



## The Effect of Nanoparticles Turmeric Consumption (*Curcuma Domestica Val*) on Blood Pressure and Lipid Profile in Hypertension Patients with Hypercholesterolemia

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**Abstract. Introduction:** The main risk factors for blood pressure disease are hypertension, smoking, and elevated cholesterol. Irregularities in lifestyle and lifestyle cause health problems that can cause death, such as hypertension. **Objective:** The study aimed to examine the effectiveness of the giving nanoparticles turmeric consumption on blood pressure and lipid profile in hypertension patients with hypercholesterolemia. **Methods:** This study applied the true experiment, pretest-posttest design with a non-equivalent control group design. Data collection involved 42 respondents with a medical diagnosis of hypertension with hypercholesterolemia, selected through a probability sampling technique with a simple random sampling method, divided into two groups of 21 respondents each. Data analysis using Paired t-test and independent t-test. **Results:** Independent t-test showed a significant difference p value <0.05 that the intervention group is better in reducing systolic and diastolic blood pressure, total cholesterol, HDL, LDL, and triglycerides compared with the control group. **Conclusion:** Consumption of turmeric nanoparticles (*Curcuma Domestica Val*) is effective in lowering blood pressure and lipid profile (total cholesterol, HDL, LDL, and triglycerides) in hypertension patients with hypercholesterolemia

**Keywords:** turmeric nanoparticles, blood pressure, lipid profile, hypertension, hypercholesterolemia



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## INTRODUCTION

Hypertension is one of the biggest causes of morbidity in the world. It can also be called a silent killer (1). World Health Organization (WHO) estimates the number of people with hypertension in 2025, an estimated 29% of people in the world can experience the same thing with increasing time. Currently, most people with hypertension live in developing countries, including Indonesia(2). In Southeast Asia, hypertension is 36%. The latest basic health research results in 2018, the prevalence of hypertension are 34.1%. Three hypertension in Central Java according to the results of the 2015 health profile as much as 26.4%. At the Sronдол Health Center, Semarang City, Central Java, in 2020, there were 212 people with hypertension. The main risk factors for blood pressure disease are hypertension, smoking, and elevated cholesterol (3-4)

An irregular pattern of life causes an increase in blood pressure. Irregularities in lifestyle and lifestyle cause health problems for humans themselves and can cause death, such as hypertension(4). Signs and symptoms that can be observed are headache, restlessness, flushed face, sore neck, blurred vision, back of the head feels heavy, ringing in the ears, quickly tired, difficulty sleeping, shortness of breath, bleeding from the nose, and irritability(5).

The impact that will occur if hypertension is not treated will cause problems such as blockage of blood vessels, cardiovascular disease, damage to vision, poor sense of vision, and brain disorders that will result in morbidity and mortality(6). Problems that can cause it to need to be limited or even inhibited not to worsen the situation in the elderly(7).

Increased cholesterol levels affect the intake of carbohydrates, protein, fat, fiber, and cholesterol. Suppress this increase can be suppressed by the management of diet. These settings can control nutritional intake in a balanced manner according to needs. In addition, bacteria ferment fiber to produce acetic, propionic, and butyric acids, which slow down cholesterol synthesis (8).

Treatment of hypercholesterolemia almost 70% have not been effective in

Indonesia because it failed to achieve the target of cholesterol treatment. Including therapy is classified as expensive so that it triggers a relapse and the addition of side effects is more dangerous. Pharmacologically, the treatment of hypercholesterolemia could be managed by various kinds of normolipidemic drugs, namely statins, fibrates, resins, effective cholesterol absorption inhibitors, and nicotine (9).

Provision of drugs has side effects and resistance to certain medications. To prevent complications, can be given drugs. Therefore, it is necessary to do a safe and inexpensive alternative treatment. Turmeric (*Curcuma domestica Val*) is a potential herb. Besides being easy to obtain and cheap, the content possessed by this plant can be used as medicine. Turmeric rhizome (*Curcuma domestica Val*) can be used as an ingredient in traditional medicine (10).

