al.,2017; Tan et al., 2018), biochemistry and nutrition (Carjaval-Zarrabal et al., 2014), cellular and extracellular biomorphology (Abboud et al., 2015; Silva et al., 2020), biomedical science and Health (Gokkaya et al., 2022), and biological sciences (García-Berumen et al., 2022).

The study location is the location of the first author's institutional affiliation with the largest number in this article coming from Mexico (30%) and Brazil (30%) followed by Malaysia (20%) then Egypt and Turkey (10%). Mexico is the country with the largest avocado producer in the world

with an increase of 1,107,135 tons in 2010 to 2,300,889 tons (32%) in 2019, and Brazil is the 7th largest producer in the world at 242,932 tons (3.4%) [13]. Based on the study locations in this article, Mexico and Brazil are associated with the highest amount of avocado production in their countries.

Avocado oil as anti-dyslipidemia

Dyslipidemia is an abnormality in lipid profile levels characterized by increased levels of cholesterol, *low density lipoprotein* (LDL), triglycerides and decreased levels of High-Density Lipoprotein (HDL). Meanwhile, hyperlipidemia is an abnormality in lipid profile levels which is only characterized by an increase in cholesterol, *low density lipoprotein* (LDL) and triglyceride levels without causing a decrease in HDL levels [14].

Based on data from *the National Center for Health Statistics* (NCHS), 11.4% of adults had high total cholesterol levels, and 17.2% had low HDL in 2015-2018. Dyslipidemia also causes heart disease, with an estimated 17.9 million people dying in 2016, representing 31% of the total deaths globally [15].

The results of research by Abboud et al., (2015) on rats that were implanted with silicon pellets containing testosterone for 20 weeks to create an androgenic stimulus, were then given avocado oil and the results were found that giving avocado oil was able to reduce TG, VLDL and LDL levels, and increase HDL levels ($p<0.05$). The research of Abboud et al., (2015) is in line with the research of Silva et al., (2020) which used the same method and obtained results with the addition of avocado oil which was able to reduce TG, VLDL and LDL levels, and maintain HDL levels ($p< 0.05$).

Table 2. Role of Avocado Oil

No	Author and year	Research methods				The Role of Avocado Oil
		Research design	Research subject	Model	Induction	
1	Furlan et al., (2017) [16]	Crossover study design	Humans	Overweight	-	• Butter substitute • Anti-Hyperlipidemia • Increases inflammatory response
2	Tan et al., (2018a) [17]	Experimental	Male Sprague-Dawley rat	Hypercholesterolemia	HFD	Anti-dyslipidemia
3	Tan et al., (2018b) [18]	Experimental	Male Sprague-Dawley rat	Hypercholesterolemia	HFD	• Anti-dyslipidemia • Hepatoprotective
4	Garcia-Berumen et al., (2022) [20]	Experimental	Male Wistar rat	NAFLD	HFD+Fructose	Hepatoprotective
5	Abozaid et al., (2018) [21]	Experimental	Male Wistar rat	Hepatocarcinogenesis	Diethylnitrosamine	Protective hepatocarcinogenesis
6	Carvajal-Zarrabal, et al., (2014a) [22]	Experimental	Male Sprague-Dawley rat	Metabolic syndrome	Sucrose	Improve liver function (biochemistry)
7	Abboud et al., (2015) [25]	Experimental	Male Wistar rat	Androgenic stimulation	Implant silicon pellets (1 ml testosterone propionate)	Improving lipid levels in androgenic stimulated rats
8	Gokkaya et al., (2022) [26]	Experimental	Male Wistar rat	Hepatotoxicity	Paracetamol	Protective hepatotoxicity
9	Carvajal-Zarrabal, et al., (2014b) [28]	Experimental	Male Sprague-Dawley rat	Metabolic syndrome	Sucrose	• Antihyperlipid • Anti-inflammatory
10	Silva et al., (2020) [29]	Experimental	Male Wistar rat Androgenic stimuli	Androgenic stimulation	Implant silicon pellets (1 ml testosterone propionate)	• Anti dyslipidemia • Improve liver function (biochemistry)

Androgenic steroids are related and have indirect effects on dyslipidemia. Avocado oil contains beta sitosterol, this phytosterol has the same chemical structure as the steroid hormone (testosterone) so it has anti-androgenic properties which inhibit testosterone from binding to ABP (Androgen Binding Protein) [30], [31]. Oleic acid, linolenic acid, and linoleic acid reduce the susceptibility of LDL to oxidation [29].

In a study conducted by Furlan., et al (2017) humans consumed butter, eggs, bacon, whole wheat bread, potatoes and ice sugar (KK) and replaced the butter with avocado oil (KP), then biochemical biomarkers were measured. Replacing butter with avocado oil as breakfast for 6 days was found to result in avocado oil being able to reduce lipid levels (TC, TG, and LDL) significantly ($p<0.05$). The higher intake of trans fats together with saturated fats can increase the risk of dyslipidemia [32]. Butter contains trans fat and saturated fat so it can increase the lipid profile level, while replacing butter with avocado oil can reduce the lipid profile level because the unsaturated fatty acid content in avocado oil is higher than saturated fat or trans fat.

The results of the study by Carvajal-Zarrabal, et al., (2014b) in rats that were induced with 30% sucrose for 4 weeks and then given avocado oil reduced TG, VLDL and LDL levels, and maintained HDL levels. Other results were also found by Tan et al., (2018a); Tan et al., (2018b) stated that hypercholesterolemic rats that were induced by HFD for 4 weeks and then given avocado oil were able to reduce TC, TG, and LDL ($p < 0.05$) and increase HDL ($p < 0.05$). High fat diet (HFD) is effective as an animal model of induction of dyslipidemia and statosis depending on the fatty acid composition because it can influence the experimental results such as trans fatty acids causing insulin resistance, increased lipid profile levels, and steatosis, while sucrose has a damaging effect on tissue without increasing fat mass [33].

