The Effect of Giving Tempeh Flour (*Rhizopus oligosporus*) on The Body Weight of Mice (*Mus muscullus*) on A Diet High in Saturated Fat

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ABSTRACT

Obesity is caused by an imbalance between energy intake and expenditure, leading to the accumulation of excess fat. Obesity is increasing globally, and pharmacotherapy to treat it often has side effects and is difficult to access. Alternatively, traditional medicinal plants such as tempeh (Rhizopus oligosporus) are known to have efficacy in reducing obesity. The objective is to investigate the effect of tempeh flour on weight loss in mice fed a high saturated fat. Methods experimental study with pretest post-test controlled group design using male mice divided into 4 groups: regular, quail egg control, quail egg + drug control, and quail egg + tempeh flour control (2,4 grams/day/bb). Results: The group given tempeh flour showed better weight loss than the other groups. The group given orlistat also experienced weight loss. Conclusion Tempeh flour 2,4 grams/day/bb effectively reduces mice's body weight with a high saturated fat diet.

Keywords: Tempeh Flour, Orlistat, Quail Egg Yolk, Weight, Obesity.

INTRODUCTION

Obesity is a complex state where the risk factor can be prevented. WHO data shows that physiologically, obesity is interpreted as a condition of excess fat accumulating abnormally in adipose tissue to certain levels so that it disrupts health. According to WHO data, there are around 650 million adult residents in the world who are obese, and 340 million children and adolescents aged 5 to 19 years experience excess weight. RISKESDAS shows that the prevalence of obesity in Indonesia continues to increase from 14,8% to 21,8% in 2018. The impacts caused by obesity, among others, are a disruption of cardiovascular systems, respiratory system disorders, and endocrine system disorders. Tempe is a soybean product

traditionally fermented in Indonesia and consumed as a significant source of protein; in addition to a high protein, Tempe is also high in fiber, saturated fat, and low in sodium. Tempe is a functional natural source of antioxidants and bioactive peptides. In addition, consuming tempeh is associated with the prevention of degenerative diseases such as hypertension, atherosclerosis, cardiovascular disease, diabetes, and cancer. Zhang et al. mention that isoflavones can lead to weight loss through an increased digestive hormone rate of kolesistokinin (KSK). In the form of complex structures between isoflavones and proteins in soybeans, it is unclear which components can be more beneficial in weight loss.

LITERATURE REVIEW

According to previous research conducted by the Obesity Association, obesity is a condition in which a person's weight exceeds the average body weight, resulting from the accumulation of carbohydrates, fats, and energy consumption, where energy intake is greater than the need for energy use. Overweight and obesity do not only occur in adults but also children. UNICEF/WHO/World Bank revealed that in 2020, overweight (including obesity) was a common problem in the WHO Europa Region, affecting 4.4 million children under 5 years of age (representing 7.9% of children in this age group, with considerable variation between countries. Tempeh is a traditionally fermented soybean product from Indonesia that is widely consumed as a cheap source of protein. In addition to being high in protein, tempeh is high in fiber, saturated fat, and sodium. Tempeh is a source of functional properties such as antioxidants and bioactive peptides and is linked to preventing degenerative diseases such as hypertension, atherosclerosis, cardiovascular disease, diabetes, and cancer. Tempeh also contains antioxidants in the form of isoflavones, which help inhibit the reaction of free radical formation, which can inhibit the aging process, prevent various diseases of the gastrointestinal system, prevent anemia from lowering LDL levels, lose weight, improve brain work, prevent asthma, inhibit the aging process, reduce the risk of Parkinson's, overcome the effects of flatulence or flatulence, and meet the requirements of vitamin B12. Isoflavones are polyphenolic compounds that belong to the flavonoid group. The mechanism of action of isoflavones by decreasing the absorption of cholesterol and bile acids in the small intestine induces an increase in the extraction of bile acids and steroids, isoflavones will respond to the liver to convert cholesterol into bile so that it can lower cholesterol and increase the activity of the body's LDL cholesterol receptors. In the end, the body's cholesterol levels will decrease, and the potential of isoflavones to reduce cholesterol, especially total cholesterol

and LDL cholesterol, has been demonstrated by several studies using experimental animals. The chemical drug used to treat obesity that the Food and Drug Administration has approved is Orlistat and is sold over the counter. Studies show that Orlistat can reduce 2.9% of total body weight after reducing the placebo for at least 12 months.

