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RESEARCH ARTICLE

The Comparative Effect of Liquid and Tablet Preparation of Purple Sweet Potato (*Ipomoea batatas L*) Extract to Lipid Profile, MDA, and SOD Level in Male Wistar Rats After Given High-Cholesterol Diet

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Abstract

Background: Recent developments in tablet preparation of extract have brought advantages to keep active ingredients from plants in stable forms physically and chemically. This study aims to compare the liquid and tablet preparation of purple sweet potato (*Ipomoea batatas L.*) extract to lipid profile, MDA, and SOD level in rats after given high-cholesterol diet. Methods: A randomized pre- and post-test control group experimental study was conducted during 4 weeks among 21 male Wistar rats. They were divided into 3 groups in this study namely: control (only high-cholesterol diet), Treatment 1 (T1) group (high-cholesterol diet and 200mg/day tablet of purple sweet potato extract), and Treatment 2 (T2) group (high-cholesterol diet and liquid form of purple sweet potato tubers extract about 2 mL/day). Lipid profile, MDA, and SOD level examination were performed twice from retro orbital sinus blood drawn and analyzed using ANOVA in SPSS version 17.Results: Mean value of lipid profile was significantly lower in T2 group (Cholesterol 84.48 ± 3.38; LDL 23.05 ± 2.32; HDL 63.39 ± 1.56; and triglycerides 96.03 ± 3.82; $P < 0.05$) after study period. The mean value of MDA was also significantly lower in T2 group (1.25 ± 0.09; $P < 0.05$) and SOD level was significantly higher in T2 group (73.72 ± 4.14; $P < 0.05$) in the end of study. Conclusion: Liquid preparation of purple sweet potato extract showed a better efficacy in reducing lipid profile and MDA level, as well as enhancing SOD level in rats given high-cholesterol diet.

Keywords: *Lipid Profile, Liquid, MDA and SOD Level, Purple Sweet Potato, Tablet.*

Introduction

Purple sweet potato (*Ipomoea batatas L.*) is one of tropical plant that have been widely used and studied in Bali both for health [1]. Several studies of purple sweet potato tuber extract in liquid dosage form have been conducted in decreasing blood cholesterol level and act as antioxidant properties in rats and rabbits [1, 2]. As an antioxidant, the extract of purple sweet potato tubers contains anthocynains where it has been shown increasing the SOD-2 and SOD-3 expression in human vascular endothelium [3]. These action mechanisms on hypertensive patients proved that the liquid preparation of purple sweet potato tubers extract could lower blood pressure and reduce oxidative stress [4]. However, the previous study found that the liquid preparation of purple sweet potato tuber extracts was less stable when stored for a long period [4]. The colour and viscosity of liquid preparations that have been opened and stored for several weeks changes, thus raising doubts in taking the drug further. In addition, the active compounds of anthocyanin can be transformed into a positively charged compound (cationic) in the acid environment that allows the interaction of active substances and excipients when formulated in both anions and cations [5,6].

Based on the explanation above, it is necessarily important to find an alternative dosage form to improve the stability of purple

sweet potato tuber extract and strengthening the efficacy of therapeutically properties. Tablets are one of the relatively more stable forms of solid doses physically and chemically.

A study were proved that tablets containing various active ingredients from plants were able to survive for three months and are still physically and chemically stable [7,8]. The tablet also a drug preparation in the form of a solid dosage where the drug ingredients are often made with the addition of a pharmaceutically designed ingredient. Drugs in tablet dosage form, the doses of relatively active substances can contain large quantities in small volumes; can be packed properly, easily swallowed and practical in terms of transport and storage, and low prices for packaging [8].

In addition, the discomfort of the active ingredient will decrease as the tablet is swallowed so that contact with the mucous membrane does not last long. According to these issues, this study aims to determine the difference efficacy and therapeutically properties between tablet and liquid preparations of purple sweet potato tuber extracts to lipid profile, MDA, and SOD level in male Wistar rats after given high-cholesterol diet.

Materials and Methods

Animals Model

This study was an experimental laboratoric study, with randomized pre- and post-test control group design. Male wistar rats (170-200g), 3-4 months old, were obtained from Animal House Facility from Department of Pharmacology Udayana University, Denpasar, Bali, Indonesia, and used in this study. The samples were divided into 3 groups (7 rats per group). Group 1 was administered with high cholesterol diets as a control group.

