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A Literature Review of Effect of Moringa Oleifera Leaf Extract Toward Lipid Profile Level in Hyperlipidemia Patients

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Abstract

Background: Hyperlipidemia is a lipid disorder characterized by increased total serum cholesterol, LDL (Low-Density Lipoprotein), triglycerides, and a decrease in HDL levels. **Objective:** This research aims to identify the effectiveness of Moringa oleifera leaf extract on lipid profile levels (total cholesterol, LDL, HDL, and triglycerides) in hyperlipidemic patients. **Method:** The research design of a Systematic Literature Review was done by identifying, evaluating, and interpreting all available relevant research, especially on problem formulation. The journal search process was done by screening, assessing journal quality, analysis, and conclusions. **Results:** That process obtained 25 national and international journals. Then, the writer's analysis concluded that Moringa oleifera leaf extract was more effective in increasing HDL levels with a yield of 34% and lowering LDL levels with a journal yield of 24%. On the other hand, giving Moringa oleifera leaf extract was less effective in reducing total cholesterol and triglyceride levels in the blood by a 21% yield percentage. **Conclusion -** The intervention effectiveness of Moringa oleifera leaf extract is effective in increasing HDL serum (High-Density Lipoprotein) levels and decreasing LDL serum (Low-Density Lipoprotein) levels in hyperlipidemic patients. **Recommendation**: The author recommends other researchers examine the effectiveness of giving moringa leaf extract in liquid dosage forms and Moringa leaf extract in powder or powder with doses of moringa leaf extract of 300mg/kg-BW and 700 mg/kg-BW for more than 14 days

Keywords: moringa oleifera leaf extract, lipid profile, hyperlipidemia

Introduction

Hyperlipidemia is a lipid disorder characterized by an increase in serum total cholesterol, LDL (Low-Density Lipoprotein), triglycerides, and a decrease in HDL (High-Density Lipoprotein) levels with a total cholesterol concentration value of > 240 mg/dl, LDL 160 mg/dl, and triglycerides 150 mg (1).

The increase in cholesterol levels is mainly caused by consuming foods containing high cholesterol and high saturated fat and other factors such as smoking habits, excess body weight, and lack of physical activity(2). Consumption of cholesterol within the recommended safe limit is no more than 300 mg/dl daily. It was consistent with research conducted by Berthalina that there is a significant relationship between cholesterol intake and blood cholesterol levels(3).

The risk due to high body fat or cholesterol levels will trigger the production of free radicals, which are accelerated by oxidative reactions. Free radicals are unstable compounds from within the body (endogenous) and outside the body (exogenous). Free radicals from within the body come from fat in the food consumed, stress, illness, and excessive exercise. In contrast, free radicals from outside come from cigarette smoke, pollutants, X-ray radiation, and others. If there are large amounts of this in the body, it will cause oxidative stress(4).

WHO stated that cardiovascular disease rose to 20 million people in 2015. In 2016 there were 1,863,000 people in Indonesia suffering from heart disease, the highest at the age of 45-75 years and over. In 2018 it increased by 1.5%, and around 2,784,064 Indonesian people suffered from heart disease(5). WHO predicts that by 2030 cardiovascular disease will be the cause of death for approximately 23.6 million people in the world and account for about 25% of the number of cases of death that has increased, especially in developing countries in the Southeast Asian region(6). Cardiovascular disease with a high morbidity rate is coronary heart disease(5).

In Indonesia, 37% of cardiovascular diseases due to hyperlipidemia are the highest causes of death among non-communicable diseases such as cancer, stroke, diabetes mellitus, and chronic respiratory disease(7). The mortality rate for coronary heart disease (CHD) reached 1.25 million with a population of 250 million with a diagnosis of 1.5% of symptoms in 2014(8). According to RISKESDAS (Basic Health Research) data, the prevalence of coronary heart disease is increasing. In 2018 as many as 2.6% of the incidence of cases(7).

A preliminary study conducted by researchers at the Anutapura General Hospital in Palu City in 2017 recorded 297 patient visits with dyslipidemic metabolic disorders. About 462 patients visit the health care services under dyslipidemic conditions with disorders metabolism and hyperlipidemia(9).

