



**Invited editorial**

**TAKING ADVANTAGE OF MALNOURISHED MICE:  
AN ANIMAL MODEL FOR EVALUATING THE  
IMMUNOSTIMULATORY POTENTIAL OF MUSHROOM-  
DERIVED FOOD AND PHARMACOLOGICAL PRODUCTS**

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Mushrooms have been used for many years due to their nutritional and pharmacological properties. The edible mushrooms with functional or medicinal properties include species of *Lentinula*, *Auricularia*, *Hericium*, *Grifola*, *Pleurotus*, *Ganoderma*, *Agaricus* and *Flammulina*. These mushrooms particularly have long been suggested to possess immunomodulatory effects<sup>5</sup>.

Immunity is a very complex homeostatic system consisting of a network of interacting cells, tissues and organs. It allows the organism to exist within itself and maintains a surveillance to recognize components considered nonself. The

body's immunity has been shown to be suppressed in several diseases, like AIDS and cancer.

It is important to point out that before AIDS recognition, the main cause of acquired immunodeficiency was the immunological dysfunction associated with protein-energy malnutrition (PEM). In this context, Ancel Keys published some human data that included infectious diseases in human famine experiments he ran from about 1942-1945<sup>2</sup>. Whatever its origin, malnutrition results in an immune deficiency; the cell-mediated immunity and T cell functions are the

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most affected. At present, PEM is a critical, yet underestimated factor in susceptibility to infection, including the “big three” infectious diseases: HIV/AIDS, tuberculosis and malaria<sup>4</sup>.

The use of mushrooms immunotherapeutic agents could solve these problems largely. However, in spite of the large use of mice in the immunological research, little data are available about the immunostimulatory potential of edible and medicinal mushrooms on models closer to clinical situations of PEM.

Based on these ideas, we would like to propose a hypothesis that malnourished mice by food deprivation could be used as an animal model of acquired immunodeficiency with application in the field of mushroom immunopharmacology. To test the hypotheses, an experimental study was designed to assess the effects of oral administration of an aqueous extract from *Pleurotus* fruiting bodies on the recovery of both innate and specific immune responses of undernourished mice. The facts in support of the hypothesis are as follows: the treatment of starved mice with *Pleurotus* extract provided benefits in terms of (a) haemopoiesis (recovery of bone marrow cellularity and white blood cells counts in peripheral blood), (b) macrophage activation and phagocytosing capacity, and (c) stimulation of both humoral and cell immune functions, such as antibody response and the reconstitution of delayed-type hypersensitivity response. Different immune cell populations might be induced after activation in the gut-associated lymphoid tissue<sup>3</sup>.

According to Chandra<sup>1</sup>, “the era of nutritional manipulation of the immune system has finally dawned and it brings with it the promise of using diet and nutrition as innovative powerful tools to reduce

illness and death caused by infection”. Therefore, the hypothesis presented and its confirmation introduce a new approach for evaluating pharmacological mushroom-derived agents at research/development stages as well as, foods or diets, suitable to improve the immunological status.

The use of malnourished mice in both mushrooms immunonutritional and pharmacological studies could also impact on some unexplored topics on the link between malnutrition and immunity, such as the identification of immunonutrients and the development of food supplements for societies with chronic PEM.

## LITERATURE CITED

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