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Effects of Angelica polysaccharide on erythrocyte immunity and marrow hematopoiesis in chickens

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To investigate the effects of Angelica polysaccharide on erythrocyte immunity and marrow hematopoiesis in chickens, Angelica polysaccharide was used for the study of immunity and hematonic mechanism in order to provide basis for clinical reference. In this experiment, three gradient dosages (50, 100, 150 mg/kg body weight) of Angelica polysaccharide were drenched to the control group and the anemia groups, respectively. The anemia chickling model was made by abdominal injection of cyclophosphamide (CY) for 6 days (80 mg/kg·day). Red blood cell-C3b receptor (RBC-CR1) and red blood cell-immune complex (RBC-IC) rosette rates were measured and analyzed. Ectogenetic semi-solid culture medium of bone marrow hemopoietic progenitor cells was used to observe Angelica polysaccharide and separated serum from Angelica polysaccharide treatment on the proliferation of colony-forming unit-erythrocyte (CFU-E), burst-forming unit-erythrocyte (BFU-E) and colony-forming unit-granulocyte macrophage (CFU-GM). The results showed that Angelica polysaccharide can significantly increase RBC-CR1 rosette rate in the healthy chicken groups (p<0.01), but had no more effect on RBC-IC rosette rate (p>0.05). At the same time, Angelica polysaccharide can restore the RBC-CR1 rosette rate and the RBC-IC rosette rate caused by cyclophosphamide to the normal level. Serum containing Angelica polysaccharide can significantly facilitate the proliferation on CFU-E (p<0.01), BFU-E (p<0.01) and CFU-GM (p<0.01), but Angelica polysaccharide had no more direct proliferation on CFU-E, BFU-E and CFU-GM. This indicated that Angelica polysaccharide had the proliferation on hemopoietic progenitor cells of marrow by the change of hemopoietic factor.

Key words: Polysaccharide, chicken, erythrocyte, immunity, hematopoiesis.

INTRODUCTION

Dozens of Chinese herbal medicinal formulas have been used for promotion of blood production for centuries. Beneficiary effects of medicinal plants have been reported on a series of biological functions such as antioxidants or diuretic (Zhang et al., 2012; Khan et al., 2012a, b). The root of Angelica Sinensis, known as Danggui in China, is one of the most popular Chinese herbal medicines and widely used in traditional Chinese medicinal therapy for various diseases as well as a healthful food tonic and spice for thousands of years (Huang and Wei, 2002). Being called the “female ginseng”, it is excellent as an all purpose women's herb (Hardy, 2000). Danggui can be used for anemia due to chronic renal failure (CRF) (Bradley et al., 1999) and can enhance hematopoiesis by stimulating macrophages, fibroblast, lymphocytes in hemapoietic inductive microenvironment and muscle tissue to secrete hematopoietic growth factors (Mak et al., 2006). A. Sinensis is contained by more than 80 composite formulae. Modern researches indicate that phthalides, organic acids and their esters, polysaccharides are main chemical components related to the bioactivities and pharmacological properties of Danggui (Yi et al., 2009). Angelica polysaccharide (APS), as the main component of Herbal medicine Angelica, has the efficacy of enriching