Turmeric (*Curcuma domestica Val*) contains natural chemical compounds such as terpenoids (monoterpenes and sesquiterpenes). The content can lower blood pressure, such as curcumin, essential oils, antioxidants, minerals, phosphorus, and high potassium, and contains lots of vitamin C. Antioxidants and fiber in curcumin helps to control low-density lipoprotein in the blood. The content of curcumin and potassium in turmeric helps lower blood pressure in people with hypertension and cholesterol (6).

Giving turmeric steeping water (*Curcuma domestica Val*) can reduce hypertension because *Curcuma* (turmeric) is an herbal plant rich in potassium.<sup>11</sup> Mechanism of action of potassium in potassium lower blood pressure, which can minimize expenditures that can cause a decrease renin-angiotensin II eventual downsizing of the reduced blood vessel lumen and decreased eventual aldosterone absorption of salt and water into reduced. Potassium also affects Na-K; namely, potassium is inflated from the extracellular fluid into cells, and salt is bubbled out and secreted out of the body. Eventually, blood pressure can be lowered by potassium.

A study conducted by Yanik (2019) showed that the effect of boiled turmeric

rhizome (*Curcuma domestica* Val) is an herbal drink made with 10 grams of fresh turmeric and 300 ml of water. Turmeric (*Curcuma domestica* Val) was cleaned and washed. Then pounded and put into 300 ml of water. Boil until boiling until the water becomes half or 150ml. The results were obtained after being given a turmeric stew on a significant decrease in blood pressure(12).

Another test by Angelina Thendry (2015) with the effect of giving turmeric extract on the histopathological picture of the aorta in hyperlipidemic Wistar rats induced with margarine. This study used 20 Wistar rats separated into five groups, each group consisting of 4 rats. Group A (negative control group) was only given standard rums, group B (positive control group) was given margarine 5 g/head/day for 28 days. Group C was given margarine 5 g/head/day for the next 28 days with standard pellets for 28 days. For seven days, group D was given margarine 5 g/head/day for the next 28 days by providing 50 mg/head/day of turmeric extract. Group E was shown margarine 5 g/head/day and turmeric extract 50 mg/head. /day for 28 days. According to the microscopic view, the aortic wall with foam cells in the tunica intima and tunica media in the control group reduced after the 50 mg turmeric extract cells were provided (13).

This indicates that more accurate doses are needed to lower cholesterol and blood pressure in humans. Referring to this study, the researchers were interested in testing the effectiveness of consuming turmeric (*Curcuma domestica* Val) nanoparticles in reducing blood pressure and lipid profiles in hypertension patients with hypercholesterolemia. The hope is that the administration of turmeric nanoparticles can lower blood pressure and lipid profile in hypertension patients with hypercholesterolemia.

## OBJECTIVE

It aims to prove the effectiveness of the giving nanoparticles turmeric consumption (*Curcuma Domestica* Val) on blood pressure and lipid profile in hypertension patients with hypercholesterolemia.

## METHODS

### Design

This study applied true experiments with pretest-posttest designs with a non-equivalent control group.

### Nanoparticle turmeric

Researchers arranged two groups, namely the intervention group, which was given turmeric nanoparticles (*Curcuma domestica* Val) with captopril and simvastatin. In contrast, the control group was only given captopril and simvastatin without turmeric nanoparticles (*Curcuma domestica* Val). Administration of turmeric nanoparticles (*Curcuma domestica* Val) at a dose of 1 x 58 mg (4-gram dose), captopril 1 x 1 dose of 25 mg, and simvastatin 1 x 1 dose of 20 mg for 14 days. Blood pressure measurement using a sphygmomanometer digital brand OMRON HEM-8712 and lipid profile examination at the Srondol Health Center Semarang Laboratory. In addition, the manufacture of nanoparticle capsules is carried out at the Diponegoro University Integrated Laboratory. Measurement of blood pressure and lipid profile (total cholesterol, HDL, LDL, and triglycerides) of respondents before and after treatment (pre-test and post-test).