Suppose cholesterol levels are not controlled over time. In that case, they will accumulate, causing atherosclerosis, a vital risk factor for cardiovascular diseases, such as coronary heart disease, heart failure, hypertension, acute myocardial infarction, and stroke. Cardiovascular disease is one of the biggest causes of death in the productive age(10). management of hyperlipidemia is essential to prevent an increase in cases of cardiovascular disease caused by an increase in fat levels.

Several medical therapies are used to treat hyperlipidemia, namely conventional medicine and complementary treatment (11). Pharmacologic medications to lower lipid levels include simvastatin, fibrates, resins, selective cholesterol absorption inhibitors, and nicotinic acid(12). The role of simvastatin is to inhibit the action of the HMG-CoA reductase enzyme. It is a precursor of cholesterol synthesis in the mevalonate pathway. In addition, by increasing LDL receptor activity, LDL catabolism rate, and liver LDL precursor extraction. Thus plasma LDL levels decrease.

Complementary therapy or non-conventional medicine is a form of healing

that originates from various health systems, modalities, and practices that are supported by theories and beliefs, including self-healing efforts. According to the Health Regulation of the Republic of Indonesia that concerning the implementation of alternative medicine in health care facilities aimed at improving the health status of the community, including promotive, preventive, curative, and rehabilitative efforts(13). Types of complementary medicine include Hypnotherapy, mediation, acupressure, nutritional diet, herbs, and hyperbaric therapy.

Indonesia is famous for its wealth of medicinal plants with traditional medicine. One of the conventional treatments is treatment using Moringa leaves (Moringa Oleifera Lam)(14).

Antioxidant compounds such as flavonoids, saponins, and tannins have been shown to have a hypolipidemic effect that can lower cholesterol levels in the body. In addition, it is also proven that research using Woodfordia Fruticosa extract given to rats can change the lipid profile in the blood. Flavonoids work by reducing levels of 3-hydroxy-3-methylglutaryl-CoA (HMG-CoA) reductase, which will have a lowering effect on cholesterol levels in the body(15).

One plant with a hypolipidemic effect is Moringa leaves (moringa oleifera lam). Moringa leaves contain high antioxidant compounds, including flavonoids, alkaloids, saponins, essential oils, and tannins(15). Moringa leaves are also used in traditional medicine in India and Africa. Moringa is known to have 539 compounds and more than 90 types of nutritional nutrients in the form of essential vitamins, amino acids, minerals, and anti-inflammatory and anti-aging. It also functions as a cardiac stimulant, antiepileptic, anti-inflammatory, and diuretic. In addition, it can lower cholesterol and prevent more than 300 diseases (16).

The results showed flavonoids in the form of flavanols and flavonols in Moringa leaves were higher than in other plants. The results showed that the concentrations of flavanols and flavones per 100 g of Moringa leaves were 5.53 mg of lutein, 409.06 quercetin, and 84.48 mg kaempferol(17). The flavonoids in Moringa leaves work by preventing LDL oxidation by donating H+ and inhibiting the activity of 3-hydroxy-3methylglutaryl coenzyme-A reductase (HMG-CoA Reductase). While high vitamin C in Moringa plays an essential role in lipid metabolism, preventing LDL oxidation(18).

The high antioxidants in Moringa leaves can be used in patients with inflammatory conditions, cancer, hypertension, and cardiovascular disease(19). The combination of antioxidant content found in Moringa leaves proved more effective than a single antioxidant. This was caused by synergistic and antioxidant cascade mechanisms (19).

The flavonoids in Moringa leaves work by preventing LDL oxidation by donating H+ and inhibiting the activity of 3-hydroxy-3methylglutaryl coenzyme-A reductase (HMG-CoA Reductase)(18). Tannins in Moringa leaves act as antioxidants, and astringent tannins react with mucosal proteins and small intestinal epithelial cells to inhibit fat absorption. Saponins function to bind cholesterol with bile acids, thereby lowering cholesterol. Vitamin C helps hydroxylation of bile acid clots and increases cholesterol excretion. Vitamin B3 reduces the production of VLDL (Very Low-Density Lipoprotein) and also stimulates blood circulation. Thereby reducing the occurrence of fat deposition in the blood vessels(20).