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blood, purifying blood quality, emmenagoue, acesodyne, lenitive and improving circulation (Varga et al., 2010; Wang et al., 2006). It is used frequently in clinical practice and also frequently appears as the main ingredient in prescriptions for bone injuries (Yang et al., 2002). It also has significant functions on immune and hematopoietic system, and better curative effects on anti-inflammation. Recent pharmacological studies demonstrated that APS had radio-protective effects in irradiated mice through modulation of proliferating response of hematopoietic stem cells (Ye et al., 2001). Gastrointestinal protective effects (Cho et al., 2000; Ye et al., 2003) and the mechanism (Ye et al., 2001) of Angelica polysaccharide in rats have been reported and APS was known to be protective against ethanol- or indomethacin-induced mucosal damage (Choy et al., 1994). It was also reported that A. sinensis crude extract increased the proliferation of gastric epithelial cells through modulation of several proliferation-related genes, including epidermal growth factor (EGF) receptor and ornithine decarboxylase (ODC) and c-Myc (Ye et al., 2003, 2001). Effects of Angelica polysaccharide on blood coagulation and platelet aggregation (Yang et al., 2002) and the protective effect of the polysaccharides-enriched fraction from A. sinensis on hepatic injury (Ye et al., 2001) were also studied. In cancer cells, Angelica polysaccharide has been reported to possess anti-tumor effects (Shang et al., 2003; Tsai et al., 2005) and also exhibited immunostimulating activities both in vitro and in vivo (Cho et al., 2000). Cyclophosphamide (CY) is a cytostatic agent that produces systemic toxicity especially on cells with high proliferative capacity, while polysaccharides from Angelica polysaccharide have been shown to increase the turnover of hemopoietic stem cells (Hui et al., 2006). In the modern society, Angelica polysaccharide has a better potential for drug development (Sarker and Nahar, 2004). However, the protective effect of Angelica polysaccharide on CY-induced cytotoxicities in both erythrocyte immunity and the hemopoietic was undefined. Any of these actions would extend the therapeutic application of CY in cancer patients in which the herb could be used together with the cytotoxic agents in cancer therapeutic regimen. In this study, we investigated whether Angelica polysaccharide could protect the erythrocyte immunity and hematopoiesis from the cytotoxicity of CY in chickens. We also tested the changes of the hemopoietic factors in response to the damage by CY and protection by Angelica polysaccharide.

MATERIALS AND METHODS

Treatment of animals

One-day-old Hyline Brown chickens (male) were purchased from Hebei Laboratory Animal Center, housed in cages and lighted for 24 h at the beginning of pretrial period. The chicklings were given free access to feedstuff and water. All the experimental animals were treated in accordance with the guidelines of the Chinese Council for Animal Care.

Preparation of reagents

Angelica polysaccharide and heparin sodium were purchased from Beijing Biochem Co., Ltd. (China). Cyclophosphamide, microzyme, trypan blue, and methylcellulose were purchased from Sigma Biotech Co., Ltd. (USA), FBS, Ficol, and RPMI-1640 were purchased from Invitrogen Biotech Co., Ltd. (USA). L-glutamine, 2-mercaptoethanol were obtained from Amresco Biotech Co., Ltd. (USA).

Preparation of anemia chicken model (Ji et al., 2004; Mao et al., 2003)

The anemia chicken model was made by abdominal injection daily of cyclophosphamide for 6 days (80 mg/kg-day) starting from 14-day-old. Red blood cells (RBC) and hemoglobin were measured.

Experiment 1. Effects of Angelica polysaccharide on erythrocyte immunity in Chickens

Experiment design

Forty 20-day-old normal chickens were randomly divided into four groups with the same number and similar body weight. The healthy chickens in Group I were not given Angelica polysaccharide as control, but the healthy chickens in Groups II, III and IV were given the gradient dosages (50, 100 and 150 mg/kg) of Angelica polysaccharide respectively. Forty 20-day-old anemia chickens were also randomly divided into four groups with the same number and similar body weight. The anemia chickens in Group V were not given Angelica polysaccharide, but the anemia chickens in Groups VI, VII and VIII were given the gradient dosages (50, 100 and 150 mg/kg) of Angelica polysaccharide respectively. After 7 days, the blood samples were collected from heart for RBC-CR1 and RBC-IC rosette rates tests.