### Samples & sampling technique

The population in this study were hypertension patients with hypercholesterolemia who received captopril and simvastatin. The participants were at the Srondol Health Center Banyumanik Semarang City in March-April 2021. The samples were selected using probability sampling technique with simple random sampling and based on inclusion and exclusion criteria. A total of 42 respondents were divided into two groups, with 21 respondents each in the intervention group (turmeric nanoparticles (*Curcuma domestica* Val) with captopril and simvastatin). The 21 respondents in the control group (captopril and simvastatin without turmeric nanoparticles (*Curcuma domestica* Val)).

Table 1. Data Demographic

Category	Group		P-value
	Intervention n (%)	Control n (%)	
<b>Age</b>			
45-55	3 (14.3)	8 (38.1)	0.364
56-66	13 (61.9)	6 (28.57)	
67-80	5 (23.83)	7 (33.38)	
<b>Gender</b>			
Male	1 (4.76)	5 (23.81)	0.078
Female	20 (95.24)	16 (76.19)	
<b>Education</b>			
Primary school	7 (33.33)	1 (4.76)	0.002
Junior high school	7 (33.33)	1 (4.76)	
Senior high School	5 (23.81)	15 (71.43)	
College	2 (9.52)	4 (19.05)	
<b>Occupation</b>			
Housewife	16 (76.19)	12 (57.14)	0.766
Pension	2 (9.52)	4 (19.05)	
Entrepreneur	1 (4.76)	2 (9.52)	
Private	1 (4.76)	1 (4.76)	
Teacher	1 (4.76)	1 (4.76)	
Labor	0 (0.00)	1 (4.76)	
<b>Total</b>	21 (100)	21 (100)	

**Statistically analysis**

In this study, researchers collected data using observation, identification, and interviews. The collected data were analyzed through the IBM SPSS version 21.0 program and continued with a different test, namely the parametric test (Paired t-test and independent t-test). The processed data is used as the basis for discussing the statement problem, which is then presented in tabular form so that conclusions can be drawn.

**Results**

Table 1 explains the data demographic among the experimental group and the control group. The results found that the respondents' age, gender, and occupation in the intervention and control groups were significant p-value >0.05. However, on the contrary, the education category p-value <0.05 means that it is not the same or not homogeneous.

Table 2. The mean difference in systolic blood pressure between the intervention and the control group

Measurement time	Group (Mean ± SD)		Statistics	P-value
	Intervention	Control		
Day 1	168.33±8.523	166.48±8.559	0.705	0.485
Day 8	144.33±9.096	151.19±11.08	-2.192	0.034
Day 15	123.24±10.188	134.57±11.788	-3.333	0.002
Difference	45.10±14.707	31.90±10.816	3.311	0.002

**Table 3. Mean difference of diastolic blood pressure between the intervention and the control group**

Measurement time	Group (Mean ± SD)		Statistics	P-value
	Intervention	Control		
Day 1	99.90±6.107	100.33±6.406	-0.222	0.826
Day 8	85.29±5.640	89.33±6.288	-2.196	0.034
Day 15	78.14±5.434	85.81±5.715	-4.455	0.000
Difference	21.76±6.28	14.52±7.24	3.459	0.001

**Table 4. Mean difference of diastolic blood pressure between the intervention and the control group**

Variable	Measurement time	Group (Mean ± SD)		Statistics	P-value
		Intervention	Control		
Total cholesterol	Pre-test	243.57±26.261	243.71±26.898	-0.017	0.986
	Post-test	180.43±14.784	218.05±21.791	-6.547	0.000
	Difference	63.14±26.507	25.67±15.717	5.573	0.000
Triglycerides	Pre-test	251.62±49.703	250.48±52.214	0.073	0.942
	Post-test	116.38±25.238	182.29±42.257	-6.136	0.000
	Difference	135.24±52.700	68.19±45.511	4.413	0.000

