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The antihyperlipidemic properties of whey from goat's milk

Yelliantty
Department of Food Technology, Faculty of Engineering, Pasundan University Bandung, Indonesia

Abstract
Whey is a by-product of cheese making. Generally whey is widely used derived from cow's milk. Although usually dumped into waste, but whey still has a beneficial nutritional content. Whey can also be obtained from goat's milk. Allegedly, whey goat milk also has health potential. In this study will be used whey protein from goat milk to suppress adipogenesis and triglyceride formation. The purpose of this study was to describe the effect of whey protein on cholesterol and triglyceride levels *ex vivo* and *in vivo*. The experimental method used was experimental test of whey potential by using 3T3-L1 cells and *in vivo* test using mice. The results show that whey treatment may decrease the production of cholesterol and triglycerides in the cell line. Similar results were also demonstrated in *in vivo* tests, in which whey administration reduced cholesterol and triglyceride production in mice, but still a smaller decrease compared with goat milk treatment. From this study it can be concluded that whey goat milk has the potential to suppress the production of cholesterol and triglycerides *ex vivo* and *in vivo*.

Keywords: adipogenesis, cholesterol, obesity, goat's milk, triglyceride, whey

Introduction

Cases of obesity are increasing rapidly in both developed and developing countries. According to the World Health Organization (WHO) in 2008, more than 1.4 billion adults over 20 years old are overweight. Of overweight adults, more than 200 million men and nearly 300 million women are obese. Overall, more than one in ten of the world's adult population is obese [1].

The etiology of obesity is complex and not yet fully understood. Factors that play a role are genetic, environmental, and psychological factors. However, simply obesity is a disturbance of the energy balance. Epidemiological studies show that there is a close relationship between health status, life expectancy and consumption patterns. People in areas that consume lots of fat, sugar, and salt like the Minangkabau region, are more prevalent with degenerative diseases than people in many consumptive regions and vitamins [2].

Obesity is a major risk factor for cardiovascular disease, especially heart disease and stroke, which is the leading cause of death in 2008; diabetes; joint disorders; some cancers such as endometrial, breast and colon cancers. Although much research has been done on the causes and prevention of obesity, the prevalence of obesity has steadily increased over the past decade. Because adipocytes play a very important role in fatty homeostasis, obesity studies related to adipose tissue are very important to do [1].

One of the tissues that most plays a role in the pathogenesis of obesity is adipose tissue primarily formed by white fat cells. Normal adipose tissue when cells are hyperplated and excessive hypertrophy will have an adverse effect because of pathological processes leading to adipocyte dysfunction and, ultimately, adipose tissue inflammation. At this time the process of differentiation and maturation of adipocyte cells (adipogenesis) becomes one of the targets of obesity therapy.

Adipogenesis that leads to obesity has an adverse impact on health in the future. Nowadays, many parties have realized the importance of maintaining and regulating the intake of nutrients so that the condition of the body especially those associated with fat metabolism can be controlled properly. Lots of research has led to antiadipogenesis. Various sources both herbal and non herbal are used in controlling adipogenesis to prevent obesity. However, recent research results show the absence of agents that have high effectiveness and without side effects in inhibiting adipogenesis.

Whey protein is a protein contained in whey, which is a part of water that is separate from curds when cheese is made. Whey proteins are commonly used to improve athlete's performance, as a supplement, as an alternative milk for individuals who have lactose intolerance, to replace or enrich infant formula and to restore body weight and improve glutathione (GSH) in HIV patients. Whey proteins are also used for protein allergies, asthma, high cholesterol, obesity, and weight loss, preventing allergies in infants, advanced cancer and colon cancer. Some of the benefits of whey, especially against cholesterol and obesity have not yet been scientifically proven. The statement appears based on some empirical findings [3].

Whey protein isolates can achieve 95% protein, after removal of fat and lactose, and contain useful minerals and vitamins. Essential and non essential acids contained in whey serve as a substrate for protein synthesis and can improve body mass index in individuals who exercise [4].

Calcium allegedly affects energy metabolism because intracellular calcium regulates lipid metabolism in adipocytes and triglyceride reserves. Zemel *et al* showed an influence on calcium derived from dairy products compared with non-dairy to improvements in body composition. The study was

conducted by comparing calcium-fortified cereals with dry milk and without adding milk powder. The results showed a faster weight loss in mice fed with milk powder. It shows the addition of milk can produce a good effect in weight loss. However, the mechanism responsible for the acceleration of body mass loss with the addition of milk remains unknown. The researchers only suspect that there is an activity given by whey proteins from milk. The bioactive component in whey is thought to play a synergistic role with calcium to inhibit lipogenesis, accelerate lipolysis and the nutritional partition effects between adipose tissue and skeletal muscle [5].