The Ministry of Health of the Republic of Indonesia states that the Moringa plant is safe and efficacious for consumption(8). In the Guidelines for Herbal Medicine in Family Health Care (2010), Moringa plants are useful plants with high nutritional content. They have been tested for toxicity and safety levels in determining safe doses for daily consumption. A study by Lucia (2013) showed that giving Moringa leaf extract to

rats at a dose of 300 mg/200 g BW was not harmful and caused side effects or death (21).

Research on Moringa plants has been carried out before; namely, Moringa leaf extract at a dose of 75 mg/BB can reduce total blood cholesterol levels of normal rats by a value of 47.5%(22). Moringa leaf extract research conducted by previous researchers showed that there was an effect of giving Moringa leaves a dose of 2x1 day (1000mg/day) on HDL cholesterol (High-Density Lipoprotein), LDL cholesterol, and cholesterol triglycerides with a p-value <0.05 (23). The effect of giving Moringa leaf capsules on reducing cholesterol levels with the rule of drinking 2x2 a day with a dose of 500 mg in the paired t-test sample test with a 95% confidence level obtained p-value = 0.000 (p <0.05)) in the treatment group, and p-value = 0.595 in the control group(24). Research on the administration of Moringa leaf flour to pregnant women with a dose of 1000 mg/day showed that there was a significant effect of giving Moringa leaf flour to MDA in pregnant women with a p-value of 0.001 (p<0.05) with a dose of 2x 1000 mg/day for 60 days(25). Research conducted by Affan, administration of Moringa leaf extract using a dose of 300-600 mg (2x1 day) affects reducing systolic and diastolic pressure in patients with hypertension, LDL, HDL, and triglycerides(26).

Research on the effectiveness of Moringa leaves in reducing cholesterol levels or lipid profiles has been carried out on animals and humans as research samples. The content of flavonoids in plants is proven to reduce cholesterol levels in the blood. However, there has been no in-depth study on the effect size of Moringa leaf extract administration, whether it is more effective in reducing cholesterol, LDL, and triglyceride levels or increasing HDL levels in hyperlipidemic patients. Therefore, researchers are interested in writing a systematic literature review study to determine the effectiveness of moringa leaf extract on lipid profiles in hyperlipidemic patients.

Objective

The study aimed to identify the effectiveness of Moringa oleifera leaf extract on lipid profile levels (total cholesterol, LDL, HDL, and triglycerides) in hyperlipidemic patients.

Methods

Desain

The method used in the preparation of this thesis is the Systematic Literature Review method. The steps in implementing a systematic review are very well planned and structured, so this method is very different from the one to convey literature studies.

Data Bases

The data used to search the literature is through selection based on research criteria regarding the effectiveness of giving Moringa leaf extract on lipid profiles. Next, apply a literature review related to Moringa leaf extract, lipid profile, and hyperlipidemia. Articles were searched using the Scient-Direct, Google Scholar, and PubMed databases.

Keywords

The search for articles relevant to this research topic was carried out using the keywords: Moringa leaf extract, lipid profile, humans, hyperlipidemia.

Inclusion	Exclusion
The maximum period of journal publication is five years (2015 – 2020)	Journal published year below 2015
Indonesian and English	Journals are not in full text (not fully accessible)
Adult humans, in vivo and in vitro	Journals that do not contain Moringa leaf extract
Original research articles (not reviews) National, international journals indexed and full text	Journals that are not indexed Web of Science (ISI)
Moringa leaf extract interventions on lipid profiles in hyperlipidemic patients	