**Table 5. Mean difference of diastolic blood pressure between the intervention and the control group**

Variable	Measurement time	Group (Mean ± SD)		P-value
		Intervention	Control	
HDL	Pre-test	71.73±6.323	71.39±6.289	0.864
	Post-test	49.29±5.460	63.14±7.648	0.000
	Difference	22.44±5.770	8.26±7.719	0.000
LDL	Pre-test	178.64±6.498	179.87±8.474	0.600
	Post-test	98.73±17.923	132.10±22.010	0.000
	Difference	79.91±17.716	47.77±19.134	0.000

Table 2 shows a significant difference in the decrease in systolic blood pressure on days 1, 8, and 15 between the intervention group and the control group significantly with a p-value of 0.002 (<0.05).

Based on table 3 above shows that there is a significant difference in the decrease in diastolic blood pressure on days 1, 8, and 15 between the intervention group and the control group significantly with a p-value of 0.001 (<0.05).

Table 4 shows a significant difference in the decrease in total cholesterol and triglycerides between the intervention group and the control group with a p-value of 0.000 (<0.05).

Table 5 showed a significant difference in HDL and LDL between the intervention and control groups with a p-value of 0.000 (<0.05).

## Discussion

### **The effectiveness of turmeric nanoparticles on reducing systolic and diastolic blood pressure in hypertension patients with hypercholesterolemia.**

Statistical significance systolic and diastolic 1 x 58 mg effectively reduced systolic blood pressure 123.24 compared to the control group 134.57 who only received captopril 1 x 25 mg with a significant value ( $F = 168,201, p = 0.000$ ).

The analysis results showed a significant decrease in diastolic blood pressure in the intervention group 78.14 from day 1, day 8 to day 15, namely in each group with  $p\text{-value} = 0.000$ .

On day 8 and day 15, both groups showed a significant difference in systolic and diastolic blood pressure with a  $p\text{-value} < 0.05$ . administration of captopril 1 x 25 mg, plus 1 x 58 mg of turmeric nanoparticles for 15 days was effective in reducing systolic and diastolic blood pressure compared to the control group who received captopril 1 x 25 mg.

Clinical significant systole and diastole based on the calculations, the effect Size for systolic blood pressure by 44.32% and diastolic blood pressure by 62.53%, which means that there is the influence of nanoparticles turmeric to decrease systolic blood pressure and diastolic blood pressure in hypertensive patients

Mechanism Nanoparticles turmeric against pressure drop systolic and diastolic blood can penetrate the intercellular space, which colloidal particles can also penetrate. The nanoparticle method is assumed to be absorbed and assimilated by the body quickly and adequately.

Liposomes as vaccine adjuvants and drug delivery vehicles are useful as carriers of nutrients and pharmaceutical drugs. Turmeric in this form is used as a drug delivery function. The function of drug delivery in hypertensive patients with hypercholesterolemia is getting better. It was due to nanomaterials modified in detail to be adjusted to release drugs when they touch the target organs, namely arterial blood vessel tissue cells (14).

The blood pressure reduction among hypertensive patients with hypercholesterolemia due to the active ingredients in turmeric nanoparticles. It consisted of flavonoids with 228.6 mg/100gr and total phenol 1.76 GAE/100 gr. Polyphenols are well known as catechins. Catechins are potent antioxidant compounds even more than vitamin E, vitamin C, and beta-carotene. Polyphenols can protect cells in the body against damage caused by free radicals.<sup>12</sup>

The content of flavonoid substances therein serves as an ACE inhibitor, angiotensin II. It was not formed in the blood vessels and improving blood flow. The flavonoid quercetin can act directly on the smooth muscle of the arteries, which will cause vasodilation.

