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HYPOGLYCEMIC AND HYPOCHOLESTEROLEMIC EFFECTS OF LESSER YAM SYNBIOTIC YOGHURT (*DIOSCOREA ESCULENTA* L) ON METABOLIC SYNDROME WISTAR RATS

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ABSTRACT

This study aims to determine the effect of consumption of lesser yam synbiotic yoghurt on glucose levels and blood lipid profiles of metabolic syndrome rats. Synbiotic yoghurt has positive effect on health such as increasing body immunity, lowering blood glucose and cholesterol levels. In this study, lesser yam synbiotic yoghurt was made from cow's milk and lesser yam extract with (1:1) proportion, sugar, skim milk and starter of lactic acid bacteria and then followed by bioassay test using experimental rats. The results showed that lesser yam synbiotic yoghurt can reduce glucose levels and improve the blood lipid profile of rats. The best treatment is to give 4 ml of synbiotic yoghurt per day which can reduce glucose levels and total blood cholesterol of metabolic syndrome rats. It can be concluded that lesser yam synbiotic yoghurt which had high levels of dietary fiber and inulin, had hypoglycemic and hypocholesterolemic effect.

Keywords: hipoglycemic, hypocholesterolemic, lesser yam, synbiotic yoghurt

ABSTRAK

Penelitian ini bertujuan untuk mengetahui pengaruh konsumsi yoghurt sinbiotik gembili terhadap kadar glukosa dan profil lipid darah tikus sindrom metabolik. Yoghurt sinbiotik memiliki efek positif bagi kesehatan seperti meningkatkan kekebalan tubuh, menurunkan kadar glukosa darah dan kolesterol. Dalam penelitian ini, yoghurt sinbiotik gembili dibuat dari proporsi susu sapi: ekstrak gembili (1:1), gula, susu skim dan starter bakteri asam laktat kemudian dilanjutkan dengan uji bioassay menggunakan tikus percobaan. Hasil penelitian menunjukkan bahwa yoghurt sinbiotik gembili dapat menurunkan kadar glukosa dan memperbaiki profil lipid darah tikus. Perlakuan terbaik adalah pemberian yoghurt 4 ml per hari yang dapat menurunkan kadar glukosa dan kolesterol total darah tikus sindrom metabolik. Dapat disimpulkan bahwa yoghurt sinbiotik gembili yang kaya serat pangan dan inulin mempunyai efek hipoglikemik dan hipokolesterolemik karena tingginya kadar serat pangan dan yoghurt.

Kata kunci: hipoglikemik, hipokolesterolemia, gembili, yoghurt sinbiotik

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INTRODUCTION

Synbiotics are combination of probiotics and prebiotics. Both are interrelated where prebiotics selectively provide nutriti to probiotic bacteria, so that it will stimulate the growth of probiotic bacteria the intestinal epithelium/mucosa (Hamed et al., 2012). Consuming probiotics, prebiotics and synbiotics affects the composition of the microflora, which is to restore the balance of microbes, so that this intake has the potential for human health (Morelli et al., 2003).

In the market recently, there are many synbiotic which contains prebiotics and probiotics. The advantage of the combination of prebiotics with probiotics is to increase the viability of the probiotics themselves because specific substrates are available for fermentation. In addition, consumers will get double benefits from both. The application of the synbiotic concept is often found in fermented beverage products. Fermented drinks often use Lactic Acid Bacteria (LAB) in the fermentation process. The fermentation process provides added value in terms of nutritional value and taste in the resulting product (Andriyani, 2005)

In this research, synbiotic yoghurt was made from lesser yam tract (*Dioscorea esculenta* L) and cow's milk. Lesser yam is minor tuber that has not been explored and utilized optimally because its presence is still rare compared to other types of tubers. Dioscorea tubers contain thick mucus consisting of glycoproteins and water-soluble polysaccharides. Glycoproteins and polysaccharides are bioactive ingredients that function as water-soluble dietary fiber and are hydrocolloid which are useful for lowering blood glucose levels and total cholesterol (LDL) levels (Trustinah et al., 2013). Lesser yam has the prospect to be developed as synbiotic yogurt because it contains a lot of inulin and dietary fiber or is often called prebiotic component (Surya, 2015). The resu of the previous study showed that lesser yam synbiotic yoghurt, produced from propor n of milk: lesser yam extract (1:1), which had a total lactic acid bacteria of 7.23 logCFU/ml, dietary fiber (3.05%) and inulin content (1.2%) (Rosida et al. , 2021).