Inclusion and Exclusion Criteria

Table 1. List of criteria in the literature review

PICO Process

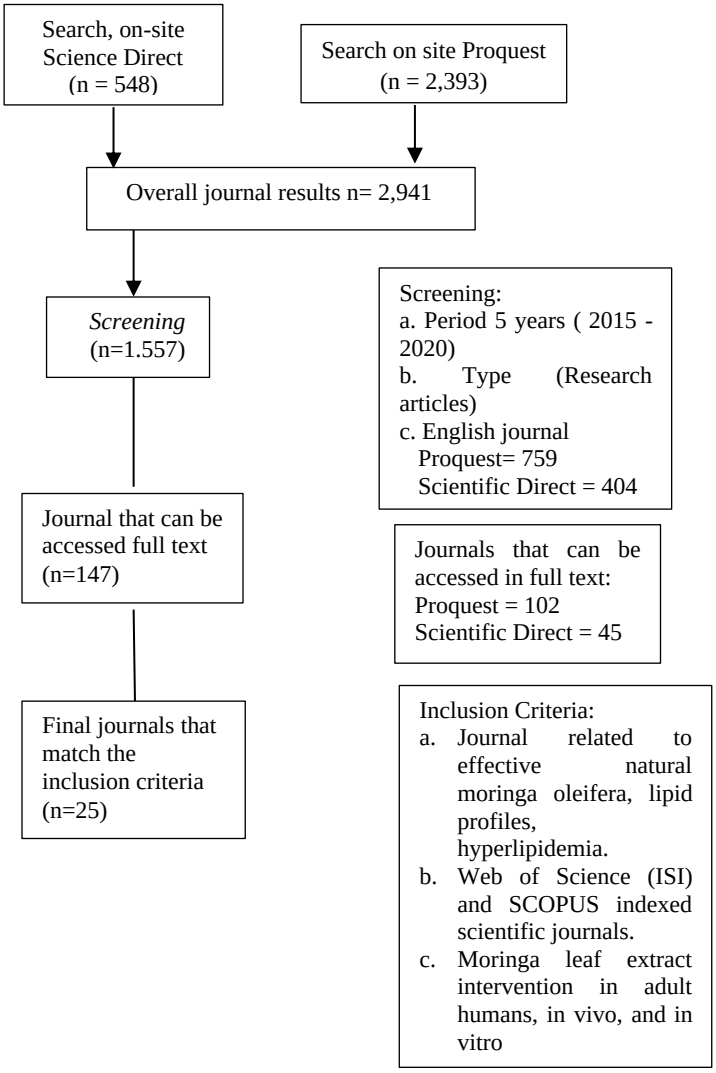

Figure 2. *Journal Search*

Data extraction is carried out if all journals or data have been collected. After going through the screening process and meeting the requirements to be classified, the data extraction results can be it is known for sure how much initial data have and data that still meet the requirements for further analysis.

Results

Twenty-five studies met the criteria for a systematic literature review of the intervention of Moringa leaf extract on the lipid profile of patients with hyperlipidemia. The results obtained were 14 journals using a Randomized Controlled Trials (RCT), five journals using an actual experiment, 5 journals with a quasi-experimental, and one with a pre-experimental.

The literature found that the intervention of Moringa leaf extract on lipid profile levels significantly increased serum HDL levels and reduced serum LDL levels in the blood compared to the effect of Moringa leaf extract.

Discussion

The effectiveness of moringa leaf extract on total cholesterol levels

Based on the analysis of 25 journals, administration of Moringa leaf extract at a dose of 500 mg/kg-BW for 90 days effectively reduced total cholesterol levels. This is because Moringa leaves contain 0.09% β-sitosterol, inhibiting endogenous cholesterol reabsorption and increasing cholesterol excretion in feces through neutral steroids[27]. Moringa leaf extract also contains high polyphenol and antioxidant compounds such as flavonoids, alkaloids, triterpenoids, saponins, and tannins[28].

Flavonoid compounds can reduce total cholesterol levels by inhibiting 3-Hydroxy-3-Methyl-Glutaryl-CoenzymeA (HMG-CoA) reductase, which causes a decrease in cholesterol synthesis and decreases the activity of the enzyme Acyl-Coa Cholesterol Acyltransferase (ACAT) and reduces absorption cholesterol in the digestive tract[28].

The polyphenol content in Moringa leaves reduces cholesterol absorption by binding to the cholesterol carrier membrane. In addition, another mechanism of polyphenols in lowering cholesterol levels is by decreasing the secretion of Apo B (Apolipoprotein B), which causes a decrease in lipoproteins[29].

The authors found that gender, age, and obesity affect the effectiveness of

Moringa leaf extract on lipid profile levels. Giving Moringa leaf extract samples of postmenopausal women >50 years old or elderly is less effective at lowering cholesterol levels because hormonal changes and other physical activities influence it.

Research conducted by Munawar with adult male respondents proved the effectiveness of significant changes in lipid profile reduction compared to other studies using random samples with mixed male and female respondents. It was supported by a previous study that showed that men significantly decreased cholesterol during adolescence due to the influence of the hormone testosterone, which had increased then(30).

