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Glycemic Index of Insu 100® Herbal Preparation Containing Korean Red Ginseng, Carob, Mulberry, and Banaba

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In this study, we determined the glycemic index (GI) of an herbal preparation (Insu 100®; Korean red ginseng, carob, mulberry, and banaba). Ten subjects (men and women) took part in standard glycemic testing during a 4-week study period (with duplicate trials of each treatment). Informed consent was obtained from each subject. No adverse effects resulted from the administration of the herbal preparation. The GI of Insu 100® was 19.5±5.1, indicating that administration of this herbal cocktail may be beneficial to people with metabolic disorders and to those who wish to maintain their overall health. This study complied with the Declaration of Helsinki.

Keywords: Glucose, Glycemic index, Insu 100®

INTRODUCTION

The glycemic index (GI) is a measure of the effect of carbohydrates on blood sugar levels. The GI of a test food is calculated using the area under a 2-hour blood glucose response curve (AUC) obtained after the intake of a fixed portion of carbohydrate (50 g) in that test food. The AUC of the test food is divided by the AUC of a standard food (glucose, white bread) and multiplied by 100 (GI values range, 0 to 100) [1-3]. Generally, high-glycemic-index (HGI) foods have GI≥70, whereas low-glycemic-index (LGI) foods have GI≤55 [4].

Consumption of HGI food raises blood glucose rapidly, which leads to an increased release of insulin and a decreased release of glucagon. This stimulates the absorption of glucose by muscle and the liver and suppresses glucose synthesis and lipid break down in the liver [5]. HGI foods have a tendency to promote the appetite and the accumulation of body fat [5]. The consumption of HGI foods is associated with increased risk of obesity, diabetes, and high blood pressure. In contrast, LGI foods lower the glucose response after meals, have a beneficial effect on blood lipid levels, and reduce the symptoms of insulin resistance [6-8]. The replacement of HGI with LGI foods may have important implications for the prevention and control of metabolic diseases.

In studies with streptozotocin-induced diabetic rats, *Panax ginseng* water extract was shown to have antidiabetic activities [9], the fat-soluble fraction of *Panax ginseng* C.A. Meyer was found to lower blood glucose and lipid levels [10], and Korean red ginseng (steam-treated *Panax ginseng* C.A. Meyer) was reported to reduce acute postprandial glycemia [11]. *Ginseng Radix Rubra* treatment of streptozotocin-induced diabetic rats resulted in the highest antidiabetic activity and the

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greatest improvement in plasma glucose and insulin levels when compared to *Ginseng Radix Alba* and *Panax quinquefolius Radix* [12].

Carob contains high levels of pinitol, which is a natural regulator of blood glucose. Pinitol has been reported to improve glucose metabolism in hyperglycemic patients independent of insulin or sulfonylurea drug treatment [13].

Mulberry leaves are a rich source of iminosugars, which include the glucose analogues 1-deoxynojirimycin (DNJ), N-methyl-DNJ, and 2-O-α-D-galactopyranosyl-DNJ. 1-deoxynojirimycin is the most abundant mulberry imminosugar and is a potent α-glucosidase inhibitor. In clinical studies, mulberry enriched with DNJ suppressed the elevation of postprandial blood glucose and insulin secreteion [14].

A combination diet including Korean red ginseng, mulberry (*Morus alba* L.), and banaba (*Lagerstroemia speciosa* L. Pers.) was reported to improve hyperglycemia through the regulation of lipid metabolism [15]. We prepared a new herbal supplement by adding carob *(Ceratonia siliqua* L. Taub.) to the combination of Korean red ginseng, mulberry (*Morus alba* L.), and banaba. In this study, we examined the GI of this herbal preparation (Trade name, Insu 100®).

MATERIALS AND METHODS

Materials

The test herbal supplement (Insu 100®) was produced by Korea Ginseng Corporation Co., Ltd. following the good manufacturing practices guidelines. In compliance with these guidelines, Insu 100® was made in liquid form. It contained 7% crude saponin derived from 6-year old Korean red ginseng, 25% pinitol derived from carob, 60% total solids obtained from mulberry, and 1% corosolic acid derived from banaba. This study was carried out after approval by the Institute Review Board of Inje University Hospital and was conducted in accordance with the Declaration of Helsinki.

Subjects

Ten healthy volunteers (5 males: average age, 25.4 years; 5 females: average age, 26.4 years) were recruited from Inje University Hospital. Volunteers were excluded from the study if they had a body mass index greater than 23, were taking medication or related products, had diabetes, were pregnant, suspected to be pregnant, or were breastfeeding, had a history of allergies to medicine, or were found to be generally unsuitable by the physicians in charge of the study.

The volunteers who fulfilled the selection criteria were screened for blood glucose, aspartate aminotransferase, alanine aminotransferase, and total cholesterol (Table 1).