Avocado oil contains MUFA and PUFA. MUFA can change the composition of VLDL, which in turn determines the conversion of VLDL to other lipoproteins and triacylglycerol metabolism. MUFA can regulate the activity and expression of enzymes and proteins involved in endovascular VLDL processing and catabolism, both of which can reduce serum triacylglycerol concentrations. Dietary intake of MUFA-rich canola oil can substantially reduce serum TC and LDL-C levels. PUFA can inhibit the synthesis of VLDL-C and apolipoprotein-B100, which leads to a reduction in serum TG concentrations by reducing triglyceride synthesis thereby inhibiting diacylglycerol acyltransferase, fatty acid synthase, and acetyl-CoA carboxylase. MUFA and PUFA have the same role in regulating the lipid spectrum [34].

Avocado Oil as Hepatoprotectiv

The liver is the largest organ which has an important role as a metabolic center (carbohydrates, proteins, fats and bile), a storage place for vitamins, and has a role as a detoxifier and regulates fluid or electrolyte balance [35].

High testosterone levels in plasma can cause damage to liver tissue and in the long term can cause permanent liver damage and liver cancer [36], [37]. Avocado oil was able to improve liver function (biochemistry) in androgenic stimulus model rats by showing a decrease in the concentration of total serum protein by 24%, albumin by 26%, urea by 14%, and creatinine by 33% ($p <0.05$) as well as maintaining ALT and AST levels [29].

Liver enzyme biomarkers in the form of AST, ALT, ALP levels function in liver structural integrity and damage and can help in the diagnosis of NAFLD and other liver toxicity conditions. Providing a high-fat diet usually increases the levels of this enzyme biomarker through induction of oxidative stress [38]. A study conducted Tan et al., (2018b) on a hypercholesterolemia mouse model found that administration of avocado oil could improve liver function

(biochemistry) by showing significant differences in ALP, AST and ALT levels ($p < 0.05$) and reducing accumulation lipids in the liver by examining the results of HE staining preparations. Rats that were induced with 20 mg/kg BW of diethylnitrosamine and then given avocado oil (1 ml/250 g BW) were able to reduce AFP levels (tumor markers) and levels of ALT, AST, ALP, total bilirubin and direct bilirubin significantly ($p<0$ .05) while also reducing the observed neoplastic and dysplastic changes [21]

Another study conducted by Carvajal-Zarrabal, et al., (2014a) also found that administering avocado oil (7.5%) for 4 weeks could improve liver function, total protein levels ($p<0.005$) and reduce bilirubin levels ($p<0.005$). in rats induced with 30% sucrose for 16 weeks. Bilirubin and total protein levels are non-specific markers of liver dysfunction, increased bilirubin levels or hyperbilirubinemia are a marker of changes in the liver and have prognostic value in certain liver diseases [39].

High fat intake is associated with low serum bilirubin levels and influences hepatic lipid metabolism. The liver plays an important role in lipid metabolism, dietary fats and oxidized metabolites not only influence the pathogenesis of liver diseases, but can also prevent or reverse disease manifestations [40], [41]. HFD increases free fatty acids, thereby triggering fat accumulation which will increase β-oxidation of fatty acids and increase ROS production. The accumulation of free cholesterol also increases mitochondrial dysfunction, endoplasmic reticulum, and activates hepatic Stern and Kupffer cells, which trigger inflammation and fibrosis by producing pro-inflammatory cytokines such as TNF-α and IL-6. In addition, TNF-α and IL-6 increase the inflammatory response and increase insulin resistance. Furthermore, all these mechanisms trigger the hepatocyte apoptotic route [42].

Study by García-Berumen et al., (2022) rats were given HFD+fructose for 6 and 12 weeks to create a NAFLD model, then given avocado oil (1 ml/250 g body weight) for 6 and 12 weeks, results were found if the oil was given Avocado improves liver inflammation (steatosis), increases Respiratory control ratio (RCR) up to 3 times higher, reduces ROS up to 40%, reduces IL 6 and TNF-α levels. To assess liver hepatotoxicity in rats that were given paracetamol 600 mg/kg BW and avocado oil 200 mg/kg every day for 5 days, it was found that liver tissue improved when compared with the control group and the level of total oxidant status (TOS) in the liver decreased significantly while total antioxidant status (TAS) levels increased with administration of avocado oil [26].

Avocado oil contains Polyunsaturated Fatty Acids (PUFA) are able to limit triglyceride deposition in the liver, while a diet lacking PUFA can induce fatty liver and chronic disease [41]. Avocado oil also contains β-sitosterol which can prevent NAFLD or steatosis by reducing oxidative stress, endoplasmic reticulum stress and inflammatory responses [43]

CONCLUSION

In conclusion, based on the literature, avocado oil is significantly able to overcome dyslipidemia by reducing Total Cholesterol (TC), Triglyceride (TG) and Low-Density Lipoprotein (LDL) levels and maintaining High-Density Lipoprotein (HDL) levels. Biochemically in the liver, avocado oil significantly reduces levels of ALP, AST, ALT, total protein and bilirubin, so it is said to be able to protect the liver from disease. Apart from that, administering avocado oil can reduce lipid accumulation in the liver, and improve inflammation (steatosis) of the liver.

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