Adult men over 20 years generally have higher cholesterol levels than women because of the presence of the female hormone estrogen. After women reach menopause, they have higher cholesterol levels than men. This is due to reduced estrogen hormone activity after menopause or going through menopause(30).

Age is related to metabolic syndrome, especially in the elderly or >50 years. According to Garrow, body fat will increase with age, and the prevalence of obesity will continue to grow until the age of 50 in men and age 65 in women(31).

The proportion of fat to muscle in women is 18:35, so the muscle strength is less, and the anatomy of women is 7-10% smaller than men. In men, the proportion of fat to muscle is 18:42 so that the muscles have maximum strength, and anatomically men are 7-10% larger than women(30). This is also driven by the female hormone estrogen, causing an increase in the amount of fat stored in the subcutaneous tissue. As a result, the percentage of fat in the subcutaneous tissue in the female body is considered to be greater than the male body. Fat deposits occur in the breasts and other body parts, which are part of the characteristics of the figure of feminism(30).

In contrast to research from Seriki, which showed that Moringa leaf extract at a dose of 300 mg/kg BW for 15 days with respondents who had a Body Mass Index (BMI > 25) showed less effectiveness in lowering cholesterol levels in hyperlipidemic patients.

This is in line with research conducted by Diyah regarding predictors of metabolic syndrome for six years in the city of Bandung. The results showed that central obesity was associated with lipid profiles (total cholesterol, LDL cholesterol, HDL cholesterol, and triglycerides). In addition, another study by Chawada et al. showed that cholesterol, LDL, and triglyceride levels in the obese group were significantly higher than in the non-obese group(32).

The effectiveness of moringa leaf extract on LDL levels

The administration of Moringa leaf extract in liquid dosage forms at a dose of 20 mg/kg-BW up to 300 mg/kg-BW effectively reduces LDL levels in hyperlipidemic patients. This is because the flavonoid content in Moringa leaves works by preventing LDL oxidation by donating H+ and inhibiting the activity of 3-hydroxy-3-methylglutaryl Coenzyme-A reductase (HMG-CoA Reductase). Cu and Zn compounds work by increasing the activation of SOD. This mechanism can reduce blood cholesterol levels by preventing the oxidation of Low-Density Lipoprotein (LDL) so that the formation of foam cells and lipid damage does not occur(18).

Age, gender, and type of preparation of Moringa leaf extract reduce LDL levels in hyperlipidemic patients. The above is in line with research conducted by Nadia on gender characteristics of dyslipidemia subjects. It can be seen that dyslipidemia is more common in women, namely 62.5% compared to men. Gustomi et al. stated that gender affects LDL levels(30). It is proven that LDL levels in men tend to be higher than in women. This is because, in childhood, women have higher cholesterol values than men(6).

In postmenopausal women, the hormone estrogen decreases. This estrogen

hormone consists of estriol, estrone, and estradiol compounds which have the most substantial estrogenic potential in the body. So if the hormone estradiol is reduced until it disappears, it will result in loss of ovarian function, decreased organ function, and metabolic disorders, including lipid metabolism(14).

The author also found that the preparation of Moringa leaf extract in liquid form was more effective in reducing lipid profile levels compared to the practice of Moringa leaf extract in powder or powder. As in the results of the journal analysis above, the administration of Moringa leaf extract in a liquid dosage form of 20 mg/kg-BW – 300 mg/kg-BW was more effective in reducing LDL levels than the administration of Moringa leaf extract in powder form at a dose of 700 mg/kg-BW.

The effectiveness of moringa leaf extract on HDL levels

Flavonoids work as H+ donors in oxidant compounds so that the activity of these oxidant compounds can be inhibited, inhibiting HMG-CoA reductase activity and increasing SOD (Superoxide Dismutase) activity. Flavonoids and vitamin C can also boost LCAT, converting free cholesterol into hydrophobic cholesterol esters. Cholesterol esters formed will bind to the lipoprotein core to form new HDL. Antioxidants will increase serum HDL cholesterol by producing Apo-A1, a coenzyme cofactor for LCAT (Lecithin Cholesterol Acyl Transferase), an increase of Apo-A1 can increase serum HDL cholesterol levels(18).