METHODS

The study used an experimental methodology that included a pre-test and post-test control group design within the preclinical range with an in vivo study. This study was conducted and supervised under the Universitas Prima Indonesia ethical committee, number 040/KEPK/UNPRI/X/2024; the study included a sample of 28 mice fed a standard diet for 7 days. Then, groups of mice were given different treatments for 10 days. Standard food, standard food + quail egg yolk, standard food + quail egg yolk + tempeh flour, standard food + quail egg yolk + orlistat. The data were processed using SPSS 23 for Windows, and the weights of the mice before and after treatment were compared by paired t-test; the effect of tempeh flour was measured by One-way ANOVA, and post hoc LSD compared the effect of tempeh flour.

RESULTS

Reporting Research Results

Table 1. The Average Body Weight Of Mice Before And After Treatment Of Each Group

Group	Average Pretest	Average Post test
K0(Standard)	23,50±3,988	25,2±3,752
K1(standard food+quail egg yolk)	26,58±2,311	25,58±3,611
K3(standard food+quail egg yolk+orlistat)	28,83±3,327	28,17±4,698
K4(standard food+quail egg yolk+tempeh flour)	28,00±1,58	19,30±1,581

The results of the study in Table 1 above found that the average weight of mice (Mus musculus) pre-test and post-test at K1 (given standard feed + quail egg yolk sonde) was 26.58±2.311 and 25.58±3.611; K2 (given standard feed + quail egg yolk sonde + orlistat drug sonde) is 28.83±3.327 and 28.17±4.698; K3 (given standard feed + quail egg yolk sonde + tempeh flour sonde) is 28.00±1.58 and 19.30±1.581; Meanwhile, the control group (only given standard feed) was 23.50±3.988 and 25.2±3.752.

Table 2. The Diffrences Of Mice Weight Before And After Treatment Of Each Group

Group	*Mean difference*	P
K0 (standard food)	-0,80	0,481
K1 (standard food+quail egg yolk)	1,00	0,264
K2 (standard food+quail egg yolk+orlistat)	0,67	0,371
K3 (standard food+quail egg yolk+tempeh flour)	8,70	0,000*

The results of the study in Table 2 above stated that there was a significant difference in the weight of mice (Mus musculus) pre-test and post-test given standard feed + quail egg yolk sonde + tempe flour sonde with a value of p = 0,000 ($p \leq 0.05$), whereas Other groups show results that have no significant differences. The weight of the mice decreased by 8.70g after being given a standard feed + quail egg yolk sonde + tempeh flour. Loss of mice weight after consuming tempe flour can be caused by an increase in the levels of kolesistokinin hormone (KSK) contained in the content of isoflavones, which also reduce the absorption of cholesterol and bile acid in the small intestine so that it is effectively losing weight.

DISCUSSION

From the research conducted, it was found that the administration of tempeh flour to mice that underwent a diet high in saturated fat experienced significant weight loss, just like mice given orlistat also experienced weight loss. As previous researchers have shown, the consumption of isoflavones from tempeh effectively lowers total cholesterol and LDL. The genistein

isoflavones in tempeh regulate body fat and can potentially lose weight through an increase in digestive hormones such as cholecystokinin.

CONCLUSION

Based on the study's results, it was concluded that there was a difference in the weight of mice (Mus musculus) after being given tempeh flour with a diet high in saturated fat and after being given orlistat. Overall, the administration of tempeh flour showed a significant effect on weight loss in mice on a diet high in saturated fat.

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