

THE EFFECTS OF PIPER NIGRUM (BLACK PEPPER) EXTRACT ON THYMOCYTE CELLS

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Abstract

Black pepper (*Piper nigrum*) has been extensively used in the food industry as a spice and in traditional medicine to improve digestion and appetite. It is rich in flavonoids, polyphenols, alkaloids, and tannins. Recent studies have demonstrated its antioxidant properties, anti-aging effects, and natural antibiotic characteristics. However, the mechanisms by which black pepper extract affects cellular structures, specifically membranes, remain inadequately studied. This study investigates the effects of black pepper extract on the membrane regulatory processes of rat thymocyte cells under hypoosmotic stress conditions.

Introduction

*Piper nigrum*s bioactive compounds have garnered attention for their medicinal properties, yet their cellular impact remains poorly understood. Thymocyte cells, which are essential to the immune system, exhibit regulatory volume decrease (RVD) mechanisms to maintain homeostasis under osmotic stress. This study aims to elucidate the impact of black pepper extract on the RVD mechanism in thymocyte membranes, providing insights into its potential as an immunomodulator.

Materials and Methods

The experiments were conducted using thymocyte cell suspensions. The light transmission of the suspension was measured to assess cell volume changes. Under hypoosmotic conditions, thymocytes initially swell and subsequently recover their volume through the RVD process. Black pepper extract concentrations of 5.35 µg/mL, 26.75 µg/mL, and 53.5 µg/mL were tested. The hypoosmotic medium was prepared with an osmotic pressure of 147±2 mOsm/kg H₂O. Thymocyte cells were incubated for 15 minutes under these conditions, and changes in RVD were recorded.

Results

1. Control Group:

- In hypoosmotic conditions, the average RVD after 15 minutes was 92.8±3.9% (n=5).

2. Black Pepper Extract Effects:

- At a concentration of 5.35 µg/mL, the RVD was reduced to 44.7±7.5% (n=5).
- At a concentration of 26.75 µg/mL, the RVD was further reduced to 13.4±1.8% (n=5).
- At a concentration of 53.5 µg/mL, the RVD was significantly inhibited, reaching 8.0±3.5% (n=5).

The results indicate a concentration-dependent inhibition of the RVD mechanism by black pepper extract.

Discussion

Black pepper extract demonstrated a significant inhibitory effect on the RVD process in thymocyte cells. The inhibition appears to be linked to the blocking of ion channels involved in volume regulation. At higher concentrations, the extract effectively prevented thymocyte cells

from restoring their volume under hypoosmotic stress, suggesting potential interference with cellular ion transport systems.

These findings provide a mechanistic understanding of how black pepper extract affects thymocyte membranes and highlight its potential role in modulating immune cell function. The concentration-dependent inhibition suggests that black pepper's bioactive compounds may serve as novel tools for exploring immune system regulation.

Conclusion

The study reveals that black pepper extract significantly inhibits the RVD mechanism in rat thymocyte cells under hypoosmotic stress, with the degree of inhibition being concentration-dependent. This effect likely results from the blockade of ion channels essential for cell volume regulation. The results offer a foundation for further investigations into the immunomodulatory potential of black pepper and its bioactive components, opening new avenues for research in immune system regulation and therapeutic development.

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