Flavonoids have a mechanism of action as a diuresis, namely by absorbing sodium ion fluid from the cells into the renal tubules, increasing the glomerular velocity. The sodium soaked accumulates in the urine, which causes the production of urine to be significant.<sup>16</sup>

The study of turmeric nanoparticles with a dose of 58 mg plus captopril 1 x 25 mg, an amount of 11.9 mg of flavonoids for 14 days can reduce systolic blood pressure by an average of 168.33 after the intervention was 123.24 ( $p = 0.000$ ), and mean diastolic blood pressure of 90.9. after intervention 78.14 85.81 ( $p = 0.000$ ) while on the effect of bay leaves on lowering blood pressure, 10 bay leaves equivalent to 4 grams then boiled into 1 cup equal to 240 ml, flavonoids 0.56 mg/100 given twice a day for two weeks. Statistical analysis showed systolic blood pressure was 140.00 ( $p=0.000$ ) and 75.5 ( $p=0.087$ ) for diastolic blood pressure.

So it can be concluded that the boiled water of bay leaves has an effect on reducing systolic blood pressure and has no impact on decreasing diastolic blood pressure in elderly with hypertension (17). It can be seen that the administration of turmeric nanoparticles plus captopril 1 x 25 mg for 14 days is more effective in reducing systolic and diastolic blood pressure than giving a decoction of 4 salt bay leaves boiled into 1 cup for two weeks.

Thus, it can be concluded that the use of captopril 25 mg/day and simvastatin 20 mg/day as the primary drug plus turmeric nanoparticles 58 mg/day as an adjuvant is highly recommended. It can reduce the systolic blood pressure of 123.24 mmHg and diastolic blood pressure of 78.14 mmHg, which effectively lowers systolic and diastolic blood pressure  $\pm 3$ x higher than the group that only received captopril 25 mg/day and simvastatin 20 mg/day. The blood pressure and lipid profile in the intervention group decreased than the control group. Due to turmeric nanoparticles helping captopril and simvastatin support the work system in the body of hypertensive patients with hypercholesterolemia.

#### **The effectiveness of turmeric nanoparticles on reducing total cholesterol in hypertension patients with hypercholesterolemia.**

Statistical significance of the analysis showed that the treatment in each group was carried out for 15 days. The intervention group received simvastatin 1 x 20 mg plus nanoparticles 1 x 58 mg effectively reduced cholesterol the total between the intervention group and the control group with the results of statistical tests obtained p-value <0.05. Total cholesterol in the intervention group had a mean of 180.43, while the control group's mean 218.05 ( $t = -6.547$ ,  $p = 0.000$ ).

The Effect Size of total cholesterol was 71.07%, which indicated that nanoparticles reduce total cholesterol in hypertensive patients with hypercholesterolemia.

The mechanism of turmeric nanoparticles in reducing total cholesterol can penetrate the intercellular space, which colloidal particles can also penetrate. The nanoparticle method is assumed to be absorbed and assimilated by the body quickly and adequately. Liposomes as vaccine adjuvants and drug delivery vehicles are useful as carriers of nutrients and pharmaceutical drugs.

Turmeric in this form is used as a drug delivery function. The function of drug delivery in patients with hypertension with hypercholesterolemia is getting better because nanoparticles can be modified in

detail to be adjusted to release drugs when they touch the target organ, namely cholesterol levels in the blood(14-15).

The decreasing of total cholesterol among hypertensive patients with hypercholesterolemia was due to the active ingredients in turmeric nanoparticles. It consists of flavonoids with 228.6 mg/100gr and total phenol 1.76 GAE/100 gr. Polyphenols are well known as catechins. The polyphenolic compounds contained in turmeric are thought to have an essential role in reducing oxidative stress through their mechanism as antioxidants directly on lipoprotein-particles (12).

