Long-term feeding of chitosan ameliorates glucose and lipid metabolism in rats with diabetes induced by streptozotocin and nicotinamide

Meng-Tsan Chiang¹, Shi-An Feng¹, Chen-Yuan Chiu², Shing-Hwa Liu³

¹Department of Food Science, National Taiwan Ocean University, Taiwan, ²Institute of Food Safety and Health, National Taiwan University, Taiwan, ³Institute of Toxicology, National Taiwan University, Taiwan

Background: Chitosan has beneficial effect of on plasma lipids and glucose was reported. However, there is little information concerning long-term study of chitosan. Methods: This study was designed to investigate the comparative effect of chitosan (average molecular weight was about 380000 Dalton and degree of deacetylation was about 89.8%) on plasma glucose, lipids and lipid absorption between normal and diabetes induced by nicotinamide and streptozotocin in rats for 11 weeks. Male Sprague-Dawley aged 7 weeks rats were used as experimental animals. Rats were divided into three groups: (1) control group (C) (2) chitosan group (CS) (3) diabetes (DM) (4) diabetes+ thiazolidinediones group (DM+TZD) (5) diabetes + chitosan group (DM+CS). The rats were fed the experimental diets and drinking water ad libitum for 11 weeks.

Results: Chitosan supplementation significantly decreased perirenal fat mass weight but increased the lipolysis rate in normal and diabetic rats. Chitosan causes a decrease in plasma glucose, HOMA-IR (homeostasis model assessment equation-insulin resistance) and improves impairment of glucose tolerance in diabetic rats. Intake of chitosan reduced the accumulation of hepatic lipids including relative total cholesterol (TC) and triglyceride (TG) contents. The phosphorylation of AMPK (AMP-activated protein kinase) was activated in rats fed a diet with chitosan supplementation. In addition, chitosan significantly decreased plasma TC, low-density lipoprotein cholesterol (LDL-C). It is interesting to note that the intestinal angiopoietin-like 4 (ANGPTL4) protein expression was significantly increased but MTTP (microsomal triglyceride transfer protein) protein expression was decreased after chitosan supplementation.

Conclusion: These results indicate that chitosan can improve the impairment of glucose and lipid metabolism in diabetic rats for a long-term feeding study.