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Effectiveness of a soy-based compared with a traditional low-calorie diet on weight loss and lipid levels in overweight adults

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Abstract

Objective: This study investigated the effects of a soy-based low-calorie diet on weight control, body composition, and blood lipid profiles compared with a traditional low-calorie diet.

Methods: Thirty obese adults (mean body mass index 29–30 kg/m^2) were randomized to two groups. The soy-based low-calorie group consumed soy protein as the only protein source, and the traditional low-calorie group consumed two-thirds animal protein and the rest plant protein in a 1200 kcal/d diet for 8 wk. A diet record was kept everyday throughout the study. Food intake was analyzed before and after the study. Anthropometric data were acquired every week, and biochemical data from before and after the 8-wk experiment were compared.

Results: Body weight, body mass index, body fat percentage, and waist circumference significantly decreased in both groups ($P < 0.05$). The decrease in body fat percentage in the soy group (2.2%, 95% confidence interval 1.6–2.8) was greater than that in the traditional group (1.4%, 95% confidence interval −0.1 to 2.8). Serum total cholesterol concentrations, low-density lipoprotein cholesterol concentrations, and liver function parameters decreased in the soy-based group and were significantly different from measurements in the traditional group ($P < 0.05$). No significant change in serum triacylglycerol levels, serum high-density lipoprotein cholesterol levels, and fasting glucose levels was found in the soy or traditional group.

Conclusion: Soy-based low-calorie diets significantly decreased serum total cholesterol and low-density lipoprotein cholesterol concentrations and had a greater effect on reducing body fat percentage than traditional low-calorie diets. Thus, soy-based diets have health benefits in reducing weight and blood lipids.

Keywords: Soy; Obesity; Body fat percentage; Serum cholesterol; Weight loss

Introduction

The prevalence of overweight and obesity worldwide has dramatically increased in recent decades [1]. Compelling evidence has linked obesity not only to various chronic diseases, such as diabetes mellitus, heart disease, hypertension, stroke, cholecystolithiasis, and gout, but also to cancer, including colorectal and breast cancers [2,3]. In 1996, the World Health Organization and the Food and Agriculture Organization announced that obesity can be regarded as a chronic disease and emphasized the importance of maintaining an ideal body weight. According to results from a survey in Taiwan in 1998 [4], nearly 25% of adults are overweight. This report indicates that obesity has become a serious public health problem in Taiwan. Energy imbalance, i.e., energy intake higher than energy expenditure, is the main reason for people becoming overweight and obese. Dietary patterns are closely related to obesity [5,6].

Soy contains abundant nutrients and is a common component of the traditional Chinese diet. Soybean proteins are used in a variety of forms, including infant formulas, flours, protein isolates and concentrates, and textured fibers. Soy-containing foods include cheese, drinks, miso, tempeh, tofu, salami, and vegetarian meat substitutes. It has been shown that a soy-based diet has a weight-loss effect and can pre-

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vent obesity because soy is rich in dietary fiber, thereby increasing satiety [7], and that a soy-based meal helps to decrease fat mass [8]. Further, soy peptide seems to improve the thermic response of brown adipose tissue and thus may be a useful treatment option for obesity [9,10]. However, those findings were based on animal studies, and no clinical studies have examined the results of a weight-loss program using soy products for obese people. The effectiveness of soy products on weight loss is still unclear [11]. Therefore, this study investigated the effects of a soy-based diet on weight management and body composition. The results of this study will be applied to clinical therapies for the overweight and obese and to decrease morbidity associated with obesity.

Materials and methods

Subjects

This study was carried out at Taipei Medical University. Flyers and leaflets were used to recruit 30 volunteers (6 men and 24 women) before the experiment's start date. Subjects had to be 20–60 y of age, have a body mass index (BMI) >26 kg/m^2, and have no history of chronic disease, including cardiovascular disease, kidney disease, and diabetes mellitus. Female subjects could not be pregnant or breast-feeding. All subjects submitted written informed consent before their participation. The guidelines and procedures were approved by the research ethics committee of Taipei Medical University, Taiwan.

Study design

Subjects were randomly allocated to two groups: a traditional group (traditional low-calorie diet) and a soy group (soy low-calorie diet). The soy group consumed soy protein as the only protein source, and we provided various soy foods, including drinks, miso, tofu, and vegetarian meat substitutes, from markets. Each subject in the soy group received a meal box for every lunch and dinner for 8 wk. Two-thirds of the protein for the traditional group was animal protein, and the rest was plant protein. Table 1 lists differences in the prescribed diet content for each group. We also educated participants on the dietary guidelines for 1200-kcal diets and clarified the concepts of protein sources and food portions. A meal plan was given to subjects in the traditional group, but no prepared food. Both groups were given lectures on weight management at each visit. A diet record was kept everyday throughout the study. Food intake records were analyzed using Nutritionist Pro 1.0 (E-Kitchen Business Corp., Taiwan). Thirty subjects completed the study. Anthropometric measurements including height, weight, blood pressure, and body composition were weekly measured. Biochemical parameters were analyzed at the beginning and the end of the intervention. Side effects including gastrointestinal symptoms, effects on skin, hair, and bone, and physical activity were evaluated.

Table 1
Contents of the prescribed diet for each group

Nutrient content/group	Soy group*	Traditional group†
Total energy (kcal)	1200	1200
Carbohydrates (60%)	180 g	180 g
Lipids (25%)	33 g	33 g
Protein (15%)	45 g	45 g
Animal protein	0	30 g
Soy protein	45 g	15 g

* Soy products were the main protein source in the soy group.
† Two-thirds of the protein of the traditional group was from animals, and one-third was from plant proteins.

Anthropometric measurements

The height of each subject was measured with a stadiometer. Body composition including body weight and body fat percentage were determined with the InBody 3.0 Body Composition Analyzer (InBody 3.0, Biospace, Seoul, Korea), which uses an 8-point tactile electrode system that measures the total and segmental impedance and phase angle of alternating electric current at four different frequencies. It was used according to the manufacturer's instructions. The accuracy of this measurement to assess percentage of body fat was reported by many researchers [12]. Subjects took a rest for $\geq$30 min before measurement. Then subjects took off excess clothing (coats, sweaters), shoes, and socks, stood on the four foot-electrodes on the instrument's platform and held the two palm-and-thumb electrodes with the arms not touching the torso. Each subject's height and age were entered, and the body composition data were calculated by the device's software and immediately printed on the paper obtained from the manufacturer. Waist circumference was measured with an inelastic scale.

Blood pressure

Blood pressure was measured on the subject's right arm with a mercury sphygmomanometer by trained personnel who confirmed and pressed the pulse before the measurement.

Biochemical measurements

Venous blood samples were collected at the beginning and the end of the intervention for analysis of serum glucose, triacylglycerols, total cholesterol, high-density lipoprotein cholesterol (HDL-C), low-density lipoprotein cholesterol (LDL-C), glutamate oxaloacetate transaminase, and glutamate pyruvate transaminase. Blood samples were drawn after overnight fasting and immediately centrifuged. Blood biochemical parameters were measured at the laboratory of Taipei Medical University Hospital. Serum total cholesterol, triacylglycerols, HDL-C, glutamate oxaloacetate transaminase, and glutamate