The group of rats given high-cholesterol diet and tablet of sweet potato extract with the dose 200mg/day namely as the treatment 1 (T1) group. And the other treatment group, rats given high-cholesterol diet and also liquid form of extract of purple sweet potato tubers with a dose of 2 mL/day, was the treatment 2 (T2) group. The duration of treatment was 4 weeks. All rats were maintained under standard laboratory conditions at 25 ± 2°C (temperature), 50 ± 15% relative humidity and normal photoperiod (12-hours light-dark cycle). Commercial high cholesterol pellet diet and water were provided ad libitum for those animals. These animals usage was approved by Institutional Animal Care and Committee of the Faculty of Medicine, Udayana University, and Bali, Indonesia.

Liquid and Tablets Preparation of the Extract

Liquid form of purple sweet potato tubers extract was made in the following manner: sweet potato tubers, 3-4 months of age, obtained from Balinese farmers, were washed with clean water and then peeled. Once peeled, the sweet potatoes are cut into small pieces (approx. 2 cm x 2 cm x 2 cm) and steamed for an hour. About 1 kg of steamed purple sweet potato was blended in a blender with distilled water (1:2, w/v).

Three layers of gauze was used to obtained filtrate and heated to boiling point for 30 minutes under room temperature. The content of anthocyanin in this filtrate was assessed about 146 mg/mL. Tablet preparation was done using direct-quake method with 1:4 as for extract-excipient ratio. The resulting tablets were evaluated further includes organoleptic test, uniformity of weight, hardness, brittleness, disintegration time, and dissolution test. Tablets were administered orally in combination with their feed.

Blood Examination

Blood samples were taken via retro orbital plexus of all rats, collected in plain tubes, and allowed to clot at room temperature. The blood samples were used for the quantification of lipid profile, MDA, and SOD level (pre and post test). The blood samples were centrifuged at 1500 rpm for 10 min. The supernatants (sera) were collected and stored at 20°C until further analysis.

The plasma serum of blood samples at baseline and at the end of the study was used for the MDA, SOD, and lipid profile examination. The MDA examination was carried out by thiobarbituric acid reactive substances (TBARS) and total antioxidant status Randox kit for SOD. Both examinations were calculated in nmol/mL. Colorimetric kits from Azmun (Tehran, Iran) were used in assessing serum triglycerides, total cholesterol, and HDL-C in mg/dL.

Statistical Analysis

The data was entered and analyzed using Statistical Package for Social Sciences (SPSS) ver. 17.0. All data are expressed as means ± standard deviation (SD) for each group. Paired t-test was performed to observe pre- and post-test mean differences. One-way analysis of variance (ANOVA) was applied to observe group mean differences. A P-value of <0.05 was considered as statistically significant.

Results

Lipid Profile

The average results of lipid profiles such as total cholesterol, low-density lipoprotein (LDL), HDL, and triglycerides at baseline as well as after treatment for four weeks in different groups can be seen in Table 1. Lipid profiles in study did not differ among the 3 groups of rats (P > 0.05) at baseline. In the end of study, there was a significant increase in total cholesterol, LDL, triglyseride, and reducing level of HDL (P <0.05) in the control group (Table 1). Similar result also found in the T1 group where there was a significant increase of those parameters but lower than in control group (P < 0.05). Total cholesterol, triglycerides, and LDL levels in T2 group (group that given purple sweet potato tuber extract in liquid form) were found significantly increase but exhibit a lower levels compared with other post-test groups (P < 0.05).

HDL levels were also statistically significant increased compared with other post-test group (P < 0.05) (Table 1). The results suggested that oral liquid preparation of purple sweet potato extract have a better efficacy in reducing lipid profile than tablet form in male Wistar rats.

Table 1: Pre- and Post-test assessment of Lipid profiles (total cholesterol, LDL, HDL, and triglycerides) between liquid (T2) and tablet preparation (T1) of purple sweet potato extract

Groups	Total Cholesterol (mg/dL)			LDL (mg/dL)			HDL (mg/dL)			Triglycerides (mg)		
	Pre-test	Post-test	P	Pre-test	Post-test	P	Pre-test	Post-test	P	Pre-test	Post-test	P
Control	68.82±3,13	209.94±3.35	0.000*	26.05±1.46	70.33±1.54	0.000*	64.14±2.76	26.33±1.78	0.000*	68.82±3.13	162.82±2.52	0.000*
T1	69.79±2,17	124.21±4,56		25.77±1.22	45.94±1.40		63.86±3.32	44.30±3.42		69.79±2.17	122.73±5.72	
T2	67.92±2,78	84.48±3.38		24.46±2.25	23.05±2.32		66.67±1.26	63.39±1.56		67.92±2.78	96.03±3.82	
*) Statistically significant; LDL = low-density lipoprotein; HDL = high-density lipoprotein												

MDA and SOD concentration

MDA and SOD concentration measurements are depicted in Table 2. There was a significant decrease of SOD concentration in control group after being given high cholesterol fed (P < 0.05). After being given daily purple sweet potato extract administration for 4 weeks, the SOD concentration was found a significantly increase in T2 (73.72±4.14 nmol/mL; P = 0.000) and T1 (34.74±4.65 nmol/mL; P = 0.000) groups.

