Effect of Peucedanum japonicum Thunb on Body Composition and Biochemical Examination of Blood

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INTRODUCTION

Metabolic syndrome is defined as a condition characterized by obesity due to visceral fat accumulation and ≥2 of the following symptoms: hyperglycemia, hypertension, and dyslipidemia. Metabolic syndrome may trigger arteriosclerotic diseases such as diabetes, hypertension, dyslipidemia, heart disease, and stroke. Therefore, prevention and treatment of metabolic syndrome are urgent issues.

Since it has been reported that excessive nutrient intake and unhealthy lifestyles may contribute to metabolic syndrome, various approaches have been introduced into the medical administration system and performed; for example, preventive and therapeutic dietary counseling and nutritional therapy for the purpose of reducing of visceral fat. Recently, the pharmacological effects of foods have been noted and a study on "functional foods" has been promoted in countries worldwide.

It has been reported that approximately 60% of Japanese adults routinely use functional foods with expectations of health maintenance, disease prevention, or the amelioration of symptoms. However, it is limited functional foods of which effect on improvement of metabolic syndrome has been demonstrated by clinical trials in human. Therefore, it is thought that the evidence of functional foods should be established immediately.

【ABSTRACT】

Peucedanum japonicum Thunb (PJT) has reported the effect of lipid and glucose metabolism at some in vivo and in vitro study. In this study, 21 subjects with dyslipidemia border zone took PJT for 12 weeks. The changes over time of body composition and biochemical test were examined. The values of HbA1c were significantly reduced compared to the values before intake. For body fat percentage, the value at 8 weeks after intake showed a significant decrease compared with the value before intake. Adiponectin was significantly increase after 8 weeks in obese subject. These results suggested PJT may improvement of glucose metabolism.

【Key words】

functional food, Peucedanum japonicum Thunb, chlorogenic acid, glucose metabolism, adiponectin
In our laboratory, a screening method for adiponectin secretagogue using human fat stem cells has been developed. Adiponectin is an adipocytokine specifically secreted by adipocytes. It is an important factor for the prevention and improvement of metabolic syndrome, and provides benefits such as improvement of insulin resistance and prevention of hypertension and arteriosclerosis. Based on this screening method, PJT promoted adiponectin secretion.

PJT is a perennial plant of the Apiaceae family, and is found primarily in the area between South Kyushu and Okinawa in Japan. In Okinawa, PJT is traditionally consumed as a vegetable or medicinal herb. It has been reported that PJT exhibits an anti-obesity effect in mice, and its mechanism of action is believed to be associated with chlorogenic acid, which is an ingredient of PJT. Moreover, it has recently been reported that pteryxin, which is another ingredient of PJT, inhibits synthesis of TG. Furthermore, in vitro study of glucose metabolism indicated that PJT extract has alpha-glucosidase inhibitory activity.

This study aimed to examine the effects of PJT on dyslipidemia border zone that contributes to metabolic syndrome in human clinical trials.

MATERIALS AND METHODS

[Study food]
Lyophilized powder of PJT (KANEHIDE BIO Co., Ltd., Okinawa, Japan) was used as the study food. No health hazard of PJT has been reported officially, and its safety has been confirmed in an animal experiment and a long-term intake study involving human subjects (3 months). The intake was set at 9 g/day (3 g * 3 times) based on a previous study.

[Inclusion and exclusion criteria]
The inclusion criteria were as follows: age between 20 and 80 years; LDL cholesterol level from borderline to mild (120-159 mg/dL), or TG level from normal to moderately high (120-199 mg/dL). The exclusion criteria were as follows: a person with an underlying disease (i.e., diabetes, hepatic disorder, renal disease, and heart disease) that requires medical treatment; person of irregular habits; a person with a history of food allergy.

[Test Schedule]
The method of intake is as follows: take 3 g of lyophilized powder of PJT dissolved in approximately 150 ml of water, 3 times per day (3 g * 3 times; total of 9 g) for 12 weeks. After the initiation of administration, the subjects underwent body composition measurements and blood tests every 4 weeks (Fig. 1).

