

THE EFFECT OF HIGH FAT DIET (HFD) OF HDL CHOLESTEROL LEVEL AND BODY WEIGHT ON MALE WHITE WISTAR RATS

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Abstract. High fat consumption causes various disease problems. One of the effects is changes in lipid profile and body weight. The purpose of this study was to determine the effect of High Fat Diet (HFD) on Body Weight and HDL cholesterol level in Male White Wistar Rats. Twelve male white rats strain wistar divided into 2 groups and replicated 6 rats. The control group was given standard diet and HFD groups was given HFD 18,69% of fat contain with source of fat were margarine, beef brain and coconut cream powder. Diet was carried out for 9 weeks. The parameters observed were body weight and HDL cholesterol level on rats. Statistical analyzed using independent T test. The results showed that HFD group have increased body weight significantly compared control groups ($p < 0.05$). In addition, HDL cholesterol levels in HFD group have not significantly difference with control group ($p > 0.05$) but have tended to decrease compared control groups. The conclusion on this study that HFD were able to increasing body weight and potential for decreasing HDL cholesterol level of experimental rat.

1. Pendahuluan

Obesity is one of metabolic syndrome. Metabolic syndrome is a collection of symptoms including increased triglycerides, decreased of high density lipoprotein (HDL), total cholesterol, blood pressure and glucose intolerance [1]. Based on Riskesdas data in 2018, 28.1% of the population aged > 18 years in Indonesia are obese [2].

Obesity is due to imbalance between energy intake and energy expended. Fat is the highest source of energy compared to protein and carbohydrates. Excessive food intake with high energy density can increase the risk of weight gain. Foods with high energy density are high in fat and/or high in sugar [3]. Consumption of excess fat can cause weight gain because fat in food is metabolized to free fatty acids, triglycerides and subsequently lipid synthesis [4]. High Fat Diet (HFD) can worsen the risk of obesity epidemic and metabolic disorders related to obesity. A long-term diet of HFD can increase the risk of obesity (over nutrition and obesity) and increase body weight [5]. HFD can also increase the risk of systemic inflammation that can lead to diabetes mellitus, heart disease, kidney disease and cancer [6].

High Density Lipoprotein (HDL) is a lipoprotein that has an anti-atherosclerotic effect by reversing cholesterol transport from peripheral tissue to the liver. Low levels of HDL in the blood can increase the risk of heart disease. Giving HFD can increase free fatty acids that contribute to atherosclerosis. HFD can increase the risk of heart disease through infiltration of adipose tissue and blood vessels by effector T cells, endothelial dysfunction and red blood cells [6]. In in vivo studies using experimental animals of the same weight and age at the start of the study and given a different diet can have an effect on weight gain and different HDL levels. Based on the background above, this study aims to determine the effect of HFD on body weight and HDL levels in wistar rats.

2. Methods

This research used true experimental post-test control study. Sample of this study were white rats (*Rattus norvegicus*) Wistar strain, body weight of 150-200gr, and age of 2 months old. Twelve rats experimental divided into two groups The distribution of experimental groups were the control groups (n = 6) and HFD groups (n = 6). The intervention group was a group of rats experimental with given High Fat Diet (HFD).

The composition of the High Fat Diet (HFD) used in this study included the standard feed (Rat Bio) 55%, margarine 25%, beef brain 5% and coconut cream powder 15%. HFD was administered for 9 weeks. Furthermore, HFD was analyzed proximately to determine water, ash, fat, protein, and carbohydrate content. HFD proximate analysis was conducted at the Food Analysis Laboratory, State Polytechnic of Jember.

Experimental rats were weighed every 7 days for 9 weeks. Body weight was weighed using a digital scale. In addition, experimental rats measured HDL levels using spectrophotometry with a wavelength of 546 nm. HDL measurements were made after HFD intervention.

2 Result and Discussion

High Fat Diet (HFD) in this study is a modification of the formula of rat feed with higher fat content than standard feed. In this study standard feeding (Rat Bio) given had a fat content of 4% [7]. In the modified diet, HFD has a fat content that is equal to 18.69% (Table 1).

The HFD formula is made from foods containing saturated fatty acids which bad substrate for the enzyme Acyl CoA cholesterol acyl transferase (ACAT), the presence of saturated fatty acids in cells causes an increase in intracellular free cholesterol thereby increasing Low Density Lipoprotein (LDL), and reduce HDL levels in the blood [8,9]. Apart from saturated fatty acids, beef brain has a cholesterol level of 2 g / 100 g which can significantly influence the lipid profile [10].

