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Study on the Anti-Radiation Function of Selenium-Enriched *Agaricus blazei* Murill Polysaccharides and Tea Polyphenol Compound Solution

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Abstract: Mice were administered a selenium-rich *Agaricus blazei* Murill (Se-AbM) polysaccharides and tea polyphenol compound solution for prevention and treatment. Following exposure to 2 Gy of infrared radiation, peripheral blood counts of white blood cells, red blood cells, and platelets were assessed, along with serum levels of apoptosis-related factors Fas and Fas ligand, inflammatory factors interferon-gamma and tumor necrosis factor-alpha, immune-related factors interleukin-3 and interleukin-6, and indicators of oxidative stress, including malondialdehyde, superoxide dismutase, and glutathione. The results showed significant differences in these indicators between the Se-AbM-treated group and the model group, suggesting that Se-AbM may inhibit apoptosis, enhance the clearance of free radicals in the body, improve antioxidant capacity, and provide a significant protective effect against radiation-induced immune damage.

Keywords: Selenium-rich *Agaricus blazei* Murill tea polyphenols; Anti-radiation; Free radicals

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1. Introduction

Selenium-enriched *Agaricus blazei* Murill (Se-AbM) is produced by artificially enriching the *Agaricus blazei* Murill variety with selenium and using polysaccharide extraction technology to obtain selenium-enriched *Agaricus blazei* Murill polysaccharides (Se-AbMP). Tea polyphenols (TP) are extracted from green tea through extraction technology. The Se-AbMP + TP compound solution is formulated with these two components in a specific ratio. Numerous studies have investigated the anti-radiation effects of AbMP [1,2], and research has also explored the anti-radiation effects of TP [3,4]. However, no studies have reported on the combined anti-radiation effects of Se-AbMP and TP as a composite material. This study aims to examine the effects of the combined solution on blood components and histopathological changes in bone marrow following radiation damage and to preliminarily explore its mechanism of action, providing theoretical and experimental support for the health benefits of the combined solution.

2. Materials and methods

2.1. Materials

2.1.1. Drug

The test compound, selenium-rich *Agaricus blazei* Murill polysaccharides and tea polyphenols (Se-AbMP + TP) compound solution, was provided by Guoling Elderly Care Service (Dalian) Co., Ltd.

2.1.2. Experimental animals

Six-week-old male ICR mice of clean grade, weighing 21–22 g, were purchased from Liaoning Changsheng Biotechnology Co., Ltd. The mice were housed in a controlled environment with regulated temperature, humidity, and a standard light/dark cycle. Sterilized bedding was provided, and the mice had free access to food and water. Housing conditions were maintained at a temperature of 19–22°C and a relative humidity of 40%–50%.

2.1.3. Reagents and instruments

The following were used:

(1) Enzyme-linked immunosorbent assay (ELISA) kits for mouse tumor necrosis factor (TNF)-α, interleukin (IL)-3, interleukin (IL)-6, apoptosis-related factor Fas (CD95), apoptosis-related factor ligand (FasL), and γ-interferon (IFN-γ), provided by Jiangsu Enzyme Immune Industrial Co., Ltd.

Kits for detecting reduced glutathione (GSH), malondialdehyde (MDA), and superoxide dismutase (SOD), provided by Jiangsu Adison Biotechnology Co., Ltd.

(2) Multiskan^{TM} FC microplate photometer, manufactured by Thermo Scientific.

2.2. Methodologies

2.2.1. Grouping and drug administration

Twenty-four male ICR mice were randomly divided into three groups (eight mice per group) following a 7-day acclimatization period:

(1) Blank group: Sham-irradiated mice administered physiological saline.

(2) Model group: Irradiated mice administered physiological saline.

(3) Se-AbMP + TP administration group: Irradiated mice treated with Se-AbMP + TP (0.2 mL/10 g, twice daily).

An animal model of radiation injury was established using whole-body irradiation with 60Co γ-rays at a total dose of 2.0 Gy, except for the blank group, which underwent sham irradiation with lead brick shielding. Se-AbMP + TP administration was initiated 7 days prior to irradiation and continued for 7 days post-irradiation. The blank and model groups received equivalent volumes of physiological saline during this period.

2.3. Observational indicators

2.3.1. Peripheral blood cell count

On the 8th day after irradiation, 100 μL of blood was collected from the canthus vein of mice in each group. Counts of white blood cells (WBCs), red blood cells (RBCs), and platelets (PLTs) were measured using a blood cell counting chamber under a light microscope to assess the condition of the model and the effects of SSC on peripheral blood cell counts.

