Antihypercholesterol activity of *Costus speciosus* water extract

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**ABSTRACT**

**Introduction:** Hypercholesterolemia is one of the causes of cardiovascular disease. *Costus speciosus* (CS) is known empirically as an antihypercholesterol remedy. **Material and Method:** This study was conducted to determine the effect of water extract of CS on cholesterol blood serum level of rat induced-propylthiouracil (PTU). The antihypercholesterol activity performed on male Wistar rats which induced 0.01% PTU (mixed in drinking water, 14 day-induction) was followed by the administration of CS for 14 days. The animals were randomly divided into seven groups: Solvent control (carboxymethylcellulose 0.5% w/v in water), positive control (simvastatin at dose 7.2 mg/kg BW), negative control (water), CS extract 50, 100, and 200 mg/kg, and normal control. The cholesterol levels were measured at day 0th, 14th, and 28th. **Result and Conclusion:** Results showed that administration of CS extract 200 mg/kg can reduce the total serum cholesterol equal to simvastatin 7.2 mg/kg.

**INTRODUCTION**

Cardiovascular disease is a degenerative disease which is the leading killer worldwide. Most of the cardiovascular diseases such as coronary heart disease are closely related to atherosclerosis [1]. One of the factors that cause atherosclerosis is a condition of dyslipidemia, which is characterized by increased levels of total blood cholesterol (hypercholesterolemia, triglycerides [hypertriglyceridemic], low-density lipoprotein cholesterol, and decreased levels of high-density lipoprotein cholesterol). The development of atherosclerosis increases with an increase in the quantitative degree of dyslipidemia [2,3].

Many synthetic drugs have been used in hyperlipidemia therapy, such as statin groups and fibrates, but their usage still provides considerable side effect. It has become a challenge for researchers to look for another resource for overcoming this problem. Indonesia has many resources for medicine, especially from a plant. *Costus speciosus* (CS) was empirically used as an antihypercholesterol remedy.

CS grows as weeds in the yard or in the garden. CS has hypolipidemic, hepatoprotective, antifertility, antioxidant, and antifungal activities. Traditionally, the plant is also known to have a role in treating arthritis, rheumatic, bronchial asthma, and leprosy [4]. It has been reported that 50% ethanol extract of the rhizome CS can inhibit the production of spermatozoa irreversibly [5]. Sari et al. reported that CS water extract can reduce 16-38% of spermatozoa without changing its morphology and viability [6]. A chemical compound which is assumed to be closely related to antispermatogenetic effect, diosgenin, is present in several parts of the CS plant. Diosgenin is present in the CS rhizomes by 0.2% while the leaves by 0.37%, 0.65% at the trunk, and the highest is at the flower at about 1.21% [4]. Water extract of the leaves and rhizomes of CS contains steroids, tannins, and phenolics [7].

People used the decoction of CS in the traditional remedy. To our knowledge, there was no research about the effectivity of water extract from CS in the form of antihypercholesterol activity on male rats. The aim of this study was to observe the antihypercholesterol activity of CS water extract on propylthiouracil (PTU)-induced male rats.

Thyroid hormones play an important role in regulating the synthesis, metabolism, and lipid mobilization. Disruption of lipid profile occurs in hypothyroid condition. PTU is a drug used to treat hyperthyroidism. Prescribing 0.01% PTU...
in drinking water in animal model showed higher cholesterol serum level than normal control [8].

**MATERIALS AND METHODS**

The main material was aerial part of CS herb, obtained from Berbah, Kalasan, Sleman, Yogyakarta Region, Indonesia.

Chemicals: Aquadest and formaldehyde were obtained from local distributor, PTU tablets (PT. Kimia Farma), Simvastatin tablets (PT. Dextra Medica), carboxymethylcellulose (Bratachem), and the CHOD-PAP enzymatic reagent kit were obtained from Dyasis.

Animals: The animal test was performed on male Wistar rat stains obtained from the Laboratory of Pharmacology, Faculty of Pharmacy, UGM.

**Method**

The plant was identified and authenticated by an expert in botany, Djoko Santosa, MSc, Department of Biology Pharmacy, Faculty of Pharmacy, Universitas Gadjah Mada, Yogyakarta, Indonesia. This is evidenced by certificate No. BF/37/Ident/ Det/I/2016.

The collected aerial part of herb was shade dried and powdered in a mixer grinder to get the coarse powder. The water extract of CS was obtained by infusionation method [8] followed by freeze drying. The antihypercholesterol activity performed on male Wistar rats which induced 0.01% PTU (mixed in drinking water, 14 day-induction) [9] was followed by the administration of CS for 14 days.

