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Research Article

Efficacy of GLP-1 Formula on Body Weight in Overweight and Obese Adults

Yung-Hsiang Lin[1], Chen-Chen Fu[1], Ning-Yuan Wang[2], Yi-An Chen[2], Ching-Fang Chang[3], Shu-Ting Chan[4] and Chi-Fu Chiang[4]*

[1]*Institute of Medical Genetics, TCI GENE INC, Taipei, Taiwan*

[2]*Product Marketing Team, TCI GENE INC, Taipei, Taiwan*

[3]*Cell Validation Laboratory, TCI GENE INC, Taipei, Taiwan*

[4]*Research and Design Center, TCI CO., Ltd., Taipei, Taiwan*

***Corresponding Author:** Chi-Fu Chiang, Research and Design Center, TCI CO., Ltd., Taipei, Taiwan.

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Abstract

Obesity is a chronic metabolic disease characterized by the excessive accumulation of body fat, affecting the health of millions worldwide. This study aimed to analyze the effectiveness of the GLP-1 Formula (product name: Slim8D No.2) in reducing body weight and exploring its potential as a treatment for obesity. The product's design and main mechanism of action are to enhance the secretion of GLP-1 by colonic L cells. The increase in GLP-1 in the body naturally suppresses appetite, thereby achieving weight loss. In this study, we demonstrated that the GLP-1 Formula product significantly enhanced GLP-1 secretion in NCI-H716 cells. The weight loss trial was conducted from October 25, 2023, to December 31, 2023. Participants took one sachet daily with water before lunch, with each pack containing 7 tablets. The results showed that among the 560 participants, the average weight loss was 4.9 kg by the endpoint. Notably, these 560 participants collectively lost a total of 2,732 kg by the end of the trial. GLP-1 Formula demonstrated promise in reducing body weight and may serve as an effective alternative therapy for treating obesity.

Keywords: GLP-1 Formula; GLP-1 Secretion; Obesity; Weight loss

Introduction

Obesity is a chronic metabolic disease caused by the excessive accumulation of body fat, affecting the health of millions of people worldwide. According to the World Health Organization (WHO), body mass index (BMI) between 25 and 29.9 indicates a person is overweight. Above 30 indicates a person has obesity [1]. The etiology of obesity is multifactorial, encompassing genetic predispositions and environmental and behavioral factors such as high-calorie diets, lack of physical activity, and stress [2]. Obesity not only impacts physical appearance but is also closely associated with a myriad of health issues, including cardiovascular diseases, type 2 diabetes, hypertension, certain cancers, and sleep apnea [3]. The prevalence of obesity presents significant challenges to global healthcare systems, as it not only increases medical costs but also markedly reduces the quality of life and life expectancy of affected individual [4].

Glucagon-like peptide 1 (GLP-1) is an incretin hormone secreted by the intestines that plays a crucial role in metabolic regulation. GLP-1, primarily produced by the L-cells of the small intestine, is released into the bloodstream postprandially [5]. It stimulates

insulin secretion and inhibits glucagon release, thereby aiding in the regulation of blood glucose levels. Additionally, GLP-1 delays gastric emptying and enhances satiety, making it a promising candidate for weight management and obesity treatment [6]. In recent years, GLP-1 receptor agonists have emerged as novel therapeutic agents for treating type 2 diabetes and obesity. These drugs mimic the actions of endogenous GLP-1, effectively lowering blood glucose levels and promoting weight loss in patients [7]. However, these medications also present some side effects, limiting their use in certain patients. Common side effects include gastrointestinal symptoms such as nausea, vomiting, diarrhea, and abdominal pain [8]. Considering these adverse effects, natural plant extracts combined with probiotics show significant potential as alternative therapies.