The content of flavonoid substances therein serves as an ACE inhibitor, angiotensin II. it is not formed in the blood vessels and improving blood flow. The flavonoid quercetin can act directly on the smooth muscle of the arteries, which will cause vasodilation.

Flavonoids have a mechanism of action as a diuresis, namely by absorbing sodium ion fluid from the cells into the renal tubules, increasing the glomerular velocity. The sodium soaked accumulates in the urine, which causes the production of urine to be significant(16).

Comparison of 58 mg turmeric nanoparticles, 11.9 mg flavonoids for 14 days can reduce total cholesterol ( $p = 0.000$ ) by giving Moringa leaf juice to total cholesterol levels in hypercholesterolemic people. One hundred grams of fresh Moringa leaves boiled for 3 minutes in 300 milliliters of water then juiced to 220 ml, 473.3 mg of flavonoids for 3 days. The results of this study were not able to significantly reduce total cholesterol levels from 236.30 mg/dl to 234.30 mg/dl ( $p=0.721$ )(18)

In this study, the reason for being given Moringa leaf juice for 3 days is that consuming Moringa leaves in a series of close times with a long duration can cause side effects such as diarrhea. Hence, researchers only give it in a short period to minimize the impact side of Moringa leaf juice.

In the administration of turmeric nanoparticles at a dose of 1 x 58 mg plus simvastatin 1 x 20 mg, flavonoids 11.9 mg for 14, there was a decrease in total cholesterol

levels in the intervention group on day 8. Therefore, the comparison here was that giving turmeric nanoparticles was more effective than providing Moringa leaf juice because of the dose, nanoparticles and drugs, as well as the duration of administration that distinguishes it from being given Moringa leaf juice for a limited time

### **The effectiveness of turmeric nanoparticles on reducing HDL in hypertension patients with hypercholesterolemia**

Statistical analysis showed significant treatment provision in each group carried out for 15 days. The intervention group received simvastatin 1 x 20 mg and nanoparticles 1 x 58 mg. It effectively reduced HDL between the intervention and control groups with statistical test results obtained p-value <0.05. The mean of HDL in the intervention group was 49.29, while the control group was 63.14 (t = -6.753, p = 0.000).

Clinically significant effect size obtained for HDL is 72.16%, which means that there is an effect of nanoparticles on decreasing HDL in hypertensive patients with hypercholesterolemia.

The mechanism of turmeric nanoparticles on decreasing HDL can penetrate the cell space, which colloidal particles can also penetrate. The nanoparticle method is assumed to be absorbed and assimilated by the body quickly and adequately. Liposomes as vaccine adjuvants and drug delivery vehicles are useful as carriers of nutrients and pharmaceutical drugs. Turmeric in this form is used as a drug delivery function.

The function of drug delivery in hypertensive patients with hypercholesterolemia is getting better. The causes of nanoparticles can be modified in detail to release drugs when they touch the target organ, namely HDL cholesterol levels (14). Nanoparticles reduce HDL in hypertensive patients with hypercholesterolemia due to the active ingredients in turmeric nano, namely flavonoids with a total of 228.6 mg/100gr and total phenol 1.76 GAE/100 gr. Polyphenols are well known as catechins.

The polyphenolic compounds in

turmeric are thought to have an essential role in reducing oxidative stress through their mechanism as antioxidants directly on lipoprotein-particles(12). The content of flavonoid substances therein serves as an ACE inhibitor, angiotensin II. It is not formed in the blood vessels and improving blood flow. The flavonoid quercetin can act directly on the smooth muscle of the arteries, which will cause vasodilation. The mechanism of action of flavonoids is to improve blood circulation and prevent blockages in blood vessels. Blood can flow normally, reduce cholesterol content, and reduce fat accumulation in blood vessel walls (16).