Whey protein derived from cow's milk has a different composition compared to goat's milk. Some studies have shown lower levels of fat in goat milk than cow's milk. In addition, the protein content of goat milk whey is higher than cow's milk, especially in some components of essential amino acids and beta lactoglobulin.

Therefore, in this research will be testing the potential of whey goat milk protein as anti adipogenesis on 3T3-L1 culture cell and mouse. The results of this study is expected to be the scientific basis of the use of whey goat milk protein as an anti adipogenesis that can contribute in preventing the occurrence of obesity conditions.

Methods

Material

Whey goat milk, Etawa goat milk, 3T3-L1 cell line, mice

Cell Treatment

The 3T3-L1 cell is placed on 6 well plates where it is 500,000 cells / well, then the cells are incubated in DMEM containing serum fetal calf (FCS) without induction, plus insulin (as inductor), plus whey and incubated for 3 days.

In vivo test

In this test method used 0.02% PTU solution and egg yolk as an inducing agent that can increase endogenous and exogenous cholesterol. During the rat tests were given drinks and standard foods. Tests were performed on 5 groups of male wistar rats, the groupings were randomly selected and each group consisted of 5 rats. • The control group was given standard beverages and foods. • Negative control group, given PTU 0.02% 10 ml / kg BW and egg yolk 10 ml / kg BW. • The treatment group uses the maximum amount of liquid that can enter orally. Before the experiments, the rats were first empowered to eat for 18 hours and were only given a drink. Giving induced PTU 0.02% 10 ml / kg BW and egg yolks 10 ml/kg BW in treatment group was administered daily at the same time from day one to day 10. Administration of suspense in treatment group was given 1 hour after induced. During the experiment rats were given food and beverages as usual, except when the total cholesterol and triglyceride levels were measured in rat blood. The mice were fasted for 18 hours before blood sampling. Measurements are made on day 10.

Analysis of triglycerides and cholesterol levels

The medium/supernatant of 3T3-L1 cell culture was taken and analyzed Triglyceride levels. Triglyceride content analysis using colorimetric based TRIGS kit. Kit used were CHOLESTEROL (CHOL), Cat No CH 200, RANDOX and TRIGLISERIDA (TRIGS), Cat No TR, RANDOX.

Result and Discussion

Whey is a popular dietary protein supplement recognized for providing antimicrobial activity, immune modulation, improves muscle strength and body composition, and prevents cardiovascular disease and osteoporosis. Advances in processing technology, including ultrafiltration, microfiltration, reverse osmosis, and ion exchange, have resulted in the development of several different whey products. Whey protein concentrates (ranging from 80-95 percent protein), reduced whey lactose, whey protein isolates, whey demineral, and hydrolyzed whey are now commercially available. Each of the whey products varies in the amount of protein, carbohydrates, immunoglobulins, lactose, minerals, and fat in the finished product. These variables are important factors in the selection of whey fractions for specific nutritional applications.

The results of the treatment in Fig.1 show the effect of whey on cholesterol and triglyceride levels produced by cell culture. The results show that the addition of whey can lower cholesterol and triglyceride levels. Based on this, it can be seen the potential of whey to help prevent the production of cholesterol and triglycerides in cell culture.

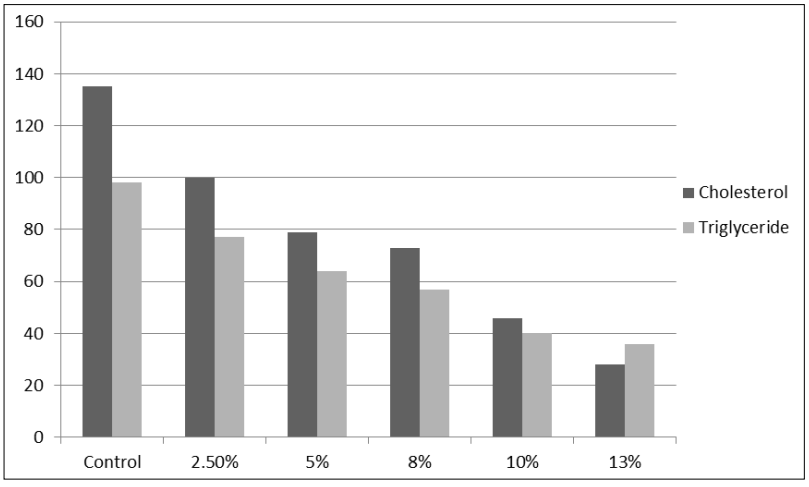

Fig 1: Level of Cholesterol and Triglyceride in cells treated with Whey

The whey mechanism of lowering cholesterol and triglyceride levels in cells may be influenced by the presence of a component of whey that can induce inhibition of cholesterol and triglyceride production. Whey is known to have good antioxidant activity, so the mechanism through which antioxidant activity in reducing or inhibiting cholesterol and triglyceride production is very likely. In addition, whey also contains proteins and peptides that also have the potential to induce or disrupt the mechanism of cell production in producing cholesterol and triglycerides. However, these allegations still need to be proven by further research.

