Preventive Effect of a Chicken Extract on the Development of Hypertension in Stroke-prone Spontaneously Hypertensive Rats

Yasuo Matsumura,† Satomi Kita, Hiroyuki Ono, Yoshinobu Kiso, and Takaharu Tanaka

1Department of Pharmacology, Osaka University of Pharmaceutical Sciences, 4-20-1 Nasahara, Takatsuki, Osaka 569-1094, Japan
2Department of Research & Development, Cerebos Pacific Ltd., 1 Kim Seng Promenade #11-01/06, Singapore 237994
3Institute for Health Care Science, Suntory Ltd., Shimamoto-cho, Mishima-gun, Osaka 618-8503, Japan

Received August 6, 2001; Accepted December 25, 2001

The antihypertensive effect of Brand’s Essence of Chicken (BEC), a popular chicken extract used as a traditional health food, was examined with stroke-prone spontaneously hypertensive rats (SHRSPs). The animals were maintained from 6 to 25 weeks of age on drinking water with or without BEC. The BEC-fed group showed a significant reduction in the development of hypertension when compared with the control animals. The levels of blood urea nitrogen and plasma creatinine in the BEC-fed group were significantly lower than those in the control group, suggesting that the renal glomerular function had been improved by the daily administration of BEC. It thus seems likely that BEC would be useful as a prophylactic treatment against the development of hypertension and renal injury.

Key words: chicken extract; stroke-prone spontaneously hypertensive rat; antihypertensive effect; renoprotective effect

In Asian regions, and particularly in Chinese communities in Southeast Asia, Brand’s Essence of Chicken (BEC) is used as a traditional health food for various purposes, including recovery from postpartum sickness, the physical development of athletes, recovery from mental stress and enhancement of the mental efficiency of students.1,2 However, there is little information on the effect of this chicken extract on the development and progression of such cardiovascular diseases as hypertension. In the present study, we evaluate whether BEC feeding has a preventive effect on the development of hypertension in stroke-prone spontaneously hypertensive rats (SHRSP) which have been extensively used as a model for human hypertension.

BEC (70 ml/bottle, Cerebos Pacific, Ltd., Singapore) is produced by a water extraction process from chicken meat for several hours under high-temperature conditions. After removing the fat, it is concentrated and bottled. The solid content consists of mainly proteins, amino acids and peptides.

Male SHRSPs (6 weeks old, Kinki University School of Medicine, Osaka, Japan) were separated into a BEC-fed group and a control group. For the BEC-fed group, BEC powder was added to tap water to drink ad libitum, the control animals being given free access to tap water. BEC was freeze-dried, and the resulting powder (about 6 g from 1 bottle of BEC) was added to the drinking water at concentrations of 0.3–0.8 mg/ml. A feed from this drinking water (20–50 ml/rat/day) was equal to a dosage of about 100 mg of BEC powder/kg/day, and corresponds to approximately one bottle of BEC/human/day. The systolic blood pressure was monitored weekly with a tail cuff and pneumatic pulse transducer (BP-98A, Softron). After 19 weeks, the animals were placed in metabolic cages, urine was collected overnight, and then all the rats were bled from the abdominal aorta to obtain blood samples. The heart, kidneys and aorta were excised from each animal and weighed. The experimental protocol and animal care method used in the experiments were approved by the Experimental Animal Research Committee at Osaka University of Pharmaceutical Sciences. The blood urea nitrogen (BUN), protein and creatinine levels in the plasma and urine were respectively determined with BUN-test-Wako, Total protein-test-Wako and Creatinine-test-Wako kits (Wako Pure Chemical Industries, Osaka, Japan). The urinary N-acetyl-β-glucosaminidase (NAG) activity, as an index of damage to the proximal tubules, was measured by using the synthesized substrate, sodio-m-cresolsulphonphthaleinyl N-acetyl-β-
Changes in the Body Weight (A) and Systolic Blood Pressure (B) of SHRSPs with or without Treatment by the Chicken Extract (BEC).

Each point and bar denotes the mean ± SEM. *\( P < 0.05 \), compared with the control value.

Table 1. Comparative Data on the Body, Heart, Kidney and Aorta Weights in SHRSPs with or without Treatment with BEC

<table>
<thead>
<tr>
<th></th>
<th>Control (n = 5)</th>
<th>BEC-fed (n = 5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body weight (BW), g</td>
<td>302 ± 6</td>
<td>295 ± 7</td>
</tr>
<tr>
<td>Heart weight (HW), g</td>
<td>1.38 ± 0.04</td>
<td>1.34 ± 0.03</td>
</tr>
<tr>
<td>HW/BW, mg/g</td>
<td>4.66 ± 0.10</td>
<td>4.54 ± 0.17</td>
</tr>
<tr>
<td>Kidney weight, g</td>
<td>1.19 ± 0.03</td>
<td>1.21 ± 0.02</td>
</tr>
<tr>
<td>Aorta weight, mg/3 cm</td>
<td>38.0 ± 1.5</td>
<td>38.6 ± 0.9</td>
</tr>
</tbody>
</table>

Each value is the mean ± SEM. SHRSPs, stroke-prone spontaneously hypertensive rats; BEC, Brand’s Essence of Chicken.