The MDA concentration, as a marker of oxidative stress, was also found a significantly increase in control group compared with other groups (P < 0.05). MDA concentration showed the lowest levels in T2 group (1.25±0.09 nmol/mL) after study period (Table 2). These results suggest that oral liquid form of purple sweet potato extract exhibit a better efficacy in reducing MDA and increasing SOD concentrations compared with tablet preparation in male Wistar rats.

Table 2: Pre- and Post-test measurement of MDA and SOD levels between liquid (T2) and tablet (T1) preparation of purple sweet potato extract

Groups	MDA (nmol/mL)			SOD (nmol/mL)		
	Pre-test	Post-test	P	Pre-test	Post-test	P
Control	1.48±0.28	5.99±0.31	0.000*	76.25±2.46	21.40±4.46	0.000*
T1	1.43±0.26	3.54±0.16		77.65±3.34	34.74±4.65	
T2	1.37±0.30	1.25±0.09		78.78±1.95	73.72±4.14	
*) Statistically significant; MDA = malondialdehyde; SOD = superoxide dismutase						

Multivariate Analysis

The result of lipid profile, MDA, and SOD levels was compared between groups after study period by using ANOVA test. In lipid profile analysis, there was a significant mean difference between groups for total cholesterol, LDL, HDL, and triglycerides (P = 0.000) (Figure 1). A significant mean difference was also found in MDA and SOD levels compared with other groups (P = 0.000) (Figure 2). These findings suggest that different form of purple sweet potato extract preparation exhibit a therapeutic efficacy between groups to those parameters mentioned.

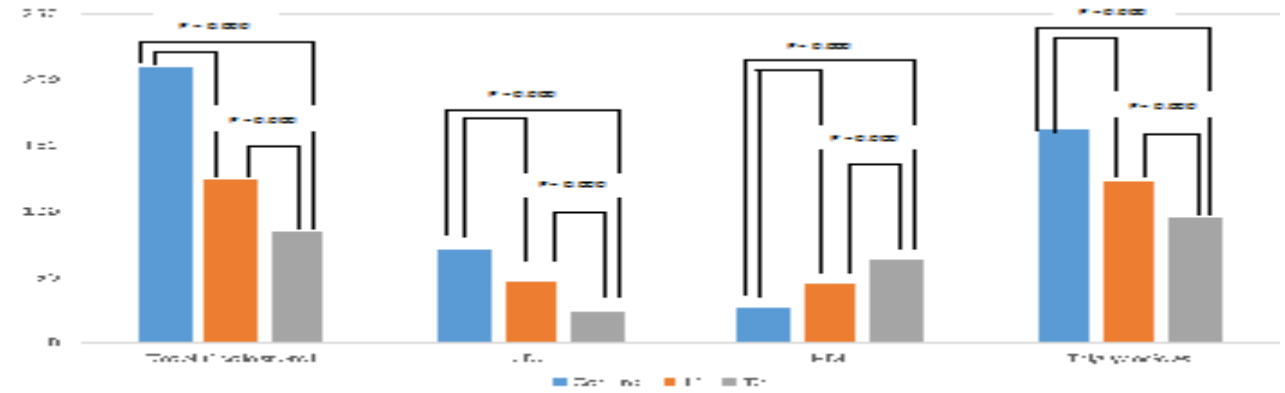

Figure 1: Mean difference comparison between groups of total cholesterol, LDL, HDL and triglycerides measurement in the ANOVA test after study period.