2.3.1. Serum indicators

On the 8th day after irradiation, blood was collected from the abdominal aorta to prepare serum. ELISA kits were used to measure the levels of:

(1) Apoptosis-related factors: Fas and FasL.

(2) Inflammation-related factors: IFN-γ and TNF-α.

(3) Immune-related factors: IL-3 and IL-6.

Biochemical kits were used to detect the serum levels of oxidative stress markers: GSH, MDA, and SOD.

2.3.3. Bone marrow pathological changes

The femurs of mice were fixed in 4% paraformaldehyde, and bone marrow tissue was stained with hematoxylin and eosin (H.E). Pathological changes in the bone marrow were observed under a light microscope.

3. Results

3.1. The effect of Se-AbMP + TP on blood components in mice with radiation injury

As shown in **Table 1**, compared with the blank group, the numbers of RBCs, WBCs, and PLTs in the peripheral blood of the model group significantly decreased ($P < 0.05$). In contrast, the Se-AbMP + TP-treated group exhibited significantly increased numbers of RBCs, WBCs, and PLTs in the peripheral blood compared with the model group ($P < 0.05$). These results demonstrate that Se-AbMP + TP can reverse changes in blood cell composition in mice with radiation injury.

Table 1. Effects of selenium-enriched *Agaricus blazei* Murill polysaccharides and tea polyphenol compound solution on blood components in irradiated mice ($n = 8$)

Group	WBC (10^9/L)	RBC (10^{12}/L)	PLT (10^9/L)
Blank group	9.58 ± 1.11**	10.65 ± 1.25**	1,033.0 ± 75.6**
Model group	7.94 ± 0.97	8.67 ± 0.95	890.6 ± 57.3
Se-AbMP + TP group	9.23 ± 0.56*	10.12 ± 0.95*	984.3 ± 84.3*

Note: Compared with the model group, **$P < 0.01$; *$P < 0.05$.

3.2. Effects of Se-AbMP + TP on the levels of IFN-γ, TNF-α, FAS, FASL, IL-3, and IL-6 in mice with radiation injury

As shown in Table 2, compared with the blank group, the levels of inflammatory factors IFN-γ and TNF-α significantly increased in the model group ($P < 0.05$). However, these levels significantly decreased in the Se-AbMP + TP group compared with the model group ($P < 0.05$), indicating that Se-AbMP + TP can reduce the elevated inflammatory factor levels caused by radiation injury.

Additionally, the levels of apoptosis-related factors Fas and FasL were significantly higher in the model group compared with the blank group ($P < 0.05$), but the Se-AbMP + TP group showed significantly reduced levels compared with the model group ($P < 0.05$).

Furthermore, the serum IL-3 content significantly decreased ($P < 0.05$) and IL-6 content significantly increased ($P < 0.05$) in the model group compared with the blank group. Se-AbMP + TP treatment reversed these changes by significantly increasing IL-3 levels and decreasing IL-6 levels ($P < 0.05$).

Table 2. Effects of selenium-enriched *Agaricus blazei* Murill polysaccharides and tea polyphenol compound solution on serum factors in irradiated mice (n = 8)

Group	IFN-γ (pg/mL)	TNF-α (pg/mL)	Fas (pg/mL)	FasL (pg/mL)	IL-3 (pg/mL)	IL-6 (pg/mL)
Blank group	4.45 ± 0.96*	5.11 ± 0.74*	9.03 ± 1.47*	4.55 ± 1.01*	7.60 ± 1.35*	5.43 ± 0.78**
Model group	6.19 ± 1.40	6.48 ± 1.04	11.29 ± 1.28	6.29 ± 1.60	5.96 ± 0.84	6.98 ± 1.03
Se-AbMP + TP group	4.50 ± 1.56*	5.20 ± 1.03*	9.14 ± 1.66*	4.60 ± 1.01*	7.97 ± 1.20*	5.66 ± 0.55*

Note: Compared with the model group, $^{**}P < 0.01$; $^{*}P < 0.05$.

3.3. Effects of Se-AbMP + TP on MDA, SOD, and GSH in mice with radiation injury

As shown in **Table 3**, the serum MDA content significantly increased in the model group compared with the blank group ($P < 0.05$), while the SOD and GSH contents significantly decreased ($P < 0.05$). Treatment with Se-AbMP + TP significantly decreased MDA levels and increased SOD and GSH levels compared with the model group ($P < 0.05$). These results indicate that Se-AbMP + TP can reverse oxidative stress indicators in mice with radiation injury.