Administration of Moringa leaf extract in liquid dosages of 20 - 500 mg/kg-BW and Moringa leaf powder at a dose of 1000 mg/kg-BW effectively increases HDL levels in the blood. In postmenopausal women and the elderly, decreasing estrogen levels can affect the effectiveness of Moringa leaf extract in raising HDL levels. The above statement is also supported by Gustomi's research which states that along with increasing age, especially in postmenopausal women, the production of estrogen levels decreases, causing instability in the role of other hormones in the body. This is because the hormone estrogen in the body works by preventing deposition in the blood vessels by increasing levels of High-Density Lipoprotein (HDL) cholesterol and lowering levels of Low-Density Lipoprotein (LDL) cholesterol(14).

1. The effectiveness of moringa leaf extract on triglyceride levels

The flavonoid compounds in Moringa leaves can also reduce triglyceride levels by increasing the activity of the LPL (Lipoprotein Lipase) enzyme(33). The activity of the LPL enzyme functions to convert VLDL into LDL so that the accumulation of VLDL is reduced. The mechanism of flavonoid compounds reduces triglyceride levels through increased LPL enzyme activity. With the increase in the enzyme VLDL which transports triglycerides, will undergo hydrolysis into fatty acids and glycerol. Muscles will absorb liberated fatty acids and other tissues, then oxidized to produce energy, and adipose tissue will store them as energy reserves. Then the flavonoid compounds in the body can also inhibit Fatty Acid Synthase (FAS), an enzyme that is very important in fat metabolism. Inhibition of FAS can directly reduce fatty acid formation, thereby reducing triglycerides' appearance (33).

The mechanism of saponin compounds can reduce triglyceride levels by inhibiting the absorption of cholesterol and triglycerides in the intestine and increasing the reaction of bile acid formation from cholesterol which is then excreted through feces(36). According to Maryani, saponins will bind to bile acids and cholesterol from food, then form micelles that the intestines cannot absorb, inhibiting the work of LPL enzymes and increasing the binding of cholesterol and triglycerides by fiber(34).

In addition to flavonoid compounds and saponins, tannin compounds also

reduce triglyceride levels in the blood by lowering triglyceride levels by lowering cholesterol and triglyceride absorption in the small intestine, increasing bile acid excretion. According to Rosyadi, the mechanism of tannins as anti-hypercholesterolemia is by inhibiting adipogenesis and absorption in the intestine. Tannins are also antioxidant compounds that act as anti-free radicals and activate antioxidant enzymes. Tannins can prevent the oxidation of LDL cholesterol, reduce body fat and reduce the incidence of cardiovascular disease(29).

Based on the results of the journal analysis conducted, the authors conclude that the significance value of journals with experimental study designs is influenced by the number of samples and the duration or duration of administration. The author states that the number of sample of respondents who are more than 40 people can affect the results of the significance of the study compared to the small number of samples. The provision of interventions in the long term, such as that carried out by Munawar, Wulandari, and Tollo for 90 days, was more effective in the significance of the results of the study on the effectiveness of Moringa leaf extract on lipid profiles compared to the duration of the intervention of Moringa leaf extract with a short period of fewer than 14 days.

Conclusion

The effectiveness of the administration of Moringa leaf extract on lipid profile levels (total cholesterol, LDL, HDL, triglycerides) is influenced by the characteristics of the respondents, the dose of the section, and the type of extract preparation, and the time interval of administration. In conclusion, the intervention of Moringa leaf extract for at least 14 days to 30 days effectively reduces total cholesterol, LDL, and triglyceride levels and increases HDL in hyperlipidemic patients.

The author hopes that this complementary therapy treatment of moringa leaf extract can be an alternative treatment recommended for people with hyperlipidemia. Further studies need to examine the effectiveness of giving moringa leaf extract in liquid dosage forms and Moringa leaf extract in powder or powder with doses of moringa leaf extract of 300mg/kg-BW and 700 mg/kg-BW for more than 14 days.

Limitations in this study include several research journals in Systematic Literature Review that do not have the characteristics of respondent selection. Several confounding variables were also found to influence the study's results, such as diet, diet, physical activity, and smoking habits. This causes the author to be unable to know for sure whether the administration of Moringa leaf extract only influences the decrease and increase in pure lipid profile levels or if other variables affect it.