RBC-CR1 rosette rate examination

The steps were followed with reference to those of previous study (Guo, 2004). 50 µl of diluted erythrocyte was taken and added to 50 µl blood plasma and 50 µl microzyme Figures 1 and 2. The mixture was incubated at 37°C water bath for 30 min, and then 0.25% glutaradheyde (50 µl) was added to the mixture, mixed by gently shaking, and was allowed to stand still for 5 to 10 min. 50 µl mixture was dropped on glass slide, fixed by methanol for one minute, dried naturally, and dyed by Giemsa-dye for 10 to 15 min. The glass slide was washed and observed after air-drying. According to the nine-point principle, nine points from the left, middle, right and up, middle, down were chosen to be observed under the optical microscope, and the erythrocytes showed the red color and the microzymes showed blue. One microzyme conglutinated with two or more red blood cells and was called one rosette. It was observed twice and the average was recorded. Later, 200 erythrocytes were considered and the rosette rate was calculated.

RBC-IC rosette rate examination

The steps were followed by measurement of RBC-IC rosette rate except that blood plasma was instead by normal saline (Guo et al.,...
Experiment 2. Effects of Angelica polysaccharide on proliferation of chicken bone marrow hemopoietic progenitor cells

Effects of serum containing Angelica polysaccharide on proliferation of chicken bone marrow hemopoietic progenitor cells

Preparation of bone marrow cell suspension: Twenty 14-old-day normal chickens with the same body weight were sacrificed, and the bilateral femurs were separated under aseptic conditions. The medullar cavity with RPMI 1640 medium (containing 10 U/ml heparin) were irrigated repeatedly. The cells were collected and lymphocyte separation medium of the same dose was added. After 20-min-centrifugation (2000 r/min), the middle layer was collected and washed by RPMI 1640 medium, and centrifuged three times at 1000 r/min for 10 min each. The cell pellet was suspended in RPMI 1640 medium. The cell viability was checked by Trypan blue. When the cell viability was over 95%, cell concentration was adjusted to 2×10⁵ cells/ml (Zheng and Wang, 2002; Yang et al., 2006).

Preparation of culture medium: Methylcellulose semi-solid culture medium was used to culture the colony of hemopoietic progenitor cells and detect the colony proliferation. Culture media were inoculated in 96-well plate at 37°C under 5% CO₂ (Liu et al., 2010). The culture media of colony-forming unit-erythrocyte (CFU-E), burst-forming unit-erythrocyte (BFU-E) and colony-forming unit-granulocyte macrophage (CFU-GM) are as shown in Tables 1 and 2.

Preparation of serum containing Angelica polysaccharide: Twenty 7-old-day normal chickens with the same body weight were drenched with Angelica polysaccharide (100 mg/kg) for 7 days. The blood was collected from heart, and the serum was separated, filtrated and stored at 4°C.

Effects of serum containing Angelica polysaccharide on proliferation of chicken bone marrow hemopoietic progenitor cells

The culture media of CFU-E, BFU-E, CFU-GM and bone marrow cells were inoculated in 96-well plates. 25 wells were divided into 5 groups, with 5 replications per group. 0.2 ml distilled water was added in Group I as control. 0.2 ml chicken serum was added in Group II. The gradient dosages (0.1, 0.2 and 0.3 ml) of serum containing Angelica polysaccharide were added in Groups III, IV and V, respectively. When CFU-E was cultured for 3 days, colony which contained 8 to 50 cells was one CFU-E under inverted microscope. When BFU-E was cultured for 7 days, colony which contained more than 50 cells was one CFU-E under inverted microscope. When CFU-GM was cultured for 6 days, colony which contained more than 20 cells was one CFU-E under inverted microscope. CFU-E, BFU-E and CFU-GM were all stained with Giemsa staining; the cell morphology was observed and the number of colony was counted (Yang et al., 2007).

Effect of Angelica polysaccharide on proliferation of chicken bone marrow hemopoietic progenitor cells

20 wells were divided into 4 groups, with 5 replications per group. The steps followed were as aforementioned for the effects of serum containing Angelica polysaccharide on the proliferation of chicken bone marrow hemopoietic progenitor cells except that serum containing Angelica polysaccharide was replaced by Angelica polysaccharide. 0.2 ml distilled water was added in Group I as control. The gradient dosages of Angelica polysaccharide were added in Groups III, IV and V, respectively at the density of 50, 100 and 150 μg/ml.