Comparison of the study of turmeric nanoparticles at a dose of 58 mg, flavonoids 11.9 mg for 14 days can reduce triglyceride levels P = <0.005) with the administration of purple sweet potato capsules on HDL levels and LDL levels. Days for 45 days (6 weeks), flavonoid-derived saponins 530.06 mg/100 g. This study showed that after the intervention using purple sweet potato capsules as much as 1000 mg/day for 45 days (6 weeks) the mean change in HDL levels in the intervention group increased from 44.93 mg/dl to 42.41 mg/dl and was statistically significant. (p <0.05). It was indicated that there is a difference between before and after the intervention (19). It can be seen on the purple sweet potato supplementation at a dose of 4 x 4 capsules/day with saponin 530.06 mg for 45 days compared to administration of a dose of turmeric nanoparticles. The dose was 1 x 58 mg plus simvastatin 1 x 20 mg for 14 days for better effectiveness. It was giving turmeric nanoparticles, 11.9 mg flavonoids plus simvastatin 20 mg for 14 days because it is seen from the dose and content of purple sweet potato capsules and the longer the range of administration with higher flavonoid content.

### **The effectiveness of turmeric nanoparticles on reducing LDL in hypertension patients with hypercholesterolemia**

Statistical significance analysis results showed that the treatment in each group was carried out for 15 days. The intervention group received simvastatin 1 x 20 mg plus

nanoparticles 1 x 58 mg, effectively reduced LDL between the intervention and control groups with statistical test results obtained p-value <0.05. LDL in the intervention group had a mean of 98.73 while the control group had a mean of 132.10 ( $t = -5.387, p = 0.000$ ).

The effect size of LDL was 63.93%, which means that nanoparticles reduce LDL in hypertensive patients with hypercholesterolemia.

The mechanism of turmeric nanoparticles in reducing LDL can overcome the solubility of the insoluble active substances, increase the stability of the active substances and improve absorption. The nanoparticle method is assumed to be absorbed and assimilated by the body quickly and adequately.

Liposomes as vaccine adjuvants and drug delivery vehicles are useful as carriers of nutrients and pharmaceutical drugs. Turmeric in this form is used as a drug delivery function. The function of drug delivery in hypertensive patients with hypercholesterolemia is getting better. It was due to nanoparticles can be modified in detail to be adjusted to release drugs when they touch the target organ, namely LDL cholesterol levels(14).

Decrease in LDL in hypertensive patients with hypercholesterolemia due to the active ingredient in turmeric nano flavonoid with 228.6 mg / 100g and total phenol 1.76 GAE / 100 g. Polyphenols are well known as catechins. The polyphenolic compounds contained in turmeric are thought to have an essential role in reducing oxidative stress through their mechanism as antioxidants directly on lipoprotein-particles (12).

The content of flavonoid substances therein serves as an ACE inhibitor, angiotensin II, so it is not formed in the blood vessels and improving blood flow. The flavonoid quercetin can act directly on the smooth muscle of the arteries, which will cause vasodilation. The mechanism of action of flavonoids is to improve blood circulation and prevent blockages in blood vessels so that blood can flow normally, reduce cholesterol content, and reduce fat accumulation in blood vessel walls (16).

Comparison of the study of turmeric nanoparticles at a dose of 58 mg, flavonoids 11.9 mg for 14 days can reduce triglyceride levels  $P = <0.005$ ) with the administration of purple sweet potato capsules on HDL levels and LDL levels. Days for 45 days (6 weeks), flavonoid-derived saponins 530.06 mg/100 g.

This study showed that after the intervention using purple sweet potato capsules as much as 1000 mg/day for 45 days (6 weeks). The mean change in LDL levels in the intervention group decreased from 176.58 mg/dl to 151.98 mg/dl. It was statistically significant ( $p < 0.05$ ), which means there is a difference between before and after the intervention.

