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OPINION PIECE

Good gut health could be a key line of defence against viral infections – UP food science academics

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Although there is no specific research that shows the positive effects of high-fibre foods in helping to fight against COVID-19, some existing research has suggested its beneficial effects against viral infection.

A healthy, balanced diet that includes dietary fibre found in fruits and vegetables, non-digestible oligosaccharides consisting of whole grains, and probiotic-rich fermented foods could help us to strengthen our immune system to act against viral infections.

Diet is a significant determinant for the increase of disease risk. Accordingly, emerging evidence has shown that functional foods may impact gut-related diseases and dysfunctions that are linked with lifestyle changes and age. The importance of the colonic microbiota in human health and well-being is a major breakthrough in both medical and nutrition research, even if this still remains to be fully understood.

The large intestine in the gut is home to trillions of beneficial bacteria that live in harmony – this is referred to as the intestinal microbiome or gut microbiome. Dietary modifications have shown to be the strongest inducers on the type of microbial colonisation in the gut as bacteria have different preferences for different energy sources. Respiratory infections may be prevented using strategies that include hand hygiene, and the administration of immunostimulants, prebiotics, probiotics and synbiotics.

Prebiotics are functional food ingredients that are resistant to the digestive processes in the upper part of the gastrointestinal tract; are fermentable by the intestinal microbiota; and are able to selectively stimulate the growth and activity of probiotic bacteria. Sources for prebiotics include dietary fibres and non-digestible oligosaccharides that have been shown to be effective in elevating immunogenicity by influencing the gut microbiome interactions and activating the physiological functions against upper respiratory illness.

It has been reported that butyrate – a short-chain fatty acid (SCFA) produced as a microbial fermentative product of prebiotics – suppresses lymphocyte proliferation, reduces cytokine expression, regulates the production of eicosanoids and chemokines. However, the mechanism involved in the systemic immune modulation is currently unknown. Furthermore, as fermentation products are absorbed in the blood stream, they reach and affect other parts of the immune system too. During a respiratory viral infection, prebiotics may influence the host's innate and T-cell responses by modulating the immune cell responses in the lungs. Studies show that dietary oligosaccharides induce changes in the microbiota, and that the latter can increase viral clearance by systemic Th1 responses.

Prebiotics play a major role in the growth of probiotics while inhibiting the pathogenic species in the gut. Probiotics are defined as “live microorganisms which, when administered in adequate amounts, confer a health benefit on the host”. The common probiotic microbes include the *Lactobacillus* and *Bifidobacterium* families. When adhered to the human intestines, probiotics help to stimulate, regulate and modulate various functions, including digestion, metabolism, innate and adaptive immunity, exclusion of pathogens and viruses, and brain-gut communication. Still, the mechanisms are not fully elucidated.

Lactobacillus and *Bifidobacterium* species play an important role in innate immunity by increasing the cytotoxicity of natural killer cells and phagocytosis of macrophages. Several studies demonstrate the ability of probiotics to stimulate the innate and acquired immune response by inducing the secretory and systemic IgA secretion, modifying T-cell responses and maintaining the homeostasis of immune cells.

The gut microbiota may have anti-viral responses against the influenza virus infection by stimulating influenza-specific T-cell response in the lung. There is growing evidence that probiotics may prevent and/or decrease the risk and duration of upper respiratory tract infections (URTIs) and seasonal illness, either bacterial or viral infections and in the attenuation of the perception of symptoms and disease duration.

Recent literature shows that an alteration in the intestinal flora may alter the innate and adaptive anti-viral immune responses in mice and lengthen the time to virus clearance. Administering probiotics like *Lactobacillus* and *Bifidobacterium* in mice has been shown to restore the balance of intestinal flora; this was important for the up regulation of TLR7 (toll-like receptors) pathways. During a viral infection, for example, the influenza virus reduces the expression of TLR7 together with the impairment of the immune response of T-cell subsets. Therefore, the composition of intestinal microbiota, the immunological functions and virus infection are connected via reciprocal causation and mutual transformation.

A healthy gut microbial diversity can prevent anti-viral effects and intestinal dysbiosis. Thus a healthy, balanced diet with the inclusion of functional foods such as plant dietary fibre found in vegetables and fruits, nuts, whole grains, and fermented foods that are rich in probiotics could help us to strengthen our immune system to act against viral infections.

Ends.

ABOUT THE UNIVERSITY OF PRETORIA

The University of Pretoria (UP) is one of the largest contact and residential universities in South Africa, with its administration offices located on the Hatfield Campus, Pretoria. This 112-year-old institution is also the largest producer of research in South Africa.

Spread over seven campuses, it has nine faculties and a business school, the Gordon Institute of Business Science (GIBS). It is the only university in the country that has a Faculty of Veterinary Science which is ranked top in Africa, and overall has 120 academic departments, as well as 92 centres and institutes, accommodating more than 55 000 students and offering about 1 100 study programmes.

UP is one of the top five universities in South Africa, according to the 2019-2020 rankings by the Center for World University Rankings. It is also ranked among the top 100 universities worldwide in three fields of study (veterinary science, theology and law), and among the top 1% in eight fields of study (agricultural sciences, clinical medicine, engineering, environment/ecology, immunology, microbiology, plant and animal sciences and social sciences).

In June 2019, the annual UK Financial Times Executive Education Rankings once again ranked GIBS as the top South African and African business school. The University also has an extensive community engagement programme with approximately 33 000 students involved in community upliftment. Furthermore, UP is building considerable capacities and strengths for the Fourth Industrial Revolution by preparing students for the world beyond university and offering work-readiness and entrepreneurship training to its students.

As one of South Africa's research-intensive universities, UP launched the *Future Africa Campus* in March 2019 as a hub for inter- and transdisciplinary research networks within UP and the global research community to maximise 4IR innovation and address the challenges and stresses our continent and world is facing. In addition, UP also launched the Javett Art Centre in September 2019 as a driver of transdisciplinary research development between the Humanities and other faculties. In 2020 UP will launch Engineering 4.0. as a hub not only for Smart Cities and Transport, but also to link the vast resources in technology and data sciences to other faculties via Future Africa. These initiatives are stimulating new thinking at the frontier of 'science for transformation'.

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