

## Splenomegaly of C57BL/6 mouse by thermal neutron exposure after Boronophenylalanine (BPA) administration

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### 1. Introduction

BNCT (Boron Neutron Capture Therapy) is a promising clinical method for a kind of tumors by killing cancer cells selectively at the cell level, its research is going on over the world, especially KURRI (Kyoto University Research Reactor Institute) in Japan and MIT (Massachusetts Institute of Technology) in USA. For the research in Korea, a neutron irradiation facility was a BNCT facility at Hanaro to support the research of BNCT (basic medical, chemical, physical and biological technology). In the present research, we firstly tried to measure the biological information for the splenomegaly of C57BL/6 mouse by thermal neutron exposure after BPA (boronophenylalanine) administration.

### 2. Experiment

In the present, the cytokines level was measured by exposure to the thermal neutron after BPA administration. And the shape of the spleen after the neutron exposure was compared with the spleen of the control mouse.

#### 2.1 Thermal Neutron by HANARO Reactor

The thermal neutron was provided from Ex-core Neutron Irradiation Facility of the HANARO reactor. The neutron beam was collimated with the diameter of 15 cm. The neutron flux is  $5.81 \times 10^8$  n/cm<sup>2</sup>s at 1.05 m from the hole surface of reactor.

#### 2.2 Thermal Neutron Exposure to the C57BL/6 mouse

Twelve mice were prepared to expose to the thermal neutron. Three groups (four mice) were exposed during 1, 2, 3 hours, respectively. However, the mouse that was exposed during 3 hours was killed after 10 days.

### 3. Analysis for the splenomegaly

#### 3.1 Size of the spleen for the 3 hours exposed mouse

The spleen was related with the inflammation in biological body. The damage of spleen from the mouse that was killed after 10 days was confirmed at the 3 hours irradiation of the thermal neutron. The spleen shows in Fig. 1. The edema of the mouse seems at the spleen as shown in Fig. 1. The color of spleen was changed from red to black. It looks like to serious edema. We guess that the reason is by the neutron irradiation and gamma ray irradiation. The gamma ray

was from the neutron capture with hydrogen of the water. The neutron capture sensitivity of oxygen was lower than the hydrogen.



Figure 1. Damage of the spleen after exposure to the thermal neutron during two hours.

#### 3.2 Size of the spleen for the 1 and 2 hours exposed mouse

The spleen that was exposed for 2 hours was compared with the control's one. The shape was shown in Fig. 2. In Fig. 2, the spleen on the left side is for the 2 hours exposed by the neutron, and the spleen on the right side is for the control's one. In the present experiment, we confirmed that the spleen will be inflamed in the thermal neutron exposure. From this reason, we can guess that the cytokines will be changed by the inflammation of the spleen.

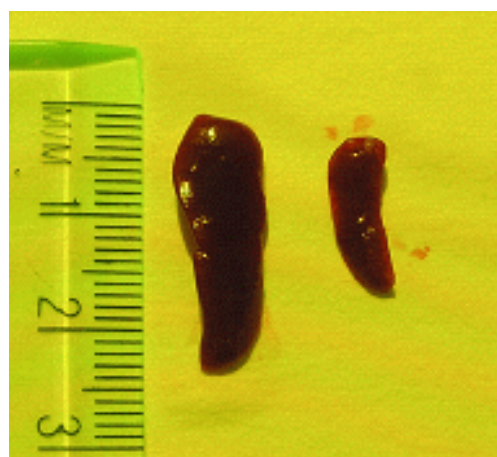


Figure 2. Size of the spleen after exposure to the thermal neutron during two hours. The spleen that was exposed by the neutron is larger than the control's one. The spleen shows splenomegaly.

In the present experiment, the variation of cytokines was measured for the control mouse, 1-hour exposed mouse and 2-hour mouse, respectively. Interleukin-2 (IL-2), interferon-gamma (IFN- $\gamma$ ), IL-6 and tumor necrosis factor-alpha (TNF- $\alpha$ ) of T helper-1-type (Th1) cytokines group was measured for three kinds of group of the mice exposed to thermal neutrons. For the exposed

mouse, IL-2 and IFN- $\gamma$  was decreased. However, IL-6 and TNF- $\alpha$  was increased 10 times than control's one. These values were shows in the Fig. 3 and Fig. 4.

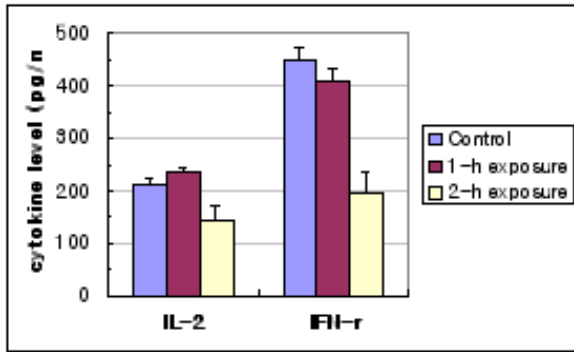


Figure 3. IL-2 and IFN- $\gamma$  was decreased. Especially the cytokine for the mouse that 2 hours thermal neutron exposed remarkably decreased.

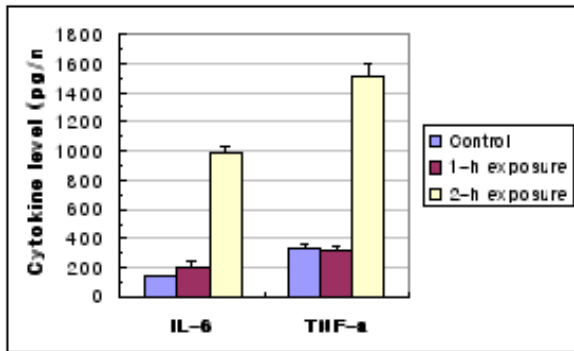


Figure 4. IL-6 and TNF- $\alpha$  was increased 10 times than control's one.

#### 4. Conclusion

Twelve mice were prepared to exposure the thermal neutron. Three groups (four mice) were exposed during 1, 2, 3 hours, respectively. Interleukin-2(IL-2), interferon -gamma (IFN- $\gamma$ ), IL-6 and tumor necrosis factor-alpha(TNF- $\alpha$ ) of T helper-1-type(Th1) cytokines group was measured for three kinds group of the mice exposed thermal neutron. For the exposed mouse, IL-2 and IFN- $\gamma$  was decreased. However, IL-6 and TNF- $\alpha$  was increased 10 times than control's one.

#### Acknowledgement

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