In addition, the difference in LDL levels between before and after the intervention was -24 (13.6%)(19). Where it can be seen in the administration of purple sweet potato capsules at a dose of 4 x 4 capsules/day with 530.06 mg of saponins for 45 days compared to the administration of turmeric nanoparticles at a quantity of 1 x 58 mg plus simvastatin 1x20 mg for 14 days. It was influential in giving turmeric nanoparticles, flavonoids 11.9 mg plus simvastatin 20 mg for 14 because the dose and content of purple sweet potato capsules are more significant, and the duration of administration is long with high flavonoid content.

### **The effectiveness of turmeric nanoparticles on reducing triglycerides in hypertension patients with hypercholesterolemia.**

Statistical significance of the analysis showed that the treatment in each group was carried out for 15 days. The intervention group received simvastatin 1 x 20 mg plus nanoparticles 1 x 58 mg, effectively reducing triglycerides between the intervention and control groups. The results of statistical tests obtained a p-value <0.05. Triglycerides in the intervention group had a mean of 116.38, while the control group had a mean of 182.29 ( $t = -136, p = 0.000$ ).

A clinically significant effect size was obtained for triglycerides of 68.76%, which means that nanoparticles reduce LDL in hypertensive patients with hypercholesterolemia.

The mechanism of turmeric nanoparticles on reducing triglycerides can penetrate the intercellular space, which colloidal particles can also penetrate. The nanoparticle method is assumed to be absorbed and assimilated by the body quickly and adequately. Liposomes as vaccine adjuvants and drug delivery vehicles are useful as carriers of nutrients and pharmaceutical drugs.

Turmeric in this form is used as a drug delivery function. The function of drug delivery in patients with hypertension with hypercholesterolemia is getting better because nanoparticles can be modified in detail to be adjusted to release drugs when they touch the target organ, namely plaque on the walls of blood vessels (14).

Decreased Triglyceride in hypertensive patients with hypercholesterolemia due to the active ingredient in turmeric nano flavonoid with 228.6 mg / 100g and total phenol 1.76 GAE / 100 g. Polyphenols are well known as catechins. The polyphenolic compounds contained in turmeric are thought to have an essential role in reducing oxidative stress through their mechanism as antioxidants directly on lipoprotein-particles (12).

The content of flavonoid substances therein serves as an ACE inhibitor, angiotensin II, so it is not formed in the blood vessels and improving blood flow. The flavonoid quercetin can act directly on the smooth muscle of the arteries, which will cause vasodilation. The mechanism of action of flavonoids is to improve blood circulation and prevent blockages in blood vessels. Therefore, blood can flow normally, reduce cholesterol content, and reduce fat accumulation in blood vessel walls (16).

Comparison of the study of turmeric nanoparticles at a dose of 58 mg, flavonoids 11.9 mg for 14 days can reduce triglyceride levels ( $P < 0.005$ ) with sweet potato leaf juice at a dose of 85 mg, flavonoids 411 mg for 14 days. effective in lowering triglyceride levels ( $p > 0.005$ ). So it can be concluded that giving turmeric nanoparticles is better in reducing triglycerides (20). It can be seen from the dose and content of flavonoids in sweet potato leaves. The management method is different

because of the nano-administration of the ability to penetrate the intercellular spaces penetrated by colloidal particles. This makes it possible to touch the intended target organ, namely plaque on the walls of blood vessels. Thus the administration of turmeric nanoparticles at a dose of 58 mg, flavonoids 11.9 mg for 14 days was better than the administration of purple sweet potato leaf juice at a dose of 85 mg, flavonoids 411 for 14 days.

## Conclusion

Based on data processing and analysis on the effectiveness of turmeric nanoparticles (*Curcuma Domestica* Val) as an alternative to complementary therapy. It can be concluded that the average reduction in blood pressure and lipid profile (total cholesterol, HDL, LDL, and triglycerides) between the intervention group and the control group shows a significant difference with a p-value  $< 0.05$ . In conclusion, turmeric nanoparticles (*Curcuma Domestica* Val) in the intervention group were better in lowering blood pressure and lipid profile than the control group.

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