The herbal preparation was composed of Korean red ginseng, carob, mulberry, and banaba extract. The 10 subjects consumed portions of the herbal preparation and the reference food (Glucodin1 glucose powder; Boots Healthcare, Australia), each containing 50 g of available carbohydrate, on separate mornings over a 4-week period. The reference food was consumed at the first and last test sessions of the study. The herbal preparation was consumed at random, once only, between the two reference food tests.

Prior to each test session, volunteers were required to fast for 12 hours, consume the same menu, and abstain from alcohol and smoking.

Table 1. Screening test result of subjects

Subject	AST	ALT	Total cholesterol	Blood glucose
Criteria level	10-40 IU/L	6-40 IU/L	≤200 desirable, 201-240 Borderline high, >240 high	70-120 mg/dL
F1	15	12	139	97
F2	17	19	178	94
F3	21	15	131	76
F4	16	15	156	71
F5	19	17	186	71
M1	17	13	153	76
M2	39	21	180	79
M3	18	13	193	92
M4	17	10	161	75
M5	17	10	137	97

AST, aspartate aminotransferase; ALT, alanine aminotransferase.

Table 2. Area under the curve of the blood glucose of reference food and test food

Subject	Reference food (glucose)			Test food (Insu 100®)		
	1st	2nd	Average	1st	2nd	Average
F1	2580.0	3498.8	3039.4	288.4	270.0	279.2
F2	2370.0	2621.3	2495.6	787.5	281.3	534.4
F3	2595.0	2422.5	2508.8	641.3	494.3	567.8
F4	2985.0	2403.6	2694.4	821.3	348.5	584.9
F5	2677.5	1856.3	2266.9	624.6	290.0	457.3
M1	1339.8	2937.5	2138.7	161.3	554.1	357.7
M2	2725.5	2683.3	2704.4	360.0	393.0	376.5
M3	2749.5	3277.5	3013.5	792.3	720.8	756.5
M4	1851.5	2216.7	2034.1	594.0	513.8	553.9
M5	2496.0	2846.3	2671.1	372.4	653.8	513.1
Average (mg/dl. min)	2436.9	2676.4	2556.7	544.3	451.9	498.1
SD	466.6	466.1	321.5	223.3	156.1	129.6
CV (%)	19.1	17.4	12.6	41.0	34.5	26.0

SD, standard deviation; CV, coefficient of variation.

Table 3. GI of subjects

Female subject	F1	F2	F3	F4	F5	Average period	SD	CV (%)
GI period	9.2	21.4	22.6	21.7	20.2			
Male subject	M1	M2	M3	M4	M5	19.5	5.1	25.9
GI period	16.7	13.9	25.1	27.2	19.2			

GI, glycemic index; SD, standard deviation; CV, coefficient of variation.

Measurement of blood glucose concentrations and GI values

Immediately before and 15, 30, 45, 60, 90, and 120 minutes after consumption of the reference food or the herbal preparation, blood glucose levels were determined using a glucometer (Accu-Check, Roche, Swiss). The incremental AUC was calculated according to the trapezoidal (Simpson's) rule using the area above the baseline (fasting glucose). The average AUC of the two reference food tests was used as the reference value. For each subject, the 120-min blood glucose AUC value for the herbal preparation was divided by the subject's average 120-min blood glucose AUC value for the reference food. This was multiplied by 100 to obtain the GI for the herbal preparation.

Statistical analysis

AUC values were calculated using the incremental method (Graphpad ver. 4.0, Prism Software, San Diego, CA, USA). Paired *t*-tests were used to compare subject data with baseline and to compare peak blood glucose values and areas under the plotted glycemic response curves. Data from the reference food and the herbal preparation were compared by *t*-tests.

Table 4. Composition of Insu 100® and active ingredient contents

Ingredient	Percent	Active ingredient
Korean red ginseng	9.00	Crude saponin
Carob	15.20	Pinitol
Mulberry	3.30	
Banaba	0.30	Corosolic acid
Herb flavor	0.01	
Purified water	72.19	
Total	100.00	

RESULTS AND DISCUSSION

Glycemic index values are traditionally classified as low (<55), medium (56–69), or high (>70); the GI of glucose is 100 [8]. We found that the GI of our herbal preparation was 19.5 (Table 3). The between-assessment reproducibility of the average AUC after intake of the reference food or the herbal preparation was

evaluated by calculating coefficients of variation (CV). These were 4.9% and 9.3%, respectively (Tables 2 and 3). This indicates that our experimental protocol was satisfactory. The between-subject CVs for the AUCs of the reference food and the herbal preparation were 12.6% and 26.0%, respectively, resulting in a between-individual CV of 25.9% for the GI of the herbal preparation. This value was relatively high and was attributed to variations in the response to glucose among the individuals in our study. The gender-specific CV for the GI values calculated for the herbal preparation was 25.8% among male subjects and 26.0% among females, indicating that no variation could be attributed to gender. The use of the herbal preparation in this study was not associated with any adverse clinical signs, behavioral alterations, or weight changes.

The herbal preparation Insu 100® has a low GI. This herbal cocktail may have beneficial effects when used as a dietary supplement for Asian people with diabetes.

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