The Favorable Effect of Style of Zea mays L. on Streptozotocin Induced Diabetic Nephropathy

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The effectiveness of water extract from the style of Zea mays on diabetic nephropathy was investigated in the development of new natural medicinal resources. Streptozotocin (STZ) induced diabetic rats were used to evaluate the therapeutic effect of the style. Urinary albumin excretion and creatinine clearance were examined for diagnosis of diabetic nephropathy. From these results it was learned that the style of Z. mays prevented glomerular hyperfiltration. The present findings indicated that the water extract of the title material suppressed the progression of diabetic glomerular sclerosis in STZ-induced diabetic rat.

Key words: diabetic nephropathy; style Zea mays L.; streptozotocin induced diabetic rat

Diabetes is a chronic and systemic disease that triggers life-changing complications in virtually every system of the body. Several candidate mechanisms contributing to diabetic complications have been proposed. These mechanisms are accepted widely and include the polyol pathway and glycation. Furthermore, the hyperaggregability of platelets, as well as their hypercoagulability in diabetic treatment has also been reported. We previously reported the effectiveness of Chinese crude drugs, marine algae and traditional Turkish folk medicines against these risk factors. However, there is a lack of reliable data to explain these effects. The kidneys are vital for ridding the body of toxic waste products, and maintaining fluid, mineral and electrolytes at levels compatible with life. Elevated blood glucose can damage the cells and micro blood vessels of the kidney. Advanced kidney damage results in the need for a kidney transplant.

MATERIAL AND METHODS

Plant Material The style of Zea mays L. (Gramineae) (Lot No. B1B01K29K) was purchased from MIKUNI & CO., LTD. (Osaka, Japan). A voucher specimen (No. NP 040111) was deposited with the laboratory of the Department of Natural Medicine and Phytochemistry at Meiji Pharmaceutical University.

Extraction of Plant Material The style of Z. mays (2 kg) was extracted with water twice at 80 °C for 2 h. The water layer was lyophilized to give a water extract (160 g).

Experimental Animals Male Wistar rats (7 weeks old) were obtained from Japan Laboratory animals Inc. (Tokyo, Japan). The experiments were carried out in accordance with the guidelines of the Institutional Ethics Committee for Animal Research, Meiji Pharmaceutical University (No. 1513).

RESULTS

Body weight, the concentration of plasma glucose, fructosamine level and hemoglobin A1C level at 12 weeks are summarized in Table 1. The difference of body weight between DM-NT and NC observed was significant (p<0.01). The plasma glucose levels in DM-NT were significantly higher than in the NC (p<0.01), however, there was no difference in the plasma glucose, fructosamine or hemoglobin A1C levels between DM-T and DM-NT. The tissue to body weight ratio of kidney, urinary albumin excretion and creatinine clearance at 12 weeks are summarized in Table 2. The weight ratios of kidney to body weight were significantly higher in DM-NT than those in the NC (p<0.01). Creatinine clearance in DM-T was significantly lower than DM-NT (p<0.05). There was no significant difference in urinary albumin excretion between DM-NT and DM-T, but the tendency of lower urinary albumin excretion in DM-T was observed.
Table 1. Effects of Water Extract of Style of Z. mays on Body Weight (BW), Plasma Glucose (PG), Fructosamine (FRA) and Hemoglobin A\textsubscript{1C} (HbA\textsubscript{1C}) Level

<table>
<thead>
<tr>
<th></th>
<th>BW (g)</th>
<th>PG (mg/dl)</th>
<th>FRA (\mu M)</th>
<th>HbA\textsubscript{1C} (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DM-T</td>
<td>289±26\textsuperscript{f}</td>
<td>442±109</td>
<td>300±11\textsuperscript{f}</td>
<td>8.2±0.9\textsuperscript{f}</td>
</tr>
<tr>
<td>DM-NT</td>
<td>262±35*</td>
<td>478±146*</td>
<td>291±17*</td>
<td>7.8±0.9*</td>
</tr>
<tr>
<td>NC</td>
<td>462±30</td>
<td>142±19</td>
<td>184±12</td>
<td>3.3±0.8</td>
</tr>
</tbody>
</table>

DM-T: administered group (diabetes), DM-NT: non-administered group (diabetes), NC: control. * p<0.01 vs. NC (means±S.D.).