Plant extracts derived from natural sources are generally considered milder and have fewer side effects [9]. For instance, some studies indicate that certain herbs and plant extracts have blood glucose-regulating and weight-reducing effects similar to GLP-1 [10]. Plant extracts are rich in antioxidants and other bioactive compounds, which, in addition to aiding in blood sugar and weight control, can enhance the immune system, improve cardiovascular health, and possess anti-inflammatory properties [11]. By balancing the gut microbiota, probiotics promote the growth of beneficial bacteria and inhibit the proliferation of harmful bacteria, thereby improving gut health [12]. Gut health is crucial for overall metabolism and weight control. Research has shown that dysbiosis is closely associated with obesity, and supplementing with probiotics can improve the gut environment, aiding in weight loss [13]. Probiotics generally do not have noticeable side effects in humans, making them safe for long-term use [14]. Therefore, the formulation of botanical extracts and probiotics can serve as an effective alternative to GLP-1 drugs and provide additional health benefits. GLP-1 Formula (product name: Slim8D No.2) provided by TCI CO., Ltd. Its formula contains a variety of plant extracts and probiotics. In previous internal clinical trials, we found that taking GLP-1 Formula can increase the level of GLP-1 in the blood and reduce appetite. This study aims to analyze whether GLP-1 Formula can reduce body weight. This clinical trial is intentionally designed to avoid disrupting participants' daily routines while monitoring changes in their body weight following the use of the GLP-1 Formula product.

Materials and Methods

GLP-1 content measurement

GLP-1 Formula product (Slim8D No.2) provided by TCI CO., Ltd. contains phenylalanine, leucine, black tea baking powder, soy protein, bifidobacterium breve, lactose, maltodextrin, erythritol, and acacia gum. NCI-H716 cells (BCRC number: 60517, purchased from the Bioresource Collection and Research Center, Taiwan were maintained in 90% RPMI1640 medium (Gibco, Cat no. 11875), 10% Fetal Bovine Serum (Cytiva, Cat no. SH30396.03), 2mM L-Glutamine (Gibco, Cat no. 25030149), and 1% Penicillin-streptomycin (Gibco, Cat no. 15140122). Before being treated with the GLP-1 Formula product, 1×10^5 cells were seeded into each well of a 24-well plate coated with Matrigel Matrix (Corning Cat.no. 356237). Additionally, cells were incubated in DMEM medium (Gibco, Cat no. 11965092) with 10% Fetal Bovine Serum for 48 hours. The next day, cells were incubated in a differentiated medium: DMEM without D-glucose (Gibco Cat no. 11966025), 1 μM Forskolin (Sigma-Aldrich, Cat no. 344270), and 1 μM 3-Isobutyl-1-methylxanthine (Sigma-Aldrich, Cat no. I7018) for 4 hours. Following this, cells were washed with 500 μl DPBS (Cytiva, Cat no. SH30028.03) containing 1 mM CaCl2 (Sigma-Aldrich, Cat no. C5670), and then the differentiated medium was exchanged with serial diluted concentrations of the GLP-1 Formula product in each well for 24 hours. After 24 hours of incubation, we collected supernatants and performed a GLP-1 ELISA assay (Elabscience, Cat no.E-EL-H6025) to measure GLP-1 content. The percentage of relative GLP-1 content were compared to the untreated group.

Clinical trial design

This clinical trial, an online weight loss program, recruited subjects from a TCI Gene Inc. dietitian care network. Eligible participants were aged 18 to 75 years with healthy, overweight or obesity who were referred by dietitian care manager and enrolled between October 25 2023 to December 31 2023. All participants were included in the intention-to-treat analysis, and these participants were included in the per-protocol analysis regardless of whether they discontinued the use of GLP-1 formula product midway. The date of data analysis is December 31, 2023.

Intervention method of GLP-1 Formula product

Participants took one sachet daily before lunch with water. One pack contains 7 tablets. All participants could start taking

GLP-1 Formula products at any time during the trial period after measuring their weight before the start. The minimum number of days to take product is 14 days, with the last start time being December 15 2023. Finally, on December 31, 2023, the weight values of all subjects were collected.

Weight measurement

No specific, any type of electronic monitoring equipment. Most importantly, participants are required use the same measuring instrument throughout the experiment to avoid discrepancies caused by different devices. Participants must provide their body weight and body fat rate every week of intervention, a photo of themselves taken with an electronic measuring device, and front and side views while wearing fitted clothing for comparison.

Statistical analysis

In order to ensure result accuracy, we excluded missing data, discarded measurements from irrelevant subjects, and removed physiologically implausible data. The total number of participants in this trial was 718 subjects, and only 560 subjects were enrolled in the end. One-way ANOVA followed by Tukey's multiple-comparison tests, Two-way ANOVA analysis followed by Šídák›s multiple comparisons tests, and Pearson Correlation Coefficient analysis were performed using Prism 10 (GraphPad Software, https://www.graphpad.com/).

