The role of red dragon fruit peel (*Hylocereus polyrhizus*) to improvement blood lipid levels of hyperlipidaemia male mice

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Abstract. The purpose of this research was to know the role of red dragon fruit peel powder to total cholesterol, triglyceride, high-density lipoprotein (HDL), low-density lipoprotein (LDL), and weight in the male hyperlipidaemic Balb-C mice (*Mus musculus*). This study used a completely randomized design (CRD) and four replicates for each dose treatments. Samples were 24 male mice that divided into six groups i.e. positive and negative controls, doses of 50; 100; 150 and 200 mg/kgBW/days red dragon fruit peel powder. Before being given treatment, mice were given feed containing high fat for 20 days until experiencing conditions hyperlipidaemia. The red dragon fruit peel powder was given at oral with used gavage for 30 days. Blood samples were taken from the tail on vena caudalis. Blood lipid samples were analysed at enzymatic with BIOLABO kits. The results of this study indicate that after administration of red dragon fruit peel powder total cholesterol levels, triglycerides and LDL-c decreased, along with increasing doses of red dragon fruit peel powder for 30 days. Furthermore showed that dragon fruit powder can increase HDL-c levels. The conclusion of this research was The red dragon fruit peel powder can improve blood lipid level of male Balb-c mice hyperlipidaemia.

1. Introduction

Hyperlipidemia is a condition excess of fatty substances called lipids, largely cholesterol and triglycerides in the blood, or both [1,2], and is a normal postprandial finding [3]. There are different types of hyperlipidemia depending on which lipid levels are high in the blood [4]. Hyperlipidemia has been implicated in atherosclerosis, which is the primary cause of coronary heart disease (CHD) and stroke [5], ischemic cerebrovascular disease, peripheral vascular disease and pancreatitis1-2 [3]. There are several factors which play a significant role in the incidence of hyperlipidemia which is the following: family history, chronic diseases (diabetes mellitus, renal failure, nephritic syndrome and hypothyroidism), alcoholism and smoking, obesity and unhealthy diets intake [6].

Efforts to cure hyperlipidemia with the use of drugs are not recommended because it has side effects, in addition to the price is quite expensive and not easy to find. One that can be selected is to consume natural medicines that can be obtained from medicinal plants. Medicinal plants are a source for a wide variety of natural antioxidants and are used for the treatment of diseases throughout the world [7]. Most of the medicinal plants have the benefit of being antimicrobial [8], anti-cancer [9], anti-diabetic [10], anti-atherosclerosis [11], immunomodulatory [12], and even reno-protection or...
hepato-protective effects [13,14]. Dragon fruit or well known, Pitaya into one of the plants that have the potential to maintain a healthy body. Dragon fruit has attracted considerable consumer interest because of its micronutrient content and the vibrant color of the fruit itself. Dragon fruit is the fruit of several cactus species that have been classified as white \((Hylocereus undatus)\), red \((H. polyrhizus)\), and yellow \((Selenicereus megalanthus)\) [15,16]. Red dragon fruit has high moisture content and is rich in fiber, phosphorus, vitamin C and calcium. The crude dietary fiber in red pitaya is 10.1g per 100g of edible portion, in addition to the high content of antioxidant vitamins such as vitamin A, C, and E which are 102.13 µg, 540.27 mg and 105.67 µg per 100 g dry weight, respectively [17]. Red dragon fruit is usually consumed by people directly or being processed into juice. Therefore, the major byproduct of dragon fruits is the peel. It is known that the peels also contain more or less antioxidant properties due to their color. Pitaya peel constitutes 22% of the whole pitaya fruit, which is presently discarded. It contained a considerable amount of pectin, betacyanin pigment, and total dietary fiber. The peel had a good ratio of IDF to SDF (3.8: 1.0). Hence, pitaya peel could be utilized as an effective source of fiber, pectin and natural colorant [18]. Thus, both the peels and the pulps could be beneficial especially in food and pharmaceutical industry [19].

Research related dragon fruit has been done. However, observations of blood lipid levels still need to be done as a comparison of previous research data. Therefore the purpose of this research was to know the role of red dragon fruit peel powder to cholesterol total, triglyceride, high-density lipoprotein cholesterol (HDL-\(c\)), and low-density lipoprotein cholesterol (LDL-\(c\)) of male mice hyperlipidemic which in the induction of high-fat diet.

2. Methods
This study used a completely randomized design (CRD) and four replicates for each dose treatments. Samples were 24 male mice that divided into six groups i.e. positive and negative controls, doses of 50; 100; 150 and 200 mg/30g BW/days the red dragon fruit peel powder. Before being given treatment, mice were given feed containing high fat [20] for 30 days until experiencing conditions hyperlipidemia.

The research was conducted in animal cage laboratory and biotechnology research laboratory of Biology Education Department of Universitas Pendidikan Indonesia (UPI). Animals used were mice \((Mus musculus)\) male Balb-C strain that has been aged three months with an average weight of 25-30 g of 24 male mice’s. Male mice were given a drink adlibitum, and with 12 hour light and 12 hours of dark lighting.

