

## Lactoferrin: Potential to prevent COVID-19

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### Abstract

Lactoferrin is a protein found in milk and other bodily fluids that has been shown to have antiviral and anti-inflammatory properties. Recent studies have found that lactoferrin can inhibit the replication of SARS-CoV-2, the virus that causes COVID-19, and may also modulate the immune response to the virus. Lactoferrin's antibacterial properties also help to reduce the risk of secondary infections. Additionally, lactoferrin has been found to reduce the risk of respiratory infections and improve lung function in individuals with chronic respiratory conditions such as asthma and COPD. While there is a body of preclinical and observational studies supporting the use of lactoferrin as a potential therapy for COVID-19. Several clinical trials evaluate the safety and efficacy of lactoferrin as a treatment for COVID-19. Overall, lactoferrin may hold promise as a preventative measure for COVID-19.

**Keywords:** Lactoferrin, Milk, Covid-19, Health

### Introduction

COVID-19, also known as the coronavirus disease 2019, is a highly contagious respiratory illness caused by the SARS-CoV-2 virus. The virus was first identified in Wuhan, China in December 2019 and has since spread to every corner of the globe, leading to a global pandemic (Wang *et al.*, 2020). The World Health Organization declared COVID-19 a Public Health Emergency of International Concern on January 30, 2020, and a pandemic on March 11, 2020.

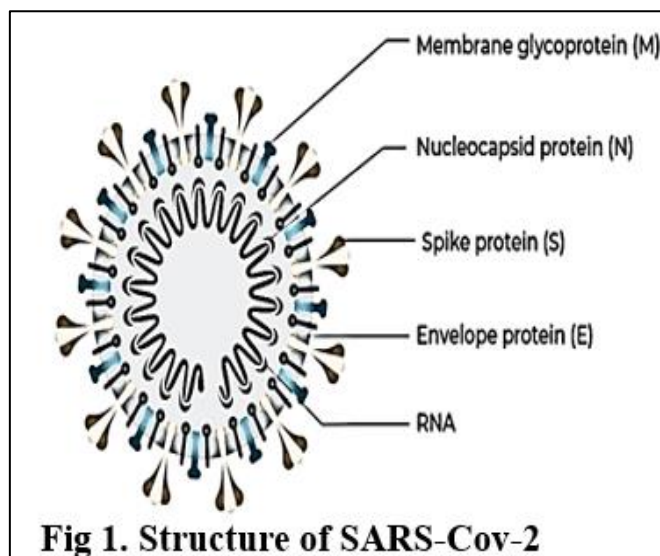
The virus has killed millions of people worldwide and has led to unprecedented disruptions to daily life. Hospitals and healthcare systems have been overwhelmed, and many countries have implemented strict measures such as lockdowns and travel ban in an effort to slow the spread of the virus (Serrano *et al.*, 2020). The pandemic has also led to widespread mental health issues, as people struggle with isolation, anxiety, and economic uncertainty. Even countries with strong healthcare systems have been overwhelmed by numbers of patients requiring critical care for COVID-19. Especially, worldwide vaccine deployment was an essential to tackle the pandemic.



Lactoferrin is a protein that is found in milk, saliva, and other bodily fluids. It is known for its ability to bind to iron, which makes it an effective antibacterial and antiviral agent. Studies have shown that lactoferrin can help to prevent the growth and spread of a variety of pathogens, including the novel coronavirus that causes COVID-19. Lactoferrin is known for its strong antimicrobial properties and has been shown to have a wide range of potential health benefits, including boosting the immune system, improving gut health, and reducing inflammation. This property makes lactoferrin an important part of the body's innate immune system and helps to protect against COVID-19. Lactoferrin has also been shown to have potential health benefits beyond its antimicrobial properties, anti-inflammatory, gut health, and gastrointestinal disorders such as inflammatory bowel disease.

## COVID-19

Corona virus is a single-stranded RNA virus and crown-like spikes are present on the surface of this virus, that is why, it is named as corona virus. The virus has a distinct spherical shape, measuring approximately 125 nm in diameter (Presti *et al.*, 2021). The viral envelope is composed of a lipid bilayer, which encloses the viral genetic material, the RNA. The envelope is studded with spike proteins, which give the virus its characteristic "crown" appearance (Fig. 1). These spike proteins are what allow the virus to bind to and infect human cells. The