Data statistics

The data were taken as mean and standard deviation, using the SPSS11.0 software. The differences were assessed by one way ANOVA.
## Table 1. Ingredients of CFU-EBFU-E culture medium.

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Amount (ml)</th>
<th>Final concentration (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMC</td>
<td>0.2</td>
<td>10</td>
</tr>
<tr>
<td>NCS</td>
<td>0.5</td>
<td>25</td>
</tr>
<tr>
<td>$10^{-5}$M 2- ME</td>
<td>0.2</td>
<td>10</td>
</tr>
<tr>
<td>3% L-Glu</td>
<td>0.02</td>
<td>1</td>
</tr>
<tr>
<td>EPO</td>
<td>0.3</td>
<td>15</td>
</tr>
<tr>
<td>2.2%MC</td>
<td>0.5</td>
<td>25</td>
</tr>
<tr>
<td>RPMI-1640</td>
<td>0.3</td>
<td>15</td>
</tr>
</tbody>
</table>

BMC, Bone marrow cell; NCS, new-born calf serum; 2-ME, 2-mercaptoethanol; L-Glu, L-glutamine; EPO, erythropoietin; MC, methylcellulose.

## Table 2. Ingredients of CFU-GM culture medium.

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Amount (ml)</th>
<th>Final concentration (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMC</td>
<td>0.2</td>
<td>10</td>
</tr>
<tr>
<td>NCS</td>
<td>0.5</td>
<td>25</td>
</tr>
<tr>
<td>3% L-Glu</td>
<td>0.02</td>
<td>1</td>
</tr>
<tr>
<td>GM-CSF</td>
<td>0.3</td>
<td>15</td>
</tr>
<tr>
<td>2.2%MC</td>
<td>0.5</td>
<td>25</td>
</tr>
<tr>
<td>RPMI-1640</td>
<td>0.5</td>
<td>25</td>
</tr>
</tbody>
</table>

## Table 3. Effects of Angelica polysaccharide on erythrocyte immunity in healthy chicken.

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Dosage (mg/kg)</th>
<th>RBC-CR1 rosette rate</th>
<th>RBC-IC rosette rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>I (control of healthy chicken)</td>
<td>10</td>
<td>0</td>
<td>7.587±0.508$^{aA}$</td>
<td>5.967±0.508</td>
</tr>
<tr>
<td>II (Low dosage)</td>
<td>10</td>
<td>50</td>
<td>7.862±0.299$^{aA}$</td>
<td>5.797±0.498</td>
</tr>
<tr>
<td>III (Middle dosage)</td>
<td>10</td>
<td>100</td>
<td>9.591±0.782$^{aB}$</td>
<td>5.994±0.562</td>
</tr>
<tr>
<td>IV (High dosage)</td>
<td>10</td>
<td>150</td>
<td>12.545±0.597$^{aB}$</td>
<td>6.453±0.635</td>
</tr>
</tbody>
</table>

The different lowercase and capital letters showed significantly difference at 0.05 and 0.01 level, respectively.

## RESULTS

### Establishment of anemia chicken model

The anemia model was made by abdominal injection of cyclophosphamide for 6 days (80 mg/kg•day) when the chickens were 14-day-old. 6 days later, the chickens behaved as follows, sluggish activity, shrinking into oneself, broken-winded, loose-feather, waxy eyelid and nonnasality. Their hemoglobin was just 60% of the normal chicken. These indicated the ideal anemia model was successfully set up.

### Effects of Angelica polysaccharide on erythrocyte immunity in healthy chickens

RBC-CR1 rosette rate in Group II (50 mg/kg) had no more change than the control group. RBC-CR1 rosette rate in Group III (100 mg/kg) was notably higher than the control group (p<0.05). RBC-CR1 rosette rate in Group IV (150 mg/kg) was significantly higher than the control group (p<0.01). However, the RBC-IC rosette rates of the three different dosage groups had no more change than that of the control group (Table 3).