Synbiotic yoghurt has physiological effects that are beneficial for digestive health and can decrease blood cholesterol and LDL content (Surya, 2015) and blood triglyceride content (Febriansyah, 2015). Za et al. (2017) stated that there is a decreasing in blood triglyceride, cholesterol total, LDL and an increasing in blood HDL on syndrome metabolic rats which are given synbiotic yoghurt after 2 weeks treatment. This study aims to determine the effect of the consumption of lesser yam synbiotic yoghurt on glucose levels and blood lipid profiles of metabolic syndrome rats

MATERIALS AND METHOD

The materials used in this study were lesser yam, cow's milk, sugar, skim milk obtained from Soponyono Market, Surabaya. Yoghurt starter (*Lactobacillus bulgaricus, Streptococcus thermophilus, and Bifidobacterium bifidum*) is obtained from the Biology Laboratory, Faculty of Science and Technology, Airlangga University, Surabaya and chemical reagents for analysis

Lesser Yam Yoghurt Production

Fresh cow's milk was pa urized at 70°C for 15 minutes and added with 5% (w/v) skim milk and 8% (w/v) sucrose. The aim of skim milk and sugar addition is as food source for the bacteria starter. Cow's milk which is being heated and mixed with lesser y tuber extract in ratio of 50:50 and then cooled. The mixture was inoculated with 5% (v/v) starter (*Lactobacillus bulgaricus, Streptococcus rmophilus, and Bifidobacterium bifidum*) and incubated at 37°C for 18 hours (Rosida et al., 2021).

Bioassay

As many as 30 white Wistar rats (aged 2 months, average weight 200 g) were acclimatized for 7 days, put in closed individual cages with the following cage conditions: light is not controlled, air ventilation in the cage is adequate, and cage temperature use room temperature. Experimental r were injected with Streptozotocin-nicotinamide (intraperitoneally) at a dose of 50 mg/kg body weight to make the rats suffering diabetes. The experimental rats were also given high-cholesterol

diet (from cow's brain) for 7 days to make the rats become hypercholesterolemia. Then the rats were fasted for 12 hours and blood taken through the eyes (retroorbital plexus) to measure blood glucose and cholesterol levels and ensure that the rats were positive for diabetes and hypercholesterolemia (Metabolic Syndrome condition).

Then the rats were divided into 5 (five) feed groups, each of which consisted of 6 (six) rats, namely the control group and the treatment group which were given with lesser yam synbiotic yoghurt as much as 1, 2, 3, 4 , ml per day. All rats received standard diet and the manufacture referred to the AIN-93 standard diet formula (Reeves et al., 1993). The rat blood serum was analyzed for glucose levels, total cholesterol, HDL, LDL, and blood serum triglycerides on week 0, week 1, and week 2. This study used Nested Randomized Design. The data obtained were analyzed by analysis of variance and further test DMRT (Duncan Multiple Range Test) at the level of 5%.

RESULTS AND DISCUSSION

In this study, rats were conditioned to have metabolic syndrome. The condition of metabolic syndrome is characterized by the criteria of rats suffering hyperglycemia, hypertriglyceridemia and having low blood HDL. The results of the Bioassay test on the serum glucose levels of experimental rats can be seen in Table 1.

Blood glucose level

Table 1. Changes of Blood Glucose Level of Rats During 2 Week Treatment

Treatment	Blood glucose level (mg/dL)			Blood glucose level
	week 0	week 1	week 2	change (mg/dL)*
control(-)	268.2	269.4	270.4	-0.8
yoghurt 1 ml	271.3	171.3	130.5	51.9
yoghurt 2 ml	270.4	182.6	111.4	58.8
yoghurt 3 ml	270.5	141.3	102.4	62.2
yoghurt 4 ml	270.3	145.8	94.4	65.1

*deduction from week 2 to week 1

Based on Table 1, in week 0 shows that streptozotocin-nicotinamide injection is very effective in increasing the blood glucose levels of rats to the diabetic level (> 200 mg/dL). Kusumawati (2004) states that hyperglycemic rats are characterized by increased blood glucose levels that exceed normal (normal glucose levels <200 mg/dL) after 2 hours of eating.