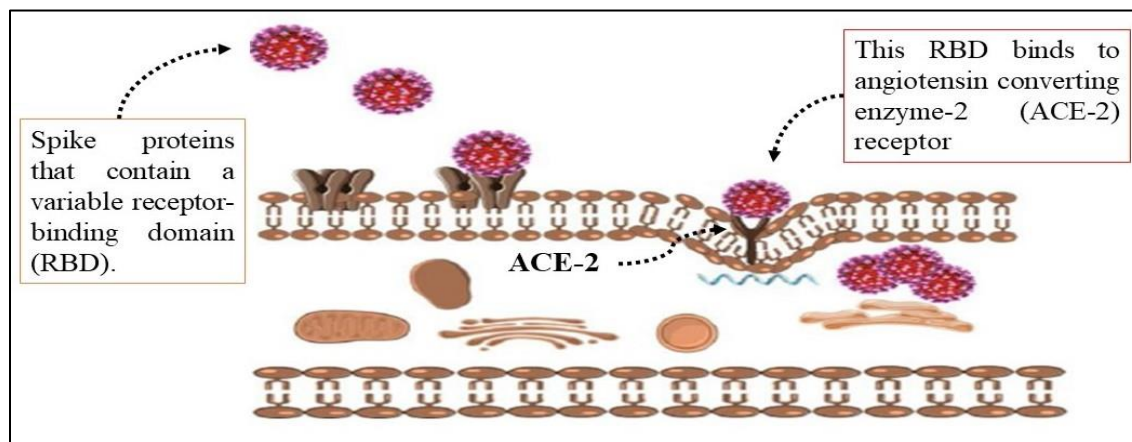


**Fig 1. Structure of SARS-Cov-2**

spike proteins are also the target of the virus neutralizing antibodies that are generated by the host. The spike protein has a receptor binding domain (RBD) which is responsible for recognizing the host receptor ACE2 (Angiotensin-converting enzyme 2) and this interaction is key for the virus entry into host cells (Fig. 2). Inside the viral envelope, there are other proteins including the envelope protein, membrane protein, and nucleocapsid protein. The nucleocapsid surrounds the viral RNA and helps to protect it and also involved in viral replication (Chang *et al.* 2020).

Overall, understanding the structure of the COVID-19 virus is important for understanding how it infects human cells and causes disease, and for developing strategies to combat the virus, such as vaccines and therapies.





**Fig.2 Mechanism of COVID-19 action on human**

### What is Lactoferrin?

Lactoferrin, is an 80-kDa iron-binding glycoprotein mainly present in milk and saliva. It is a member of the transferrin family of iron-binding proteins, and it is known for its ability to bind to and transport iron in the body (Rosa *et al.*, 2017). Various studies suggested numerous biological functions that included antimicrobial, antioxidant, immunomodulatory and many more. Therefore, now-a-days, it is supplemented in many foods and pharmaceutical products. The concentrations of lactoferrin in milk differ from species to species and type of milk which have been highlighted in Table 2.

Biological Fluid	Concentration
Cow milk	20-200 µm/ml
Cow Colostrum	1.5 mg/ml
Mature breast milk	1-2 mg/ml
Colostrum breast milk	7-7.5 mg/ml
Tear fluid	2.2 mg/ml
Seminal plasma	0.4-1.9 mg/ml
Saliva	7-10 µg/ml
-(Morello <i>et al.</i> , 2022)	

Lactoferrin has been widely studied for its potential health benefits due to its antioxidant, anti-inflammatory, and antimicrobial properties. It has been shown to have a wide range of effects on human health, including its role in immune system support, wound healing, and as a potential treatment for various infections and inflammatory conditions (Presti *et al.*, 2021). Lactoferrin is known to have antibacterial, antiviral and antifungal activity. Lactoferrin is also known to have anti-inflammatory effect, by decreasing the production of pro-inflammatory cytokines and increasing the production of anti-inflammatory cytokines. Furthermore, it has been observed to be beneficial for people with iron-deficiency anemia, as it can help increase iron absorption (Serrano *et al.*, 2020). Due to its multifunctional and broad-spectrum properties, lactoferrin is being studied as a potential therapeutic agent for a wide range of conditions, including cancer, osteoporosis, and even COVID-19, as previously



mentioned (Campione *et al.*, 2020).

### **Possible mechanism of lactoferrin against COVID-19 virus**

Lactoferrin has been observed to have several mechanisms of action that may be beneficial in preventing COVID-19.

One of the main mechanisms of action of lactoferrin against COVID-19 is through binding to the spike protein on the surface of the virus. The spike protein is responsible for allowing the virus to enter host cells, and by binding to it, lactoferrin can prevent the virus from entering host cells and thereby inhibit viral replication (Campione *et al.*, 2021). Chang *et al.* (2020) found that bovine lactoferrin was able to bind to the spike protein of SARS-CoV-2 with high affinity and may inhibit the viral entry (Fig.2).

Another proposed mechanism of action is that lactoferrin may inhibit the virus by binding to the ACE2 receptors on the surface of host cells. ACE2 receptors are the entry point for the virus into host cells, therefore, lactoferrin may be able to prevent the virus from entering host cells by binding to these receptors instead. Additionally, lactoferrin has been observed to increase the expression of ACE2 receptors, which may increase the number of available receptors and make it harder for the virus to bind to them (Bolat *et al.*, 2022). In addition to the above mechanisms, lactoferrin also has been observed to have an anti-inflammatory effect that may be beneficial in preventing or treating COVID-19. The immune response to the virus, especially in severe cases, often leads to an overproduction of inflammatory cytokines that can cause lung damage and other organ failure. Lactoferrin has been observed to decrease the expression of pro-inflammatory cytokines and increase the expression of anti-inflammatory cytokines, this can help to maintain a balanced immune response and prevent severe symptoms.

lactoferrin has also been observed to have immunomodulatory effect, that may be beneficial in preventing or treating COVID-19. Lactoferrin has been observed to increase the production of antibodies and T cells, which play an important role in recognizing and eliminating the virus. Lactoferrin also has been observed to increase the production of interferon, which is a protein that helps to prevent viral replication (AlKhazindar & Elnagdy, 2020).

### **Conclusion**

The numerous bio-functions of lactoferrin make it attractive for the designing of new nutritional supplements. Currently, the use of infant formulas supplemented with bovine lactoferrin has been widely accepted. Milk is a potent source of this magical biocomponent. Mothers' milk after born and thereafter a glass of milk that not only quench our thirst but provides basic nutrients and boosts immune system against many viral diseases including COVID-19. Lactoferrin may hold promise as a preventative measure for COVID-19 due to its antiviral properties, potential to reduce secondary infections and positive effects on



lung function. It's always important to remember that lactoferrin is not a replacement for the existing prevention and treatment method such as vaccination, maintaining physical distancing, wearing mask, and following hygiene protocols as per the guidance of the local health department.

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