Preparation of peel powder of the red dragon fruit using oven drying method [21]. The peel powder of the red dragon fruit was given at oral with used gavage for 30 days. Blood sampling performed three i.e. after acclimation, after 30 days of high-fat feeding and after treatment. The location of blood sampling in the lateral vein section of the tail. Furthermore, the serum was tested using the BIOLABO kits i.e. Cholesterol Oxidase Para-aminophenazone (CHOD-PAP) and Glycerol Phosphate Oxidase Para-aminophenazone (GPO-PAP) with spectrophotometrically method. Measurements of LDL by Friedewald method expressed in units of mg/dL. Parameters that have been observed to be analyzed using a statistical test by using analysis of variance (ANOVA) followed by Duncan's Multiple Range Test tests.

3. Results and Discussion
In this study male rats had hyperlipidemia after feeding with high fat for one month. After given the peel of dragon fruit blood lipid levels of male mice changes. The mean of total cholesterol, triglyceride, HDL, and LDL levels after administration of the red dragon fruit peel powder were presented in Table 1.

The results of this study showed total cholesterol, triglyceride and HDL levels decreased along with increasing doses of red dragon fruit peel powder, but HDL levels increased. Based on the doses of red dragon fruit flour given then the dose of 200 mg/kgBW can lower total cholesterol,
triglycerides, LDL, and almost normal HDL levels as in negative control. This can be due to red
dragon fruit peel has bioactive components that can prevent the increase in blood lipid levels.

Red dragon fruit is reported to have a high content of crude fiber and minerals, especially rich in
phenol content and antioxidant properties that have a significant influence in altering lipid metabolism
of rats [22]. Red dragon fruit peel (Hylocereus polyrhizus) consists of about 22% of all fruit weight.
The total content of dietary fiber in the peel of red dragon fruit is very high which is about 69.3%,
consisting of insoluble food fiber (IDF) 56.50% and soluble food fiber (SDF) 14.82% [18].

Table 1. Average cholesterol total, triglyceride, HDL-c, and LDL-c levels Balb-c mice
hyperlipidemia after given the red dragon fruit peel powder.

| Parameters                          | Cholesterol Total | Triglyceride | High Density Lipoprotein Cholesterol (HDL-c) | Low Density Lipoprotein Cholesterol (HDL-c) |
|-------------------------------------|------------------|-------------|---------------------------------------------|---------------------------------------------|
| Doses (mg/kgBW)                    | K(-)             | K(+)        | 50                                          | 100                                         | 150                                         | 200                                         |
|                                     | 155.01 ± 15.09a  | 546.45 ± 79.19b | 224.13 ± 31.68a                             | 257.01 ± 30.61b                             | 214.39 ± 27.64a                             | 175.87 ± 12.54a                             |
|                                     | 152.20 ± 7.02a   | 152.20 ± 23.32b | 170.04 ± 15.75b                             | 146.23 ± 8.06b                              | 53.56 ± 4.20a                               | 52.83 ± 4.03a                               |
|                                     | 84.23 ± 3.59a    | 65.56 ± 1.20a   | 73.73 ± 2.34b                               | 70.28 ± 2.35bc                              | 80.44 ± 2.36c                               |
|                                     | 71.77 ± 15.46a   | 488.24 ± 77.5c  | 128.13 ± 31.49b                             | 147.87 ± 31.19b                             | 114.87 ± 21.16b                             | 84.86 ± 12.51a                              |

Annotation:
The same lowercase notation in the same line showed no significant difference at the 95% confidence
interval (Mann-Whitney test, p<0.05).

The mechanism of decreasing cholesterol levels by the fiber is by inhibiting the synthesis of
hepatic fatty acids through the formation of fatty acid fermentation products that can inhibit
cholesterol synthesis and decrease triglycerol secretion, so the formation of short chain fatty acids can
potentially reduce cholesterol capacity. Fatty acid fermentation products such as propionate may
inhibit HMG-CoA reductase which is a catalyst for the formation of mevalonic acid and of β-hydroxy
β-methyl glutaril-CoA. Mevalonic acid is a precursor of cholesterol formation. Inhibition of
mevalonic acid will inhibit cholesterol synthesis. Fiber can also cause changes in bowel motility, high
viscosity fibers cause macronutrient absorption, one of which fat, slows down and can increase insulin
sensitivity, increase satiety so overall can lower energy intake [23].

However, after an intensive 30 days treatment with red dragon fruit peel powder, a total cholesterol
level of treatment groups decreased, which might result from an increased intake of dietary fiber as
well as the high concentration of antioxidant vitamins in red dragon fruit. Dietary fiber, particularly
soluble type, is capable of trapping cholesterol and bile acids in the small intestine [24]. The gel
matrix formed by soluble fiber that is eventually excreted in the feces may entrap some of the bile
acids released from the gallbladder. This physical entrapment appears to be more pronounced in the
terminal ileum where bile acids are usually reabsorbed. Thus, the liver then has to use cholesterol from
the blood to synthesize new bile acids which may result in reducing blood cholesterol levels [25].
Apart from dietary fiber, high tocotrienol (vitamin E) content in red pitaya attributed to the decrement
of blood cholesterol levels. Tocotrienol regulates cholesterol production in mammalian cells by
inhibiting 3-hydroxy-3-methylglutaryl-coenzyme A (HMG-CoA) reductase activity, thus decreasing
liver cholesterol levels and plasma total cholesterol and LDL cholesterol concentrations [26].
4. Conclusion
The red dragon fruit peel powder has potential in reducing total cholesterol, triglyceride, and LDL-c and increasing HDL-c levels. Red dragon fruit peel powders can be consumed as a supplement in foods that are expected to maintain a healthy body and prevent hyperlipidemia.

5. References
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