Results

GLP-1 Formula significant enhanced GLP-1 secretions by NCI-H716 cells

NCI-H716 is a cell line that is widely used to study mechanisms underlying the secretion of GLP-1. We showed that the GLP-1 Formula product can significantly enhance GLP-1 secretions by NCI-H716 cells by 3.27 ± 1.06-fold (Figure 1). Moreover, the enhancement of GLP-1 secretions by NCI-H716 cells was dose-dependent. It indicated that the GLP-1 formula product indeed stimulated colonic L-cells to secrete GLP-1.

GLP-1 Formula can reduce body weight

A total of 560 participants were enrolled in this study. Of these, 63.4% were women (n = 355) and 36.6% were men (n = 205).

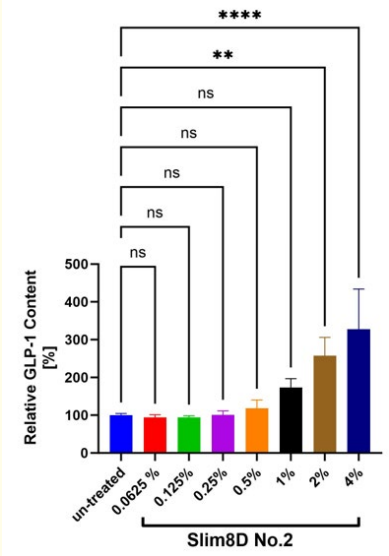

Figure 1: The percentage of relative GLP-1 content of NCI-H716 cell culture supernatant. The statistical significance and P value were calculated by one-way ANOVA followed by Tukey's multiple-comparison tests. p value <0.05 is represented as "*", p value <0.01 is represented as "**", p value <0.001 is represented as "***"; p value <0.0001 is represented as "****".

Trial		
Start and end time of study		2023.10.25~ 2023.12.31
Initial Number of participants		560
Gender	Female	355
	Male	205
Age		36.2 ± 8.7
Initial body weight of participants		75.9 ± 17.0

Table 1: The information about the participants. From October 25 2023 to December 31 2023, 560 participants were enrolled in this study. Major participants were women (63.4%). Mean age of was 36.2 ± 8.7 years. Mean body weight was 75.9 ± 17.0kg.

The mean age was 36.2 ± 8.7 years (Table 1), and the mean body weight was 75.9 ± 17.0 kg. At the endpoint, the estimated mean weight change from baseline was -4.9 kg with the GLP-1 formula product (Figure 2). Over 59.3% of participants treated with the GLP-1 formula had significantly lost at least 4 kg of their baseline body weight by the endpoint (Figure 3). Overall, the 560 subjects collectively lost a cumulative weight of 2,732 kg by the endpoint (Figure 4). These results suggested that the use of the GLP-1

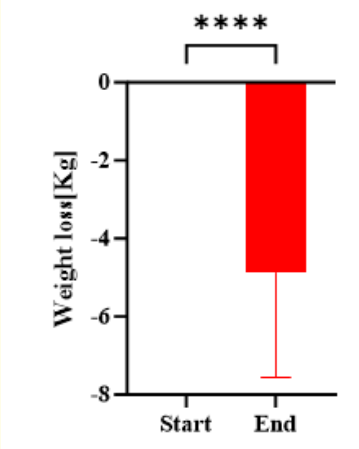

Figure 2: Body weight loss [Kg] of participants at the end point after GLP-1 formula product administration. * means P < 0.05; ** means p < 0.01; *** means p < 0.001; **** means p < 0.0001.

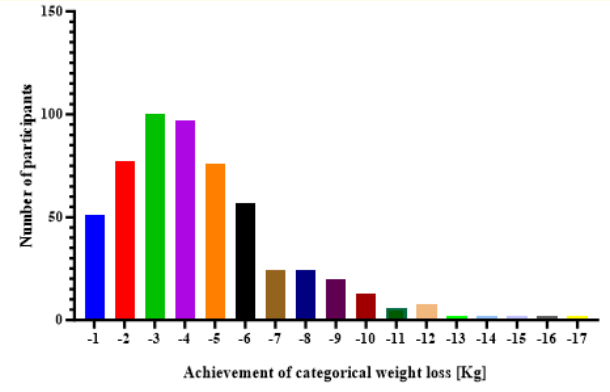

Figure 3: Participants have lost at least 1, 2, 3, 4, to 17 Kg of baseline body weight at the end point.