Table 2. Effects of Water Extract of Style of Z. mays on the Weight Ratio of Kidney to Body Weight (RW), Urinary Albumin Excretion (UAE) and Creatinine Clearance (Ccr)

<table>
<thead>
<tr>
<th></th>
<th>RW (renal wight g/100 g BW)</th>
<th>UAE (mg/d)</th>
<th>Ccr (ml/min/100 g BW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DM-T</td>
<td>1.04±0.17</td>
<td>1.70±1.23</td>
<td>0.70±0.11**</td>
</tr>
<tr>
<td>DM-NT</td>
<td>1.20±0.21*</td>
<td>2.38±1.35*</td>
<td>0.89±0.15*</td>
</tr>
<tr>
<td>NC</td>
<td>0.64±0.02</td>
<td>0.63±0.60</td>
<td>0.38±0.20</td>
</tr>
</tbody>
</table>

DM-T: administered group (diabetes), DM-NT: non-administered group (diabetes), NC: control. * p<0.01 vs. NC, ** p<0.05 vs. DM-NT (means±S.D.).

DISCUSSION

There have been many reports concerning the usefulness of herbal drugs for diabetes, many of which have indicated an anti-hyperglycemic effect. However, to our knowledge, very little is currently available in published literature on the preventive or therapeutic effect of herbal drugs against diabetic complications including nephropathy and retinopathy. It is important to report the effectivity of herbal drugs on these diseases from the standpoint of the development of new bioactive resources.

The style of Zea mays L. (Gramineae) is commonly known as corn silk and has been used in folk medicine as a decoction for diuretic treatment. An anti-hyperglycemic effect and amelioration of chronic nephropathy by this material were also presented in a dictionary of traditional Chinese medicines, although these therapeutic mechanisms have not been demonstrated clearly. A comprehensive understanding of the effectivity for diabetes and related complications of corn silk remains incomplete. To determine the potential of this material requires further investigation. The objective of the present study was to clarify the effect of water extract of corn silk (style of Z. mays) on diabetes and related complications using STZ-induced diabetic rats. The plasma glucose concentration of both the administered and non-administered groups shown in Table 1 are obviously higher than the control group at 12 weeks. This result conflicts with the reports in a dictionary on traditional Chinese medicines. In general, the herbal drugs used for diabetic treatment have an anti-hyperglycemic effect. This discrepancy is attributed to the strong induction of diabetes by STZ. Since an STZ-induced diabetic rat is extremely hyperglycemic, a weak anti-hyperglycemic effect of a crude drug might not be observable. This result is supported by the levels of fructosamine and hemoglobin A\textsubscript{1C}. Consequently, the amelioration of blood sugar dynamics of a water extract of corn silk was not indicated on this study. However, the oral administration of such an extract to the administered group did slightly improve the gain in body weight. As shown in Table 2, the weight ratio of kidney to body weight, urinary albumin excretion and creatinine clearance in the non-administered group were significantly higher than that of the normal control group. These phenomena could be explained in terms of glomerular hyperfiltration. The increase of creatinine clearance is generally observed in early diabetic nephropathy. On the other hand, increase in creatinine clearance in the administered group was significantly inhibited compared with the non-administered group. Such tendency was also observed in urinary albumin excretion. These results indicated that the water extract of corn silk would be a candidate as a useful substance against glomerular hyperfiltration. In general, herbal drugs show moderate efficiency and prolonged prescription of an herbal drug is essential for treatment against a chronic disease. Therefore, in some cases the therapeutic effect of an herbal drug might not be observed on an acute pathogenesis model such as an STZ-induced diabetic model. It must be emphasized that corn silk indicated effectivity against STZ-induced diabetic nephropathy. It is crucial to understand the mechanism of water extract of corn silk to further improve the condition of diabetic nephropathy. The anti-hyperglycemic effect of water extract of corn silk was not confirmed, therefore, its preventive effect might be attributable to improvement of blood dynamics in kidney or inhibitory activity in the late stage of glycation, in which Advanced Glycation End products (AGEs) are generated from Amadori compounds or the polyl pathway and so on. To obtain reliable evidence accounting for these therapeutic effects, further investigation is planned.

Acknowledgments This work was supported in part by a grant promoting the advancement of education and research in graduate schools from the Ministry of Education, Culture, Sports, Science and Technology of Japan, and a grant from the Japan-China Medical Association. We express our deep thanks to Prof. Shimichi Tashiro of Showa Pharmaceutical University in this paper.

REFERENCES