

## Effect of edible fungal polysaccharides on improving influenza vaccine protection in mice

Minghua HU

### Abstract

Fungal polysaccharides have been shown broad spectrum of biological activities, including anti-inflammatory, ant-oxidative and improve immunity. However, oral administration of fungal polysaccharides for rendering the conventional vaccine against influenza virus has been reported rarely. Here, we investigated the potential of fungal polysaccharides enhancing the influenza vaccine efficacy in a mouse model. Mice were immunized with inactivated H1N1 (A/PR8/1934) influenza vaccine combined with oral polysaccharides lentinan, tremellan, pachymaran, and a mixture of the three. The results showed that mice in the polysaccharides/vaccine groups had reduced morbidity, improved viral clearance, and recovered faster than the mice receiving the conventional vaccine only after infection. This effect could be attributed to the increased levels of virus-specific serum antibody IgG and decreased levels of inflammatory cytokine IFN- $\gamma$  in the lung tissue. Our finding suggests that taking fungal polysaccharides orally might be useful for improving the efficacy of conventional inactive influenza vaccines.

Influenza viruses are a major cause of respiratory tract infections in animals (Chothe et al., 2017; Yeo et al., 2017). Vaccination is recognized as one of the most effective intervention in reducing the impact of influenza pandemics (Castilla et al., 2013; Ferguson et al., 2006; Partridge & Kieny, 2010). Although influenza vaccines have been used for decades, many immunized individuals still got infected by the virus and the potential correlates of protection induced by these vaccines are still a matter of discussion (Fichera, Felnerova, Mischler, Viret, & Glueck, 2009; Leroux-Roels et al., 2007; Lin et al., 2006; Nichol & Treanor, 2006; Trombetta & Montomoli, 2016). How to improve the efficacy of conventional inactive influenza vaccine remains a major challenge in influenza prevention.

Over the years, fungal polysaccharides had been explored for their broad spectrum of biological activities that vary, depending on the sources from which they were isolated. Polysaccharides from *Hohenbuehelia serotina* and *Tremella aurantialba* possessed antioxidant activity (Du et al., 2015; Li & Wang, 2016). Lentinan and pachymaran have been found to have immunostimulatory activities and exert indirect

inhibitory effect on cancer cells (Hamuro, Maeda, Arai,

Fukuoka, & Chihara, 1971; Wasser, 2002; Wei, Hu, Chen, & Wei, 2011). *Tremella* polysaccharides were reported to attenuate sepsis through inhibiting abnormal CD4<sup>+</sup>CD25 high regulatory T cells in mice (Shi et al., 2014). Intranasally pretreatment with Ginseng polysaccharides or Lentinan could induce protective effects on influenza virus (Irinoda, Masihi, Chihara, Kaneko, & Katori, 1992; Yoo et al., 2012). However, oral administration of fungal polysaccharides for anti-influenza had rarely been reported. On the other hand, if effective, the ingestion of the polysaccharides would be more readily accepted and convenient in application than intranasal administration. To our knowledge, few studies on tremellan and pachymaran to improve the effects of influenza vaccine have been reported. In this study, we conducted studies in a mouse model to investigate the effects of lentinan, tremellan, pachymaran and a mixture of the three administrated orally on modulating the efficacy of inactivated A/PR8 (H1N1) influenza vaccine. Interestingly, these fungal polysaccharides could improve virus-specific antibody response and enhance the protective effect of the inactive influenza vaccine in their resistance to virus challenge

Mice pretreated with polysaccharides followed by PR8-vaccination and those receiving the flu vaccine only were challenged with influenza virus. On day 7 post-infection, the mice ( $n = 8$ ) with mock immunization began to die, and five of the eight mice died within 2 weeks (With PR8-vaccination, one of the eight mice died on day 10 post-infection. However, all polysaccharides pretreated groups, either individual polysaccharides or mixture of the three polysaccharides, followed by the vaccination survived throughout our analysis. Mouse body weight is another important parameter to assess the general health status upon virus infection. The body weight of mice in the control group dropped significantly after infection. The vaccine-only group showed slight weight loss. Nevertheless, the mice pretreated with polysaccharides in combination with the vaccine were found to retain their body weight throughout the study, significantly better than the one observed in the vaccination- only group.

The body weight of mice in the mixed polysaccharides/vaccine group was actually increased during our investigation time (Therefore, the mice receiving both fungal polysaccharides and

Minghua Hu  
Infinitus(China) Company Ltd. , China

vaccination presented less severity of the disease condition, which highlights the synergistic action of these polysaccharides in boosting the protective effect of the flu vaccine against influenza infection.

The weight of the lung, reflecting the extent of lung damage caused by the viral infection, was measured after virus infection. The lung index in the control group started to increase on day 3 after infection and reached 15 (mg/g) on day 6 and remained high afterwards. The vaccinated group showed a significant increase in the lung index on day 6, but then a reduction on day 14. However, there were no increases in the lung index when the mice were combined pretreated with polysaccharides and vaccine. This finding indicates that the tested polysaccharides offer better lung protection when used in combination with the vaccines, presumably by reducing the virus load or rendering the host resistant to virus-induced pulmonary lesion.

## Biography

Minghua Hu is R&D Lead Engineer of Infinitus (China) Company Ltd that is engaged in Chinese herbal plantations, R&D, production, sales and service of TCM health products. She is also the principle members of Joint Laboratory for the Research of Chinese Herbal Polysaccharides-Chinese Academy of Science Shanghai Institute of Materia Medica and Infinitus. She has published more than 20 papers in reputed journals