References

1. World Health Organization. *World Health Statistic: Monitoring Health of* SDGs. Geneva, WHO;2017.
2. Ayu M. *Faktor-Faktor Yang Berhubungan Dengan Kadar Kolesterol Darah Pegawai Dikantor Wilayah Kementerian Agama Provinsi Sumatera Barat*. Universitas Andalas. 2017.
3. Zahroh L, Bertalina B. *Asupan Energi, Asam Lemaktak Jenuh Ganda, Kolesterol dan IMT dengan Kadar Kolesterol Darah Pada Pasien Jantung Koroner Rawat Jalan*. Jurnal Kesehatan: 2016;5(2).
4. Suwandi T. *Pemberian Ekstrak Kelopak Bunga Rosela Menurunkan Malondialdehid pada Tikus yang diberi Minyak Jelantah*. Universitas Udayana Tesis: Denpasar. 2012;30-2.
5. World Health Organization: A *Wealth of Information on Global Public Health*. 2014.
6. World Health Organization. *World Health Statistic: Monitoring Health of* SDGs. Geneva, WHO;2017.
7. Badan Penelitian dan Pengembangan Kesehatan Kementrian Kesehatan RI Tahun 2013.
8. Kementerian Kesehatan Republik

Indonesia. *Profil Kesehatan Indonesia*. Jakarta: Kemenkes RI. 2014.
9. Data Rumah Sakit Anutapura. 607: *Gangguan Metabolisme*. Sulawesi Tengah; 2016-2018.
10. Ayu M. *Faktor-Faktor Yang Berhubungan Dengan Kadar Kolesterol Darah Pegawai Dikantor Wilayah Kementerian Agama Provinsi Sumatera Barat*. Universitas Andalas. 2017.
11. Perhimpunan Dokter Spesialis Kardiovaskuler Indonesia (PERKI). *Pedoman Tata Laksana Dislipidemia*. Jakarta: 2013 Hal 19.
12. PERKENI. *Pengeolaan dan Penatalaksanaan Hiperlipidemia di Indonesia*. Jakarta; 2014.
13. Gustomi, Mono Pratiko, And Rima Larasati. Ekstrak Rimpang Kunyit Menurunkan Kadar Lemak Darah Pasien Hiperlipidemia (Turmeric (Curcuma Longa Linn) Extract Toward Modification of Blood Lipid Level in Hyperlipidemia Patients). *Journals of Ners Community*. 2015: 6 (1); 1-7.
14. Gustomi, Mono Pratiko, And Rima Larasati. Ekstrak Rimpang Kunyit Menurunkan Kadar Lemak Darah Pasien Hiperlipidemia (Turmeric (Curcuma Longa Linn) Extract Toward Modification of Blood Lipid Level in Hyperlipidemia Patients). *Journals of Ners Community*. 2015: 6 (1); 1-7.
15. Raj *et al. Preparation and Characterization of BSA and Chitosan Nanoparticles for Sustainable Delivery System for Quercetin*. Journal of Applied Pharmaceutical Science. 2015:6(1);31-5.
16. Toripah S, Abidjulu J, dan Wehantow F. *Aktivitas Antioksidan dan Kandungan Total Fenolik Ekstrak Daun Kelor (Moringa Oleifera)*. Jurnal Ilmiah Farmasi. 2016:3(4);2303-2493.
17. Cindi Alverani, Desy Andari, Gita S. P. *Pengaruh Pemberian Ekstrak Daun Kelor (Moringa Oleifera Lam)*. 2014.
18. Sri Handayani , Saryono dan Hernayanti. Effek Daun Alpukat (Persea Americana M.) dan Daun Kelor (Moringa Oleifera L.) Terhadap Peningkatan Kadar HDL Pada Model Tikus Putih Hiperlipidemia. *Jurnal Keperawatan Soedirman (The Soedirman Journal of Nursing)*. 2017; 1 (12).
19. Tejas GH, Umang JH, Payal BN, Tusharbinu DR, Pravin TR. A *Panoramic View on Pharmacognostic, Pharmacological, Nutritional, Therapeutic And Prophylactic Values of Moringa Oleifera Lam.* International Research Journal Pharmacy. 2012:(3)1-7.
20. Susi Dewiyeti dan Saleh Hidayat. *Ekstrak Daun Kelor (Moringa Oleifera Lamk) Sebagai Penurun Kadar Glukosa Darah pada Mencit Jantan (Mus Musculus L) Hiperglikemik*. Jurnal Penelitian Sains. 2015: 17(2);72-77.
21. Sulistiyawati, Yuni. *Pengaruh Tepung Daun Kelor (Moringa Oleifera Lamk) Terhadap Kadar Hormon Prolaktin dan Produksi ASI pada Ibu Postpartum*. 2017.
22. Muniandy, L.A.P. *Efek Antihiperlipidemia dari Ekstrak Etanol Daun Moringa Oleifera Lamk pada Tikus Wistar Jantan*. Fakultas Farmasi ITB; 2013.
23. Muh. Syam. *Pengaruh Pemberian Tepung Daun Kelor (Moringa Oleifera) Terhadap Profil Lipid pada Penderita Pra Diabetes di Wilayah Kerja Puskesmas Samata Kabupaten Gowa*. Makassar; 2019.
24. Darmawan, W., Kurnaesih, E., & Multazam, A. Pengaruh Pemberian Kapsul Daun Kelor terhadap Penurunan Kadar Kolesterol pada Ibu Menopause di Wilayah Kerja Puskesmas Tamamaung. *Jurnal Mitrasehat*. 2018:*8* (2).
25. Misrawati. *Pengaruh Pemberian Kapsul Daun Kelor (Moringa Oleifera Lamk) pada Ibu Hamil Terhadap Kadar Malondialdehid (MDA*). Makassar: Tesis Universitas Hasanudin; 2018.
26. Muhammad Affan. *Pengaruh Ekstrak Daun Kelor Terhadap Penurunan Tekanan Darah Sistolik, Tekanan Darah Diastolik,*