[Ethic review]
This study was conducted after obtaining the approval of the ethical review board of Osaka University Hospital (UMIN000021962). And this study based on Helsinki Declaration.

RESULTS

The subjects consisted of 10 men and 11 women (total of 21 subjects; age, 52.6 ± 12.4 years [mean ± standard deviation, SD]). The value of body fat at 8 weeks after intake had decreased significantly compared with the value before intake. There was no change in total cholesterol, LDL cholesterol, and TG (indicator of lipid in blood). The value of HbA1c, which is an indicator of blood glucose, showed a significant decrease compared with the value before intake. There was no

Fig. 1 Test schedule
Consent was obtained from the subjects. After the initiation of administration, the subjects underwent body composition measurements and blood tests every 4 weeks.
change in fasting blood glucose. Although the value of adiponectin tended to elevate over time, there was no significant difference. However, stratified analysis of obese subjects with BMI of ≥25 showed a significant increase at 8 weeks after intake compared to the value of adiponectin before intake (Table 1).

**DISCUSSION**

The subjects took PJT for 12 weeks, and their data of body composition and change in blood were analyzed every 4 weeks.

With respect to body composition, no change was found in body weight throughout the 12 weeks, while body fat percentage at 8 weeks after intake showed a significant decrease compared with the percentage before intake. The decrease in body fat percentage was consistent with the results of previous animal experiments. It has been reported that accumulation of visceral and subcutaneous fat is reduced taken PJT is administered to high-fat diet compared to no taken it in mice\(^6\). The ingredients that are thought to be involved are chlorogenic acid, which is a polyphenol, and pteryxin, which is a coumarin compound. For chlorogenic acid, its inhibitory effect on obesity\(^{11, 12}\) and promotion effect of adiponectin secretion\(^{13}\) have been reported. In addition, an anti-obesity effect of pteryxin has been shown by a fundamental experiment\(^8\). Moreover, in the present human clinical trial, no subject exhibited a statistical significant change in blood adiponectin level (n=21). However, when the analysis was conducted of only obese subjects (BMI ≥25; n=7), a significant increase was found at 8 weeks after intake. It has been reported that blood adiponectin level decreases in patients with obesity, diabetes, or coronary artery disease\(^{14}\). The results of this study suggest that adiponectin level might have increased in the subjects whose adiponectin secretion was inhibited due to obesity. It seems that there are two factors for this mechanism. First, chlorogenic acid in PJT acts on adipocyte directly, which might have promoted adiponectin secretion through activated nuclear hormone receptors and peroxisome proliferator-activated receptor γ (PPARγ)\(^{15, 16}\). Second, adiponectin secretion might have been promoted by reduction of enlarged adipocyte. This mechanism is based on a previous study that reported various "bad" adipocytokines such as bioactive proteins including