### Effects of Angelica polysaccharide on erythrocyte immunity in anemia chickens

RBC-CR1 rosette rate in Group V was significantly lower than Group I (p<0.01). However, RBC-IC rosette rate in Group V was significantly higher than Group I (p<0.01). After the anemia chickens were given Angelica polysaccharide, RBC-CR1 rosette rate gradually increased and restored to the normal level as Group I, at
Table 4. Effects of Angelica polysaccharide on erythrocyte immunity in anemia chicken.

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Dosage (mg/kg)</th>
<th>RBC-CR1 rosette rate</th>
<th>RBC-IC rosette rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>I (control of healthy chicken)</td>
<td>10</td>
<td>0</td>
<td>7.587±0.508aA</td>
<td>5.967±0.508aA</td>
</tr>
<tr>
<td>V (CY without Angelica polysaccharide)</td>
<td>9</td>
<td>0</td>
<td>5.429±0.369bB</td>
<td>8.286±0.541bB</td>
</tr>
<tr>
<td>VI (CY with low dosage)</td>
<td>10</td>
<td>50</td>
<td>6.429±0.881ab</td>
<td>6.714±0.656a</td>
</tr>
<tr>
<td>VII (CY with middle dosage)</td>
<td>9</td>
<td>100</td>
<td>7.429±0.662ac</td>
<td>6.000±0.588aA</td>
</tr>
<tr>
<td>VIII (CY with high dosage)</td>
<td>10</td>
<td>150</td>
<td>7.286±0.565ac</td>
<td>6.000±0.496aA</td>
</tr>
</tbody>
</table>

CY, Cyclophosphamide. The different lowercase and capital letters showed significantly difference at 0.05 and 0.01 level, respectively.

Table 5. Productive rates of CFU-E, BFU-E and CFU-GM.

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Dosage (ml)</th>
<th>CFU-E</th>
<th>BFU-E</th>
<th>CFU-GM</th>
</tr>
</thead>
<tbody>
<tr>
<td>I (control)</td>
<td>5</td>
<td>0.2</td>
<td>106.000±12.107aA</td>
<td>14.200±5.478aA</td>
<td>24.400±7.570aA</td>
</tr>
<tr>
<td>II (serum of healthy chicken)</td>
<td>5</td>
<td>0.2</td>
<td>125.400±10.658ab</td>
<td>22.400±5.080b</td>
<td>36.400±5.369b</td>
</tr>
<tr>
<td>III (serum containing Angelica polysaccharide with low dosage)</td>
<td>5</td>
<td>0.1</td>
<td>137.600±17.441cB</td>
<td>26.200±6.305cB</td>
<td>65.200±9.208cB</td>
</tr>
<tr>
<td>IV (serum containing Angelica polysaccharide with middle dosage)</td>
<td>5</td>
<td>0.2</td>
<td>138.000±9.425cB</td>
<td>28.400±4.582cB</td>
<td>57.600±9.882cB</td>
</tr>
<tr>
<td>V (serum containing Angelica polysaccharide with high dosage)</td>
<td>5</td>
<td>0.3</td>
<td>120.600±21.255ab</td>
<td>17.200±5.245a</td>
<td>38.400±5.879b</td>
</tr>
</tbody>
</table>

The different lowercase and capital letters showed significantly difference at 0.05 and 0.01 level, respectively.

the same time RBC-IC rosette rate gradually decreased and restored to the normal level as Group I. There were no notable changes in the three different dosage groups compared with Group I (p>0.05). RBC-CR1 rosette rate in Group VII (middle dosage) and Group VIII (high dosage) were notably higher than Group V (p<0.05). RBC-IC rosette rate in Group VI was notably lower than Group V (p<0.05). RBC-IC rosette rate in Group VII and VIII were significantly lower than group V (p<0.01). In a word, Angelica polysaccharide can restore the decrease of RBC-CR1 rosette rate and the increase of RBC-IC rosette rate caused by cyclophosphamide to the normal level (Table 4).

