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Guest Editorial

COVID-19 and Selenium in Animals

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The World Health Organization (WHO) has tentatively named the virus that causes unexplained pneumonia in Wuhan, China, COVID-19. The first pandemic of COVID-19 confirmed in Wuhan, China, occurred in December 2019 and devastated economic and healthcare systems around the world. It was later named Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2). The "2" at the end of the name is a sister virus of the coronavirus "SARS-CoV" that caused SARS which originated in Guangdong Province, China and spreaded all over the world in 2002.

It is part of a large family of coronaviruses. Some strains of the coronavirida family affect humans such as Severe Acute Respiratory Syndrome (SARS) and can affect animals causing kennel cough in dogs and feline infectious peritonitis (FIP) in cats. However, some strains can affect both humans and animals. COVID-19 (SARS- CoV-2) is considered to be the seventh coronavirus that infects humans. Other coronaviruses (CoV) include HKU1, NL63, OC43, 229E, SARS-CoV, and MERS- CoV. Among them, SARS-CoV and MERS-CoV are zoonotic, have resulted in high mortality epidemics over the last 20 years. Other virus strains are usually associated with mild upper respiratory tract disease [1] and sometimes leads to complex diseases when it occurs in immunocompromised individuals. COV is an RNA virus and includes four genera of α, β, γ, and δ coronavirus, and COVID-19 and SARS-CoV belong to the β coronavirus genus.

In rare cases, animal coronavirus jumps over species barriers into humans and spreads among people. The modes of migration of zoonotic infections are aerosolization, droplet spraying, ingestion (oral), direct contact (animals, body fluids), indirect contact (e.g. fomite, contaminated tools and surfaces, or other objects in the environment), and vector-mediated transmission of infectious agents. Zoonotic diseases that infect animals and humans are very common. In fact, 60% of existing human infectious diseases are zoonotic and 75% of emerging human diseases are of animal origin. The phenomenon of human-to-animal transmission was demonstrated by an epidemic of COVID-19 in mink on farms in the Netherlands. Subsequently, mink cases have been reported in many countries around the world, including Denmark, Italy, Spain, France, Canada and the United States. COV is transmitted between mink and mink to other animals. Outflows of SARS-CoV-2 have been observed from pet owners to domestic dogs and cats and from humans at zoos to tigers and lions.

Wang Q., *et al*. [2] showed that COVID-19 host range is narrower than that of SARS-CoV. Shi., *et al*. [3] investigated the susceptibility of ferrets and animals in close contact with humans to COVID-19. They found that ferrets and cats are highly susceptible to COVID-19, while dogs have low susceptibility, and pigs, chickens, and ducks are not susceptible to the virus. In cats, the virus replicates in the nose and throat and causes inflammatory pathology deeper in the respiratory tract and airborne transmission was confirmed between pairs of cats. Wan Y., *et al*. [4] conducted experiments using receptor binding domain (RBD) similar to ACE2. Pigs, ferrets, cats, and non-human primates are more likely to recognize ACE2, but mice and rats are less likely to recognize it. Currently, there is no evidence of virus transmission from pets or livestock to humans. However, prompt diagnosis, strict vigilance, proper quarantine and strengthening of surveillance are required to stop the pandemic spread. Animal vaccines are not recommended at this time due to the duration of immunity and the effectiveness of inactivated vaccines.

Cases of COVID-19 suggest that immunological mechanisms may contribute to the pathophysiology of the disease. The immune system is constantly active, monitored, and, when infected was enhanced in activity to protect the host from pathogenic organisms such as bacteria and viruses. This increased activity is accompanied by an increased rate of metabolism that requires energy sources, substrates for biosynthesis and regulatory molecules, and a sufficient supply of a wide range of nutrients that are essential for the optimal functioning of the immune system.

Nutritional status involved in immune function is important for maintaining good health. Major dietary components such as vitamins C, D, E, zinc, selenium, and omega 3 fatty acids fully establish immunomodulatory effects that have the benefits of infectious diseases. In particular, the status of Se affects humans against COVID-19 infection, especially in people with low Se intake, which affects the cure rate. The cure and mortality rates from COVID-19 were compared by the Se content of the hair. In particular, Enshi in China is known for its high Se region, had a significantly higher cure rate, while Wuhan and Hubei has a low Se status, had a high mortality rate. Thus, Se intake was associated with cure rate [5]. In Germany, selenium in the sera of deceased and cured survivors in patients with COVID-19 was significantly higher in survivors [6].

COVID-19 is associated with thrombotic disease in both venous and arterial circulation due to excessive inflammation, platelet activation, endothelial dysfunction and stasis. The virus infects the ACE2 receptor in lung cells in the inner layer of the epithelial alveoli causing lung damage, but the ACE2 receptor is also widely expressed in endothelial cells that cross multiple organs [7,8]. As such, endothelial or immune-mediated infections can cause widespread endothelial dysfunction associated with apoptosis.

Selenium (Se) is a natural trace element that plays an important and complex role in the immune system. Se deficiency increases susceptibility to RNA virus infection and presents with immune dysfunction, including altered expression patterns of chemokines and cytokines, leading to more serious illness consequences. Replication in a selenium-deficient host makes mutations in the virus genome more likely for benign viruses to acquire pathogenicity. A characteristic of selenium is that its intake varies greatly depending on the region found around the world. Recent selenium studies have demonstrated that this trace mineral deficiency leads to an increase in the pathology of the virus [7,8]. Reactive oxygen species (ROS) are frequently produced during viral infection. ROS inactivates various enzymes, damages DNA, and is harmful to many cell functions. Serenoenzymes such as glutathione peroxidase and TrxR play important roles in endothelial cell function [9] and ROS is reduced by human endothelial cell serenants via TrxR and GPx induction [10,11].

Prophylactic Selenium supplementation, especially for livestock and poultry, represents a healthy, safe and feasible strategy. Selenium supplementation enhances livestock and poultry health and antiviral protection, neutralizes T cell proliferation, NK cell activity, innate immune cell function, free radicals as antioxidants, and protect against COVID-19 [12,13].

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