The animals were randomly divided into seven groups: Solvent control (carboxymethylcellulose 0.5% w/v in water), positive control (simvastatin 7.2 mg/kg), negative control (water), CS 50, 100, and 200 mg/kg, and normal control. The cholesterol levels were measured at day 0th, 14th, and 28th. The blood serum was taken from sinus orbital eye followed by vortexing it for several seconds. The serum layer was separated by pipetting the supernatant after centrifuging it. The total cholesterol serum level was measured enzymatic-spectrophotometrically based on CHOD-PAP method [10].

The data obtained were analyzed using ANOVA (P < 0.05).

The liver of the animals was collected at the end of this treatment. The liver was fixed using formaldehyde and prepared for the histopathology scanning. The rat liver tissue histopathology made preparations with hematoxylin-eosin staining method (HT). Observations were made with an optical microscope Olympus BX-51. Changes were observed in fatty liver hepatocyte cells.

The experimental protocol was approved by UAD Animal Ethics Committee, Ethical Approval Number: 011505046.

**RESULT AND DISCUSSION**

The antihypercholesterol activity performed on male Wistar rat induced 0.01% PTU (mixed in drinking water, 14 day-induction). The 14-day induction increased the total cholesterol level (P < 0.5). The CS extract treatment 200 mg/kg can reduce the cholesterol level after inducing PTU, the results are shown in Table 1 and Figure 1.

Figure 1 shows that the cholesterol level of the animals increased after inducing PTU. The effectivity of simvastatin (as the positive control) and the extracts was determined by calculating the % decrease of cholesterol level 28th day against the 14th day. The CS extract 200 mg/kg can reduce the cholesterol level as well as simvastatin 7.2 mg/kg, while the CS extract 50 and 100 mg/kg have not been able to lower the cholesterol level yet.

It has been shown that the CS extract 200 mg/kg has similar capability as antihypercholesterol with simvastatin. It is assumed that the steroid contains in the water extract has contributed in the antihypercholesterol effect. Steroids were known as the raw material in the biosynthesis of cholesterol. Son et al. reported that 0.1% and 0.5% diosgenin added in the high cholesterol fed could decrease total cholesterol in plasma level to about 26.1% and 32.1%, respectively [11]. The ability of extracts in lowering cholesterol premises allegedly linked to the content of diosgenin which is a steroid saponin compound. Suspected steroid compounds within the extract can inhibit the synthesis of cholesterol in the body by inhibiting the action of the enzyme HMG-CoA reductase. The other possible antihypercholesterol activity was the role of diosgenin due inhibit gastrointestinal cholesterol absorption and increasing the serum lipase activity [12]. In addition, the content of flavonoids and polyphenols has

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**Table 1:** The serum cholesterol level before and after treatment

<table>
<thead>
<tr>
<th>Groups</th>
<th>Cholesterol level (mg/dL) day of:</th>
<th>0th</th>
<th>14th</th>
<th>28th</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negative control</td>
<td></td>
<td>60.62±7.40</td>
<td>120.24±8.98</td>
<td>149.72±7.07</td>
</tr>
<tr>
<td>CMC Na</td>
<td></td>
<td>75.21±11.52</td>
<td>107.06±11.96</td>
<td>108.50±11.36</td>
</tr>
<tr>
<td>Simvastatin 7.2 mg/kg</td>
<td></td>
<td>65.82±9.93</td>
<td>118.45±18.32</td>
<td>99.79±21.79*</td>
</tr>
<tr>
<td>CS 50 mg/kg</td>
<td></td>
<td>84.68±13.83</td>
<td>104.98±28.91</td>
<td>118.81±18.75</td>
</tr>
<tr>
<td>CS 100 mg/kg</td>
<td></td>
<td>75.87±11.11</td>
<td>106.94±18.78</td>
<td>106.34±12.72</td>
</tr>
<tr>
<td>CS 200 mg/kg</td>
<td></td>
<td>69.14±2.84</td>
<td>130.07±3.12</td>
<td>108.73±17.34*</td>
</tr>
<tr>
<td>Normal</td>
<td></td>
<td>101.19±9.08</td>
<td>106.01±12.31</td>
<td>119.51±10.38</td>
</tr>
</tbody>
</table>

Data were presented as mean±SD. *P<0.05) compared with the same group at 14th day. SD: Standard deviation
The water extract of CS 200 mg/kg has antihypercholesterol activity similar to that of simvastatin 7.2 mg/kg.

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