Whey proteins have all the essential amino acids and in higher concentrations compared to various vegetable protein sources such as soybeans, corn, and wheat gluten. The amino acids found in whey can efficiently be absorbed and utilized, compared to free amino acid solutions [6, 7]. With respect to other protein sources, whey has a high concentration of branched chain-amino acids (BCAA) - leucine, isoleucine, and valine. BCAA, especially leucine, is an important factor in tissue growth and repair. Leucine has been identified as a key amino acid in protein metabolism during translation path-initiation of protein synthesis. Whey proteins are also rich in amino acid sulfurcontaining and methionine cysteine. With this high concentration of amino acids, immune function is enhanced through intracellular conversion to glutathione [8].

In this study also performed a test of mice (figure 2). *In vivo* tests were treated with maximum dose of whey (maximum volume) and also compared with pre-pasteurized pasteurized milk with the same amount of administration. The results showed the effect of whey and goat milk in decreasing cholesterol and triglyceride levels in mice.

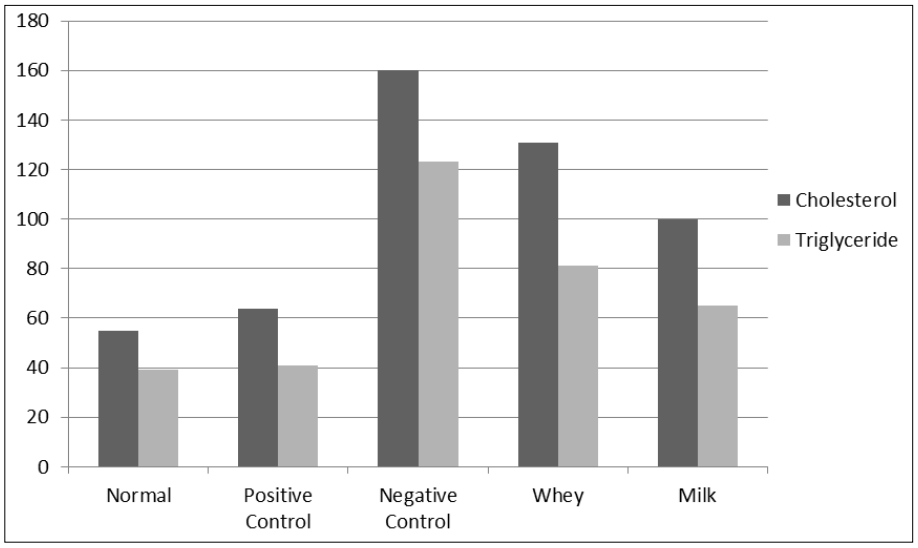

Fig 2: Level of Cholesterol and Triglyceride in mouse treated with Whey and Goat Milk

The comparison of the results in Fig 2 between whey and milk indicates a difference. The decrease in cholesterol and triglycerides in rats was greater in the treatment group with milk than whey. This is probably due to differences in the composition of whey and milk. In milk, there are still some types of unsaturated fatty acids that can also help to lower cholesterol or triglycerides, while whey does not have these components. These results show that milk is better at lowering cholesterol and triglycerides compared with whey, but from these results also seen the potential of anti hyperlipidemia from whey.

Although whey is not as good as milk, but if seen from the practical aspects, whey still has advantages compared with milk. Whey is a by-product or even waste, but still has benefits. Therefore, whey is still more profitable than milk when viewed from the economic aspect and its benefits. Several studies have shown the use of whey cow's milk as a carrier substance in the process of spray drying some types of foodstuffs. If seen from the results of this study, then goat milk whey is also potential to be used either as a carrier agent or fortifier on foodstuffs that potentially increase cholesterol and triglycerides, so the presence of substances that can offset these effects.

Research on whey goat milk is still not widely done, so the components inside are still not fully revealed. Therefore, further research on biochemical components in wheat goat milk is also needed, and also the difference compared to cow milk that has been used and consumed more. It is expected that this research can be continued in clinical trials so that the results can be applied to reduce the incidence of obesity and improve the utilization of goat milk protein supplement.

Acknowledgement

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