The results showed the potential of lesser yam yoghurt in reducing serum glucose levels in hyperglycemic (diabetic) rats. Giving lesser yam yoghurt can reduce blood glucose level for 2 weeks as much as 51.9-65.1% in the treatment of giving 1-4 ml of lesser yam yoghurt/day. A sharp decrease in blood glucose levels in rats treated with lesser yam yoghurt was associated with relatively high levels of dietary fiber and inulin. According to Marsono (2000), dietary fiber affects the viscosity and absorption of blood glucose, thus affecting the potential for lowering blood glucose. Dietary fiber can reduce postprandial glucose levels because of its viscous nature and its ability to form a gel that can inhibit macronutrient absorption (Weickert and Pfeifer, 2008).

Furthermore, Weickert and Pfeiffer (2008) explained that it is not only the ability of polysaccharides to be fermented that plays a role in lowering blood glucose levels. Dietary fiber consumption contributes to a number of metabolic effects, including insulin sensitivity, modulation of hormone secretion in digestion and various metabolic processes associated with the metabolic syndrome.

Blood cholesterol total

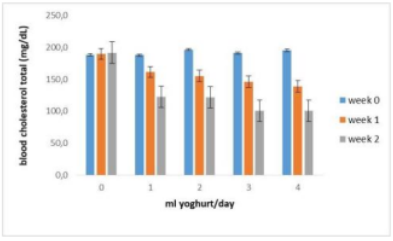

Figure 1. Changes of Serum Cholesterol Total of Rats Given Lesser Yam Yoghurt (1, 2, 3, 4 ml/day) for 2 Weeks

In Figure 1, at week 0, total blood cholesterol of all rats was relatively high (187.7-196.4 mg/dL) so that all rats had hypercholesterolemia. After the feeding intervention for 2 weeks, the serum total cholesterol level of the rats given the lesser yam yoghurt is decreased by 34.7-48.4%. However, the cholesterol level of the control group was constant (188.2 – 191.2 mg/dL).

The greatest decrease in total cholesterol levels occurred in the group of rats given 4 ml of yoghurt/day, which was 48.4%. It might be becaused lesser yam yoghurt is rich in fiber and inulin. The consumption of inulin can inhibit the absorption of cholesterol in the small intestine and ultimately lower cholesterol levels in human blood plasma (Anandharaj et al., 2014).

The hypocholesterolemic effect of probiotics is also associated with its ability to bind cholesterol in the small intestine. Sangeeta and Khaterpaul (2003), stated that probiotic bacteria found in fermented products can lower cholesterol in humans. The possible mechanism, according to Chiang et al. (2008), is the process of deconjugation of bile salts in the small intestine by probiotic bacteria. Cholesterol can also be converted in the intestine into coprostanol, which is directly excreted in the feces. This will lower the amount of cholesterol absorbed and lead to a decrease in physiological cholesterol concentrations. Cholesterol dehydrogenase/isomerase produced by bacteria such as: *sterolibacterium denitrificans* is responsible for catalyzing the transformation of cholesterol to cholest-4-en-3-one, an intermediate cofactor in the conversion of cholesterol to coprostanol. This serves as the basis for further research using probiotic bacterial strains.

Blood triglyceride level

In Figure 2, at week 0, the blood triglyceride levels of all rats had exceeded the normal value (>112 mg/dL) so that all rats had experienced hypertriglyceridemia (metabolic syndrome condition). The control group did not show a decrease in serum triglyceride levels (127.7-130.4 mg/dL), but all groups treated with yoghurt showed a significant decrease in serum triglyceride levels. The greatest decrease in triglyceride levels occurred in the group given 4 ml yoghurt/day, which was 35.8%. The decrease in blood triglyceride levels was in line with the decrease in blood cholesterol of experimental rats (Figure 2). It is in accordance with Kaur et al. research (2002) which showed that inulin could inhibit lipogenic enzyme which sinthesized fatty acid in the liver so it could reduce triglyceride content.