Table 2. Comparative Data on the Blood and Urinary Parameters in SHRSPs with or without Treatment with BEC

<table>
<thead>
<tr>
<th></th>
<th>Control (n = 5)</th>
<th>BEC-fed (n = 5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BUN, mg/dl</td>
<td>21.1 ± 1.1</td>
<td>16.4 ± 0.5*</td>
</tr>
<tr>
<td>UproV, mg/24 h/100 g BW</td>
<td>12.8 ± 4.8</td>
<td>5.7 ± 0.6</td>
</tr>
<tr>
<td>Urinary NAG activity, U/24 h/100 g BW</td>
<td>0.106 ± 0.014</td>
<td>0.089 ± 0.016</td>
</tr>
<tr>
<td>Pcr, mg/dl</td>
<td>0.424 ± 0.043</td>
<td>0.286 ± 0.026*</td>
</tr>
<tr>
<td>Ccr, ml/min/100 g BW</td>
<td>0.564 ± 0.147</td>
<td>0.756 ± 0.193</td>
</tr>
<tr>
<td>UV, ml/min/100 g BW</td>
<td>2.92 ± 0.54</td>
<td>1.84 ± 0.41</td>
</tr>
</tbody>
</table>

Each value is the mean ± SEM. *\( P < 0.05 \), compared with the control value. SHRSPs, stroke-prone spontaneously hypertensive rats; BEC, Brand’s Essence of Chicken; BUN, blood urea nitrogen; UproV, urinary excretion of protein; NAG, N-acetyl-b-glucosaminidase; Pcr, plasma creatinine level; Ccr, creatinine clearance; UV, urine volume.

D-glucosaminide. Each value is expressed as the mean ± SEM. A statistical analysis of the blood pressure from BEC feeding was performed by two-way repeated ANOVA. Student’s unpaired \( t \)-test was used for analyzing values between the BEC and control groups at the end of the experiment. Differences are considered to have statistical significance at \( P < 0.05 \).

At the beginning of the experiment, the systolic blood pressure (SBP) of the control and BEC groups was 132 ± 5 and 133 ± 4 mmHg, respectively. As shown in Fig. 1B, the blood pressure progressively increased in both groups. However, the development of hypertension was significantly suppressed by BEC feeding (\( P < 0.05 \)). At 19 weeks (25 weeks old), SBP of the control and BEC groups was 263 ± 9 and 238 ± 4 mmHg, respectively. No significant difference in the body weight change was apparent between the two groups (Fig. 1A). Comparative data for the body and some organ weights at 19 weeks with and without BEC feeding are summarized in Table 1. BEC feeding was without effect on these weights.

Table 2 indicates the renal functional parameters at the end of the experimental period. The levels of BUN and plasma creatinine in the BEC-fed group were significantly lower than those in the control group. There were no significant differences in other parameters between the two groups, although the urinary excretion of protein and the creatinine clearance tended to be improved by the supplementation of BEC.

The kidney is known to be the main target of organ damage in hypertension. Therefore, it is of interest to evaluate whether an antihypertensive treatment exerts a protective effect against the development of renal dysfunction. The results of the present study demonstrate that the BEC treatment to SHRSPs significantly suppressed the development of hypertension and ameliorated such renal functional parameters as the BUN and plasma creatinine levels, both of which are well-known markers of hypertensive renal diseases. Since BEC feeding was started at the prehypertensive stage, our results suggest that treatment with the chicken extract may be a prophylactic regimen against the development of hypertension.

SHRSPs have been used extensively as a useful model for human hypertension. This hypertensive model has shown that treatments with calcium antagonists, the angiotensin I-converting enzyme inhibitor, and angiotensin II antagonists produced an efficient antihypertensive action and prevented the progression of renal injury.

The mechanism by which BEC exerted its antihypertensive activity is unclear. Several humoral fac-
tors such as the renin-angiotensin system are known to play an important role in the development of hypertension and cardiovascular organ damage. However, it is unlikely that BEC exerted its antihypertensive action by interfering with the renin-angiotensin system, since the BEC treatment has also been found effective against renin-independent mineralocorticoid-induced hypertension in rats.

BEC is an extract of chicken muscle which is processed with water under high-temperature conditions, and contains mainly protein, amino acids and peptides. Among the ingredients in the BEC powder used in our study, the candidates for active substances which exerted the antihypertensive effect may be carnosine (β-alanyl-L-histidine) and/or the derivative of carnosine, anserine (β-alanyl-1-methyl-L-histidine), both of which are present in large amounts in chicken meat (BEC powder contains carnosine and anserine at about 10 mg/g and 30 mg/g, respectively). A recent study has demonstrated the endothelium-independent vasodilatory action of carnosine in rat aortic rings. Moreover, this peptide possesses antioxidative and free radical-scavenging functions, which may contribute to its hypotensive action, based on findings that the production of oxygen free radicals such as the superoxide anion was enhanced in vascular tissues from hypertensive animals such as SHRSPs, and that oxidative stress is closely related to the development of hypertension. Further investigations are in progress to clarify the active component and mechanism for the antihypertensive activity of BEC.

References


7) Dzau, V. J., Significance of the vascular renin-angiotensin pathway. Hypertension, 8, 553–559 (1986).