**Table 1 Body Composition and Blood Test Results**

<table>
<thead>
<tr>
<th></th>
<th>Before ingestion</th>
<th>After 4 weeks</th>
<th>After 8 weeks</th>
<th>After 12 weeks</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age</strong></td>
<td>52.6 ± 12.4</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td><strong>Gender (men/women)</strong></td>
<td>10/11</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td><strong>Height (cm)</strong></td>
<td>164.8 ± 8.2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Weight (kg)</strong></td>
<td>62.7 ± 10.3</td>
<td>62.8 ± 10.5</td>
<td>62.8 ± 10.3</td>
<td>63.1 ± 10.6</td>
</tr>
<tr>
<td><strong>BMI (kg/m(^2))</strong></td>
<td>23.0 ± 3.0</td>
<td>23.0 ± 3.0</td>
<td>23.1 ± 3.0</td>
<td>23.2 ± 3.0</td>
</tr>
<tr>
<td><strong>Body fat percentage (8%)</strong></td>
<td>25.1 ± 6.8</td>
<td>24.9 ± 6.9</td>
<td>24.5 ± 6.7*</td>
<td>24.9 ± 6.7</td>
</tr>
<tr>
<td><strong>Total cholesterol (mg/dl)</strong></td>
<td>230.6 ± 39.1</td>
<td>227.5 ± 32.8</td>
<td>227.4 ± 28.2</td>
<td>226.7 ± 33.3</td>
</tr>
<tr>
<td><strong>HDL cholesterol (mg/dl)</strong></td>
<td>61.9 ± 15.5</td>
<td>61.8 ± 14.4</td>
<td>61.6 ± 15.1</td>
<td>61.7 ± 16.0</td>
</tr>
<tr>
<td><strong>LDL cholesterol (mg/dl)</strong></td>
<td>140.3 ± 28.7</td>
<td>136.2 ± 27.4</td>
<td>138.4 ± 23.1</td>
<td>136.9 ± 25.4</td>
</tr>
<tr>
<td><strong>TG (mg/dl)</strong></td>
<td>114.0 ± 44.9</td>
<td>140.4 ± 83.0*</td>
<td>131.7 ± 73.7</td>
<td>133.0 ± 68.7</td>
</tr>
<tr>
<td><strong>Glucose (mg/dl)</strong></td>
<td>84.8 ± 8.9</td>
<td>85.1 ± 11.3</td>
<td>83.4 ± 8.3</td>
<td>84.2 ± 9.4</td>
</tr>
<tr>
<td><strong>HbA1c (%)</strong></td>
<td>5.5 ± 0.3</td>
<td>5.5 ± 0.3</td>
<td>5.4 ± 0.2**</td>
<td>5.4 ± 0.3*</td>
</tr>
<tr>
<td><strong>Adiponectin (μg/ml)</strong></td>
<td>9.7 ± 4.8</td>
<td>10.0 ± 4.0</td>
<td>10.0 ± 4.6</td>
<td>10.1 ± 4.3</td>
</tr>
</tbody>
</table>

| Adiponectin of obese subjects (μg/ml) n = 7 | 8.4 ± 3.9 | 8.9 ± 3.6 | 9.2 ± 4.3* | 9.2 ± 4.5 |

**BMI:** Body mass index, **HDL Cholesterol:** High Density Lipoprotein Cholesterol, **LDL Cholesterol:** Low Density Lipoprotein Cholesterol, **TG:** triglyceride

\(*: p < 0.05\)  \(**: p < 0.01\)
human tumor necrosis factor-α (TNF-α) or interleukin-6 (IL-6) are secreted when adipocytes are enlarged\(^{17,19}\), while adiponectin secretion as "good" adipocytokine is increased when enlargement of adipocyte is reduced. Considering that the body fat percentage decreased at 8 weeks after intake in this clinical study, these results are consistent with the previous data.

In addition, the mechanism that caused HbA1c to decrease significantly can be shown in vitro study. It has been reported that 3T3-L1 cells as preadipocyte to which cis-3',4'-diisovalerylkhellactone as extract of PJT was added showed an increase of alpha-glucosidase inhibitory activity and elevation of glucose uptake in the cells, in comparison with the cells to which it is not added\(^9\). In other words, in this clinical study, cis-3',4'-diisovalerylkhellactone included in PJT may have provided alpha-glucosidase inhibitory activity and decreased HbA1c level.

This study is the limit because it was a clinical trial without a control group. In the future, a randomized controlled trial using placebo is required.

**CONCLUSION**

In this study, it was found that intake of lyophilized powder of PJT for 12 weeks reduced body fat percentage and HbA1c level, which may contribute to improvement of glucose metabolism.

**GRANTS**

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**REFERENCES**


要 旨

沖縄産長命草（ボタンボウフウ）摂取による体組成および血液生化学的検査に及ぼす影響

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ボタンボウフウ (PJT) は、脂質及び糖代謝の改善効果が動物・細胞実験で報告されている。本研究は、脂質異常境界域の方に PJT を 12 週間摂取させ、体組成、生化学検査の経時的変化を検討した。その結果、HbA1c は摂取前と比較して有意に低下し、体脂肪率は摂取 8 週後で有意に減少した。アディポネクチンは肥満者 (n=7) において、摂取前と比較して摂取 8 週後に有意に上昇した。これらの事から、PJT は、耐糖能改善作用改善効果の可能性が示唆された。

キーワード：機能性食品、ボタンボウフウ、クロロゲン酸、糖代謝、アディポネクチン

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