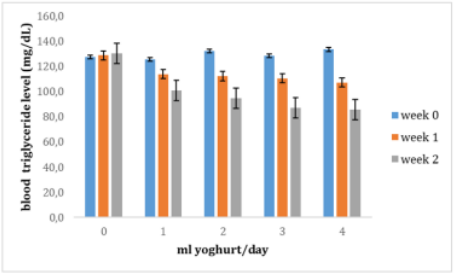

Figure 2. Changes of Serum Triglyceride Level of Rats Given Lesser Yam Yoghurt (1, 2, 3, 4 ml/day) for 2 Weeks

Blood LDL level

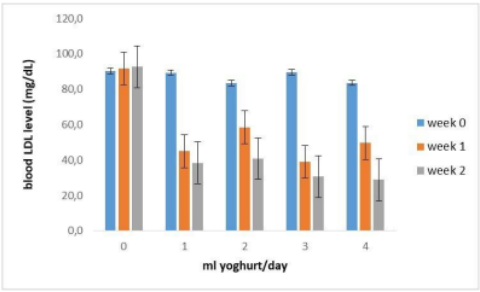

Figure 3. Changes of Serum LDL Level of Rats Given Lesser Yam Yoghurt (1, 2, 3, 4 ml/day) for 2 Weeks

After the hypercholesterolemic dietary intervention, all rats had high serum LDL (Figure 3). However, after 2-week intervention, the LDL levels of the rat group fed with the lesser yam yoghurt were lower than the control group. The greatest decrease in LDL cholesterol levels occurred in the group of rats fed with 4 ml yoghurt per day, which was 65.5%. This shows that lesser

yam yoghurt has the potential to lower blood LDL due to its fiber and inulin content.

According to Anderson et al (2009) high-fiber diet can increase the activity of LDL receptors in the liver. This activity is used to meet the availability of tissue cholesterol, so that more blood cholesterol is used, thereby lowering blood cholesterol levels (Anderson et al, 2009). Previous studies have shown that giving winged milk yoghurt to test animals can reduce the LDL lipoprotein profile of test animals. The mechanism of synbiotic yoghurt in reducing LDL content was that inulin was fermented by probiotic bacteria produced short chain fatty acid such as propionic acid. This acid reduced cholesterol synthesis in the liver by inhibiting the activity of HMGCoA reductase enzyme. The decrease in cholesterol production will hinder VLDL secretion and as a result it lowered LDL content (Akoma et al., 2000). Several studies have shown that synbiotics consisting of probiotics and prebiotics have an effect in improving lipid profiles (Ooi et al, 2010).

Blood HDL level

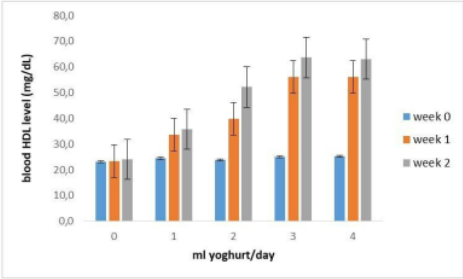

Figure 4. Changes of Serum HDL Level of Rats Given Lesser Yam Yoghurt (1, 2, 3, 4 ml/day) for 2 Weeks

Figure 4 shows that in the treatment group, there was a significant increase in HDL cholesterol levels ($p<0.05$) compared to the control group. The greatest increase in HDL cholesterol levels occurred in the group with 4 ml/day yoghurt treatment with an increase of 150.3%. The mechanism of this phenomena is Inulin in the lesser yam yoghurt could increase apolipoprotein A-1 as an enzyme cofactor and a ligand for interaction with lipoprotein receptor of HDL. So that in can increase HDL content (Mayes, 2003). According to Kai (2015) total cholesterol and triglyceride levels were reduced and HDL cholesterol levels increased in experimental rats consuming resistant starch and dietary fiber.

CONCLUSION

This research studied the effect of lesser yam synbiotic yoghurt intake on metabolic syndrome rats. The results of this study showed that after two weeks of giving lesser yam synbiotic yoghurt, metabolic syndrome rats had lower glucose, total cholesterol, triglycerides, and LDL levels, but higher HDL levels than the control group, especially those given 4 ml of lesser yam yoghurt per day. It can be concluded that lesser yam synbiotic yoghurt possibly has hypoglycemic and hypocholesterolemic effect due to its inulin and dietary fiber content.

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