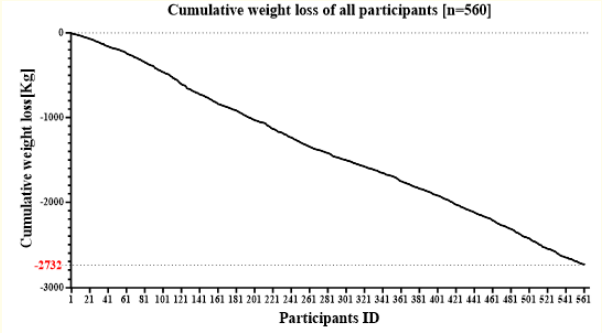

Figure 4: All participants had a cumulative weight loss of 2,732 kg at the end point.

formula product led to weight loss.

Discussion

In this trial, we are the first to discover that GLP-1 Formula products using food-grade sources can enhance GLP-1 secretions and reduce weight and body fat. The active ingredients of GLP-1 Formula product (Slim8D No.2) are phenylalanine, leucine, black tea baking powder, soy protein, bifidobacterium breve.

Phenylalanine and leucine are essential amino acids known for their roles in protein synthesis and metabolic regulation [15]. Phenylalanine is a precursor to neurotransmitters like dopamine and norepinephrine, which play key roles in appetite control and energy expenditure [16]. Conversely, Leucine activates the mTOR pathway, stimulating protein synthesis and promoting muscle preservation during weight loss [15]. These amino acids likely support the maintenance of lean body mass and metabolic rate, crucial for sustainable weight management. Black tea contains polyphenolic compounds such as catechins and theaflavins, which have been associated with anti-obesity effects [17]. These compounds can increase energy expenditure, enhance fat oxidation, and improve lipid metabolism. Black tea baking powder in the formula may contribute to these effects, potentially aiding in reducing body fat accumulation [18]. Soy protein is rich in essential amino acids and bioactive peptides that promote satiety and reduce food intake by affecting appetite-regulating hormones such as leptin and ghrelin [19]. Moreover, soy protein enhances insulin sensitivity and lipid metabolism, supporting overall metabolic health during weight loss [20]. Bifidobacterium breve is a probiotic strain known for its ability to modulate gut microbiota composition and function [21]. Probiotics like B. breve can increase the production of short-chain fatty acids (SCFAs) such as acetate, propionate, and butyrate, which regulate energy metabolism and promote satiety [22]. SCFAs can stimulate the release of gut peptides, including GLP-1, which enhance insulin secretion and reduce appetite [23]. Other ingredients various functions in the GLP-1 Formula product, including providing texture, stability, and sweetness. Lactose and maltodextrin act as bulking agents and carbohydrate sources, while erythritol and acacia gum serve as low-calorie sweeteners and fiber sources, respectively. These components contribute to the palatability and practicality of the product while supporting its overall effectiveness in weight management.

The combined effects of phenylalanine, leucine, soy protein, and Bifidobacterium breve likely contribute to appetite suppression through multiple mechanisms-phenylalanine and soy protein influence neurotransmitter pathways involved in satiety and food intake regulation [24]. Leucine supports muscle maintenance and metabolic rate, which helps in energy expenditure and appetite control [25]. GLP-1 is a gut hormone crucial for glucose metabolism and insulin secretion. Components such as Bifidobacterium breve may enhance GLP-1 secretion by affecting gut microbiota and SCFA production [26]. Increased GLP-1 levels promote insulin sensitivity, reduce glucose levels, and inhibit appetite, contributing to weight loss [27]. Specific components, potentially influenced by soy protein and Bifidobacterium breve, may slow gastric emptying. This delay can prolong satiety and reduce the likelihood of overeating, thereby supporting weight management goals. Bifidobacterium breve is pivotal in modulating gut microbiota composition, promoting a microbial environment associated with metabolic health [21]. This modulation can influence energy extraction from food and the production of bioactive metabolites, contributing to weight regulation.

The GLP-1 Formula product (Slim8D No.2) incorporates ingredients that synergistically promote weight through various mechanistic pathways. Each component plays a critical role, from amino acids supporting metabolic functions to probiotics enhancing gut health and bioactive compounds influencing appetite and metabolism. Understanding these mechanisms provides insights into how the product may effectively support individuals in achieving their weight management goals. Further clinical studies are necessary to validate these mechanisms and evaluate the long-term efficacy and safety of the GLP-1 Formula product in diverse populations.

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