**Effects of serum containing Angelica polysaccharide on proliferation of chicken bone marrow hemopoietic progenitor cells**

It was shown in Table 5 that serum containing Angelica polysaccharide in Group III (low dosage) and IV (middle dosage) had significant effects on CFU-E than Group I (p<0.01). Serum of healthy chicken in Group II had notable effect on BFU-E than Group I (p<0.05). Serum containing Angelica polysaccharide in Groups III (low dosage) and IV (middle dosage) had notable effects on BFU-E than Group II (p<0.05).

The serum containing Angelica polysaccharide in Groups III (low dosage) and IV (middle dosage) had significant effects on CFU-GM than Group I (p<0.01). Serum of healthy chicken in Group II and serum containing Angelica polysaccharide in Group V (high dosage) had notable effects on CFU-GM than Group I (p<0.05). Serum containing Angelica polysaccharide in Groups III (low dosage) and IV (middle dosage) had notable effects on CFU-GM than Group II (p<0.05).

**Effect of Angelica polysaccharide on proliferation of chicken bone marrow hemopoietic progenitor cells**

As shown in Table 6, the different dosages of Angelica polysaccharide had no notable effects on CFU-E, BFU-E and CFU-GM than the control group I (p>0.05).

**DISCUSSION**

Many methods could set up the bone marrow inhibition
The main immune function of erythrocyte is removing the immune complex in blood circulation. The level of RBC-IC rate reflects the scavenging speed of RBC-IC. RBC-IC rosette rates of anemia chicken given Angelica polysaccharide were lower than anemia chicken not given Angelica polysaccharide, which showed Angelica polysaccharide improved the removing ability of erythrocyte immunity to immune complex in blood circulation. Angelica polysaccharide may activate the activity of CR1 in cytomembrane, decrease the number of C3b receptors, accelerate the clear of immune complex, decrease RBC-IC, and then enhance the immune function of erythrocyte (Yang et al., 2006, 2005; Cui and Chen, 2002).

In this experiment, the results indicated that cyclophosphamide could significantly decrease RBC-CR1 rosette rate and increase RBC-IC rosette rate; so cyclophosphamide could make chicken blood deficiency. Angelica polysaccharide could significantly increase RBC-CR1 rosette rate, but have no notable effects on RBC-IC rosette rate of healthy chicken. At the same time, Angelica polysaccharide could restore the drop of RBC-CR1 rosette rate and the increase of RBC-IC rosette rate caused by cyclophosphamide to the normal level. The results showed that Angelica polysaccharide could not only strengthen the erythrocyte immunity but also resist the immune restrain caused by cyclophosphamide. Angelica polysaccharide had no notable effects on RBC-IC rosette rate that showed there was less immune complex in the circulation of the healthy chicken than that of the anemia chicken.

The results also showed that low dosage (50 mg/kg) of Angelica polysaccharide had no notable effects on improving the reduction of erythrocyte immunity, but middle (100 mg/kg) and high dosages (150 mg/kg) could significantly reverse the reduction of erythrocyte immunity in chicken caused by cyclophosphamide. Considering the economical benefit, middle dosage was used to treat chicken anemia. Erythrocyte immunity in chicken could be enhanced after chickens were decocted Angelica polysaccharide. Although erythrocyte immunity in chicken could be enhanced after chickens were decocted Angelica polysaccharide. Although erythrocyte immunity was the non-specific immunity, it had the promoting and adjusting functions to specific immunity. So we can come to the conclusion that the state of erythrocyte immunity actually reflects the state of organism immunity. In this experiment, Angelica polysaccharide had notable effects on erythrocyte immunity. Furthermore, Angelica polysaccharide could promote the immune function of organism; consequently gain the purpose of prevention