Table 3. Effects of selenium-enriched *Agaricus blazei* Murill polysaccharides and tea polyphenol compound solution on oxidative stress markers in irradiated mice (n = 8)

Group	MDA (mmol/mL)	SOD (U/L)	GSH (mmol/L)
Blank group	4.87 ± 1.15**	22.2 ± 2.4**	2.24 ± 0.64*
Model group	7.14 ± 1.72	17.8 ± 2.5	1.51 ± 0.38
Se-AbMP + TP group	5.21 ± 1.06*	21.2 ± 1.7*	2.22 ± 0.62*

Note: Compared with the model group, $^{**}P < 0.01$; $^{*}P < 0.05$.

3.4. The effect of Se-AbMP + TP on pathological changes in bone marrow in mice with radiation injury

As shown in **Figure 1**, compared with the blank group, the model group exhibited a significant reduction in the number of bone marrow nucleated cells. In contrast, the Se-AbMP + TP-treated group showed a significant increase in the number of bone marrow nucleated cells compared with the model group. These results suggest that Se-AbMP + TP promotes the recovery of bone marrow nucleated cells in mice with radiation injury.

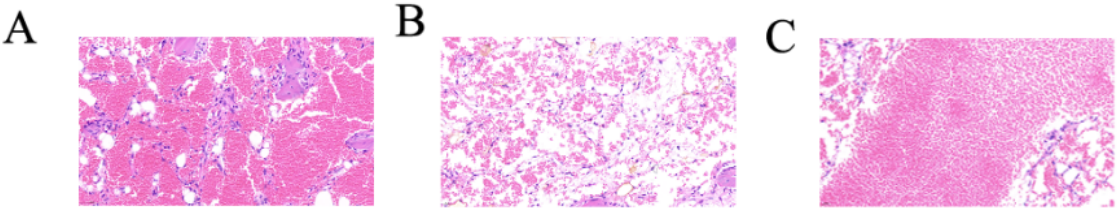

Figure 1. Pathological effects of selenium-enriched *Agaricus blazei* Murill polysaccharides and tea polyphenol compound solution on bone marrow in irradiated mice. **(A)** Bone marrow pathology of the blank group; **(B)** Bone marrow pathology of the model group; **(C)** Bone marrow pathology of the Se-AbMP + TP group

4. Discussion

Studies on the radiation resistance properties of various plants have been extensively conducted [5]. This study explored the combined radiation resistance effects of Se-AbMP and tea polyphenols.

Selenium possesses antioxidative, free radical-scavenging, and antimutagenic properties, providing comprehensive protection against various forms of radiation-induced damage.

As the primary active component of *Agaricus blazei* Murill, its polysaccharide exhibits remarkable antioxidant capacity. It enhances immune function, promotes cellular regeneration and repair, and mitigates the adverse effects of radiation on organs and tissues.

Se-AbMP combines the advantages of selenium and *Agaricus blazei* polysaccharides, resulting in enhanced anti-radiation effects.

Green tea polyphenols, a type of polyphenolic compound found in tea, exhibit strong antioxidant properties. These polyphenols exert their anti-radiation effects by competing with radiation products (including free radicals) and acting at multiple stages before, during, and after radiation-induced damage. Furthermore, green tea polyphenols regulate immune cell function, thereby reducing radiation-induced damage to the body.

5. Conclusion

In conclusion, the combination of tea polyphenols and Se-AbMP demonstrates significant anti-radiation effects and holds considerable value for health development in addressing radiation damage.

Disclosure statement

The authors declare no conflict of interest.

References

[1] Zhang X, Wang J, Wang J, 2002, Experimental Study on the Effects of Agaricus blazei Murill Polysaccharides on Granulocyte Hematopoiesis and In Vivo Hematopoietic Factors in Mice with Radiation Injury. Chinese Journal of Radiation Medicine and Protection, 2002(6): 78.

[2] Wang J, Liu J, Lan L, et al., 2014, Study on the Antioxidant Effect of Polysaccharides from Agaricus blazei Murrill on Rats with Radiation Injury. Chinese Journal of Convalescent Medicine, 23(10): 892–893.

[3] Zhou X, Gao Y, Xie T, 2010, Progress in Research on Natural Antioxidant Tea Polyphenols. Resource Development and Market, 26(11): 1034–1036.

[4] Guo S, Hu Y, Liu P, 2010, Protective Effects of Tea Polyphenols and Its Main Component EGCG in A Mouse Model of Radiation Injury. Chinese Journal of Traditional Chinese Medicine, 35(10): 1328.

[5] Hao S, Tong P, Wang C, et al., 2011, Effect of Free Radical Scavenging and Radiation Resistance of 5 Natural Plant Extracts. 38(1): 30–32 + 37.