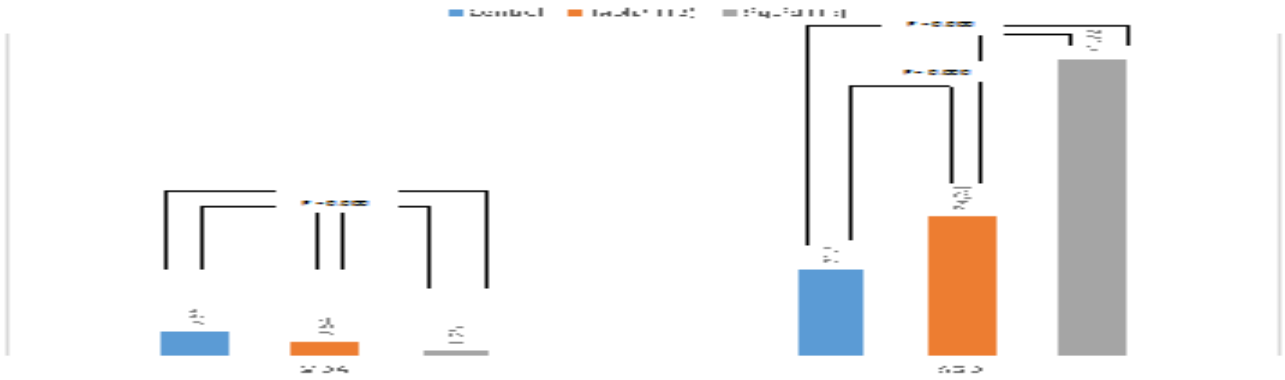

Figure 2: A significant mean difference of MOD and SDA levels measurement between groups in the ANOVA test after study period

Discussion

The lipid profile in male Wistar rats following high-cholesterol diet showed a significant increase in total cholesterol after treatment for 4 weeks. Other lipid profile parameters also significantly change such as increasing HDL, LDL, and triglyceride levels. However, the result of lipid profile examination in the group given purple sweet potato tuber extract tablet with 200 mg/day dosage for 1 month, also increasing the total cholesterol, LDL, and triglyceride, but much lower than control (p <0,05).

The decrease HDL in the group given purple sweet potato tuber extract tablet was smaller than it would be for the control. This proves the provision of tablets to prevent elevated blood cholesterol levels. Decrease in cholesterol levels after administration of purple sweet potato tuber extract because it contains flavonoids or anthocyanin which is polyphenol [9,10]. Polyphenols can prevent the rise in blood cholesterol in several ways, for example; through the barrier of cholesterol absorption in the gastrointestinal tract, through the decrease in lipoprotein production in the liver, through the regulation of LDL receptors that will lower plasma cholesterol levels and through decreased plasma triglyceride levels [11,12].

In addition, the anthocyanin substances in purple sweet potato extract also have effects in reducing MDA and increasing SOD levels as a prevention mechanism against oxidative stress [1, 3]. In this study, there is a significant difference in efficacy between liquid and tablets preparation dosage extract of purple sweet potato.

The effects of liquid preparation are having a better efficacy than tablets dosage form. This is thought to be caused by the liquid preparation easier and faster to be absorbed in the gastrointestinal tract, compared with tablets, so that the systemic effect is more rapid [13]. Tablet preparations take longer to disintegration in the gastrointestinal tract so that the effect is lower than liquid form [13] .The time it takes to disintegrated determines the blood levels of the drug.

Our study found that tablet preparation was tried to disintegrate after 15 minutes so that the result is lower than the liquid dosage extract. A similar result also found in a study conducted by Yousef F et al. where tablets and capsules form having difference disintegration time influenced by several factors [14]. Another cause of the lower effect of tablets preparation is also the influence of the tablet-making process.

The process of preparing tablets or herbal preparations must meet the standard requirements, including the collection of appropriate ingredients and dosage in each preparation [15]. The preparation of tablets in this study has been performed according to the standard even though the antioxidant property in tablet preparation is lower than liquid extract dosage. Based on these findings, it can be concluded that giving an extract of purple sweet potato tubers in tablet preparations had a significant effect in decreasing MDA, increasing SOD, and improve blood lipid profile of rats fed high-cholesterol diet. However, the effect of liquid preparation is better than tablets in rats fed with high cholesterol diet in improving lipid profile and preventing oxidative stress. It is necessary to conduct research on standardized tablet making methods and compare the extracts with various solvents to obtain better results.

Conclusion

The liquid preparation of purple sweet potato has a greater efficacy in reducing MDA levels, increasing SOD levels, and improving lipid profile as well as preventing oxidative stress in male Wistar rats, compared with tablet forms, after given high-cholesterol diet at the end of study period.

Ethics Approval

This study has been approved by the Ethical Commission of Faculty of Medicine Udayana University/Sanglah General Hospital

Conflict of Interest

The authors declare that there is no conflict of interest regarding this manuscript.

Financial Closure

The study is a self-funding with no other source of funding (e.g. grant, sponsorship, etc.).

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