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Potential application of natural honey to grow immunity against invasive aspergillosis in a murine model

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The prevalence of invasive fungal infections (IFIs) has grown in last decades. With the increasing number of immunocompromised patients, *Aspergillus* fungi have become known as one of the major causes of human infection. The pathogenesis of invasive *aspergillosis* is intrinsically linked to the competency of the host immune system and its ability to recognize and destroy the fungus. Innate immunity plays an essential role in host defense against invasive aspergillosis. Developing new antifungal agents is restricted cause of eukaryotic nature of fungi. Therefore interest in application of natural immunostimulators to increase immune responses against pathogens has expanded. Honey is a natural substance produced by honey bees. Studies indicated that honey has different health-beneficial properties including gastro protective, hepatoprotective, reproductive, hypoglycemic, antioxidant, antihypertensive, antibacterial, anti-fungal, anti-inflammatory and wound healing effects. This work was designed to study the immunological effects of three Iranian honeys on some parts of innate immunity as well as survival rate in mice infected with *Aspergillus fumigatus*. For this purpose, mice were divided into 10 groups (honey alone, honey and infection, negative and positive controls) each containing 10 individuals. Mice were treated with honey (1.5 g/kg BW/orally) for 10 days. At day 6, *Aspergillus fumigatus* conidia (5×10^5 /ml) were injected intravenously to the infection groups. The animals were sacrificed at day 11 and their peritoneal macrophages and spleen cells were cultured. Macrophage killing and nitric oxide production along with some proinflammatory cytokines (IL6, IL1 β) were measured as well. TLR2 and TLR4 genes expression in macrophages was determined by semi-quantitative RT-PCR. Ten mice from infectious groups were kept for 30 days and survival rate was monitored. Based on the obtained results, all honeys could significantly increase killing of *Aspergillus fumigatus* conidia by macrophages and mean survival rate compared with control group ($p < 0.05$). Honeys alone had immunomodulatory effect on proinflammatory cytokines, NO production and understudied genes. However by inducing infection, groups under honey treatment had higher cytokine and NO production and TLR2 gene expression compared to infection alone group ($p < 0.05$). LPS stimuli had no significant effect on macrophages neither killing nor nitric oxide production ($p > 0.05$). It is concluded that honey could boost the immune system and increase survival time in invasive *aspergillosis*; in order to illuminate the mechanism of action of honey on natural and adoptive immune responses during invasive *aspergillosis*, this study should be continued into the future.

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Taxonomy and phylogeny of Phallales from Pakistan

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Genus *Phallus* is characterized by foul smelling mushroom and represented by *P. impudicus* L. as a type species. Species of this genus are distributed worldwide, mostly in tropical regions. A comprehensive study on this genus was done by Hanns Kreisel in 1996. A key for the identification of *Phallus* spp. is also developed by Calonge (2005). According to Dictionary of Fungi this genus is represented by 18 species. In this investigation, five species of phallaceae belonging to *Phallus* have been collected and described morphologically and molecularly from different regions of Pakistan. These are *P. ahmadii* sp. nov., *P. galericulatus* (Moller) Kreisel, *P. hadriani* Vent, *P. roseus* Delile and *P. rubicundus* (Bosc) Fr. Among these, *P. ahmadii* is new to science. *P. galericulatus* is a new record from Pakistan and all other species are new reports from different localities of Pakistan. Phylogenetic analysis of *Phallus* spp. based on ITS-nrDNA region is also given.

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