LDL, HDL dan Trigliserida Pasien Hiperkolesterolemia. Semarang. 2018.
27. Gheith, Ibtsam, and Abubakr El-Mahmoudy. Amelioration of Hyperlipidemia and Atherosclerosis Risk Index by Moringa Oleifera Leaf Extract. *Life Science Journal* .2019:16(2).
28. Romadhoni D, Murwani S, Oktaviani. *Efek Pemberian Ekstrak Air Daun Kelor (Moringa Oleifera) Terhadap Kadar LDL dan HDL Serum Tikus Putih (Ratus Novergicus) Strain Wistar yang Diberi Diet Aterogenik*. 2014.
29. Sri Mutia, Fauziah dan Zairin Thomy. Pengaruh Pemberian Ekstrak Etanol Daun Andong (Cordyline fruticosa (L.) A. Chev) Terhadap Kadar Kolesterol Total dan Trigliserida Darah Tikus Putih (Rattus norvegicus) Hiperkolesterolemia. *Jurnal Bioleuser* . 2018: 2 (2); 29-35.
30. Nadia, Juwita. Di RSUD Provinsi NTB. *Jurnal Gizi Prima (Prime Nutrition Journal)*. 2019: 3 (1); 69-79.
31. Koampa, Pradika H. Pengaruh Pemberian Jus Tomat (Lycopersicum Esculentum Mill) Terhadap Penurunan Kadar Kolesterol Low Density Lipoprotein (LDL) Dalam Darah Pada Pasien Dislipidemia Rawat Jalan., Karel Pandelaki, and Marthen CP Wongkar. Hubungan Indeks Massa Tubuh Dengan Profil Lipid Pada Pasien Diabetes Melitus Tipe 2. *E-Clinic*. 2016: 4 (1).
32. Sudikno, Sudikno, et al. Hubungan Obesitas Sentral dengan Profil Lipid pada Orang Dewasa Umur 25-65 tahun di Kota Bogor (Baseline Studi Penyakit Tidak Menular di Kota Bogor, Jawa Barat). *Jurna*l *Gizi Indonesia*. 2017: 39 (2); 81-92.
33. Rusdaina dan Syauqy, A. Pengaruh Pemberian Pisang Kepok (Musa paradisiaca Forma Typical) Terhadap Kadar Trigliserida Tikus Sprague dawley Pra Sindrom Metabolik. *Journal of Nutrition College.* 2015: 4(2); 585-592.
34. Maryani, P. E., Ulva, E. U., dan Rachmawati, E. Pengaruh Ekstrak Metanol Daun Kayu Kuning (Arcangelisia flava (L.) Merr.) 2016.