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Dosage (µg/ml)</th>
<th>CFU-E</th>
<th>BFU-E</th>
<th>CFU-GM</th>
</tr>
</thead>
<tbody>
<tr>
<td>I (control)</td>
<td>5</td>
<td>0</td>
<td>106,000±14,107</td>
<td>15,200±5,818</td>
<td>24,400±6,570</td>
</tr>
<tr>
<td>II (Angelica polysaccharide with low dosage)</td>
<td>5</td>
<td>50</td>
<td>98,400±9,990</td>
<td>15,400±3,226</td>
<td>25,600±5,683</td>
</tr>
<tr>
<td>III (Angelica polysaccharide with middle dosage)</td>
<td>5</td>
<td>100</td>
<td>104,600±10,565</td>
<td>17,000±3,420</td>
<td>30,800±8,658</td>
</tr>
<tr>
<td>IV (Angelica polysaccharide with high dosage)</td>
<td>5</td>
<td>150</td>
<td>102,200±8,463</td>
<td>16,400±3,567</td>
<td>26,800±6,125</td>
</tr>
</tbody>
</table>

Table 6. Productive rates of CFU-E, BFU-E and CFU-GM.
and treatment. The study firstly revealed that Angelica polysaccharide could promote the hematopoiesis and its regulation of hematopoietic function was in multi-similarity and different ways. On the one hand Angelica polysaccharide enriches the blood directly, increases the number of RBC and hemoglobin; on the other hand it regulates the hematopoietic factors, enriches the blood indirectly. Although Angelica polysaccharide can stimulate the proliferation of CFU-E, BFU-E and CFU-GM, its action segment and pathway should be further studied. This experiment provided a better basis for the clinical use of hematopoietic (Gui and Yuan, 2000).

Hematopoietic process of organism is an active cell proliferation and differentiation and release process. Pluripotent stem cells are being self-renewed in order to maintain constant number. Pluripotent stem cells change to committed hematopoietic progenitor cell, after further proliferation and differentiation, it was then release to peripheral blood circulation. Other results suggested that Angelica polysaccharide could increase reticulocyte of healthy mice, and obviously promote the recovery of erythrocyte, hemoglobin, leucocyte and karyote caused by phenyl hydrazine and 60Co-y. No matter if healthy or anemia mice, after injecting Angelica polysaccharide it obviously stimulates the proliferation and differentiation of hematopoietic progenitor, such as BFU-E, CFU-E, CFU-GM and CFU-Meg. The productivity of CFU-E, BFU-E and CFU-GM were noticeably improved after Angelica polysaccharide injection was added to the normal person bone marrow medium. The best concentration is 50 μg/ml. The productivity of CFU-E, BFU-E and CFU-GM were improved by 36.2, 63.6 and 33.4%, respectively, after Angelica polysaccharide injection was added to aplastic anemia patient’s medium at 50 μg/ml.

Results demonstrated that Angelica polysaccharide injection could promote the proliferation and differentiation of hemopoietic stem cell and hemopoietic progenitor, no matter if it is normal person or aplastic anemia patient that is involved, and then enrich the blood. The mechanism is possibly that it heightens the hemopoietic growth factors or has synergistic effect with them and then promotes hemopoietic function indirectly (Zhang et al., 2000; Yang et al., 2006).

Angelica polysaccharide affects hematopoiesis in different ways. There is still a lot of work to be done on control mechanism of hemopoietic factors. There is less reports on the hematopoiesis of Angelica polysaccharide. In this experiment, CFU-E, BFU-E and CFU-GM were cultured in vitro; serum containing Angelica polysaccharide had more notable effect on proliferation than that of the healthy serum. But when the Angelica polysaccharide was added to the medium, there was no obvious proliferation in the three kinds of colony. For CFU-E, BFU-E and CFU-GM, Angelica polysaccharide in serum has a much stronger effect than itself (Ye et al., 2001). Results showed that hematinic promoted the proliferation of bone marrow hemopoietic progenitor cells, induced secretion of cytokines at the same time. Perhaps this is one of the mechanisms on promoting the proliferation of hematopoietic progenitor cell.

ACKNOWLEDGEMENT

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