Table 1. Nutritional Substances on High Fat Diet (HFD)

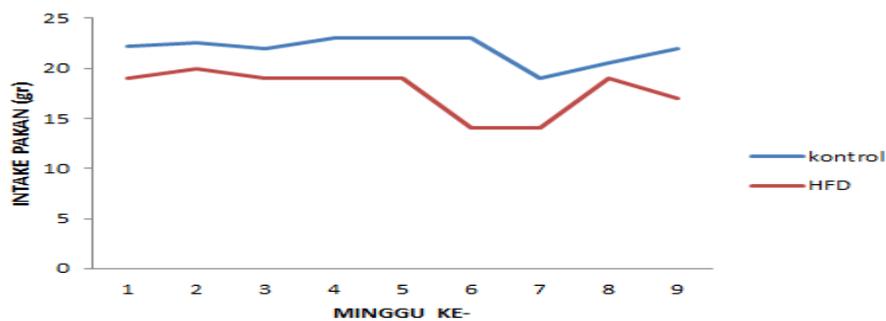
Parameter	HFD
Water (%)	7.35
Ash (%)	1.91
Fat (%)	18.69
Protein (%)	10.80
Carbohydrate (%)	61.24

During the study, feed intake of experimental rats was seen from the difference in the amount of feed given with the remaining feed per beams / day. Experimental mice in the control and HFD groups had different feed intakes per week. Feed intake of the control group and the HFD group had a significant difference $p < 0.05$ ie. In the control group had a higher average intake of feed than the HFD group (Table 2). Fat is the highest source of energy compared to protein and carbohydrates. Fat yielded 9 kcal each gram, much higher than fiber which is only 1-1.5 kcal / g [11]. Excessive consumption of fat increased the food energy density. Even though food consumption wss small, having high energy density (high in fat) can contribute to increase total energy intake [12]. Low quality diets associated with high consumption of high energy (high fat) foods, which can lead to BMI increase [13].

Table 2. Feed Intake on control and HFD group

Parameter	Groups	Mean	p-value
Feed Intake	Control	22.00 ± 1.323	0.000*
	HFD	17.78 ± 2.279	

*significantly different ($p > 0.05$)



Gambar 1. Rata-rata intake pakan pada kelompok kontrol dan HDL

There were different results of weighing rats which showed that there was an increase in body weight in mice with HFD feed even though on Figure 1 the feed intake was lower than the controls. Weighing the rats was carried out once every 7 days so that we could know the gradual weight gain. the increase is known by calculating in the final and beginning weight gain in the study. Control mice and HFD fed rats had significantly different weighted means ($p < 0.05$). The HFD group had a higher average body weight than the control group (Table 2)

Giving HFD in mice can increase body weight through modulation of intestinal microbiota resulting in increased permeability and intestinal absorption ability [14]. Increased free fatty acids that accumulate long-chain acyl-CoA and its metabolites include diacylglycerol (DAG), triacylglycerol (TAG), and intracellular ceramids. ceramide accumulation triggers dephosphorylation of protein kinase B / Akt. PKB / Akt dephosphorylation triggers glucose transport to tissues through increased glucose transporter-4 (GLUT-4) activity resulting in an increase in glycogenesis. That dephosphorylation also inhibits liposis and gluconeogenesis in tissues. Increased uptake of glucose to tissues and glycogenesis as well as downregulation of lipolysis and glyconeogenesis causes an increase in body mass [15].

Table 2. Body Weight and HDL Levels on Each Groups

Parameter	Groups	Mean	p-value
Delta BW	Control	78.42 ± 26.43	0.03
	HFD	125.95 ± 36.23	
HDL	Control	30.27 ± 7.06	0.12
	HFD	26.32 ± 3.73	

The HDL levels of the control group and HFD group showed average HDL levels that were not significantly different ($p > 0.05$). However, HDL levels in HFD group were lower than control group (Table 2). HFD can affect lipid metabolism so that it has an impact on changes in lipid composition, one of which is the decrease in HDL levels. HFD is often used as material to make obese animal models [16]. HFD has an impact on changes in fat components in the body [17].

3 Conclusion

The conclusion on this study that HFD were able to increasing body weight and potential for decreasing HDL cholesterol level of experimental rat.

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