

# Plant Based Diet- A Therapeutic Riposte to Emerging Zoonotic Infections

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## ABSTRACT

Emerging zoonotic infectious diseases like swine influenza, avian influenza and Ebola have caused massive human suffering, social upheaval and economic damage across countries and continents. There is increasing evidence that humanity's overexploitation of nature is one of the major factors responsible for the spread. Recently, mankind is traversing a hard-pandemic time due to COVID-19 outbreak which appears to be a brutal killer. When humans infringe wild adobes for food production, it generates opportunities for infectious pathogens to leap to livestock and humans. It is the time to begin brooding about more radical measures to handle the root of this crisis. A resilient food system that puts less stress on the environment would reduce the outbreak of Emerging Infectious Diseases (EID) by reducing contact between humans and wild animals thereby restoring biodiversity. World Health Organisation (WHO) advises avoidance/judicious use of animal meat consumption during or after every outbreak. It is clearly evident that a balanced, healthy plant-based diet can help to control pandemics/epidemics not only by preventing the transmission but also by strengthening the immune system of individuals to combat the infection. This paper throws light on how the human diet is directly or indirectly linked to the emergence, spread and prognosis of various infectious diseases.

**Keywords:** Animal meat consumption, Coronavirus-19, Disease out-

## INTRODUCTION

Disease outbreaks have ravaged humanity throughout history and at times, signalling the end of whole civilisations. More than 50% of EIDs that have endangered human species are zoonotic in origin. Such diseases, transmissible from animals to humans through direct contact or through food and water are commonly cited as "zoonoses" [1]. Zoonotic spill over is the transmission of an infectious pathogen from vertebrate animals to human beings [2].

A series of external events such as upsurge in global travel, aggressive trading, agronomic growth, rampant deforestation/habitat disruption and large-scale urbanisation might have contributed to spill over by increasing the interface and/or the frequency of contact between human, domestic animal and wildlife reservoir. The public health burden and socio-economic impact of infectious zoonotic diseases varies over time and across geographical settings [3]. Several dreadful zoonotic diseases have emerged globally in recent decades such as Ebola, Acquired Immunodeficiency Syndrome (AIDS), Severe Acute Respiratory Syndrome (SARS), avian influenza and swine flu [Table/Fig-1] [4-9].

Disease	Demographic origin	Source of infection	Mode of transmission among humans
Avian influenza (H5N1)	China	Wild birds and fowls	Contact with infected bird's saliva, nasal secretions and faeces.
Swine influenza (H1N1)	USA	Pigs	Droplet spread through air from infected patient or direct contact with saliva or mucus secretions of infected pig.
Ebola virus	Africa	Fruit bats	Direct contact with infected patient's body fluids like blood, vomit and faeces.

**[Table/Fig-1]:** Demographic origin, source of infection and mode of transmission of Emerging Infectious Diseases (EID).

Recently, the WHO declared coronavirus disease (COVID-19) outbreak as a Public Health Emergency of International Concern (PHEIC), based on the alarming levels of spread and severity of the infection. Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) isolated from infected humans has a close genetic relation with coronaviruses

isolated from bats, explicitly from the bats of genus *Rhinolophus* [10]. Since, it is unlikely for humans to have a direct close contact with bats, it is believed that the virus has been transmitted through an intermediate animal species which is more frequently handled by humans. Malayan pangolins (*Manis javanica*) were identified to be the possible intermediate host [11]. Large percentage of the inceptive cases in December 2019 and early January 2020 had an unswerving association with the wet market in Wuhan, China where seafood, wild and farmed animal species are sold. However, the controversy about the wet markets and origin of SARS-CoV-2 still remains an enigma [11].

Thus, both wild as well as domestic animals have proven to be a predictable breeding point for emerging zoonotic diseases. To add to this, growing population densities, alarming stress levels, inadequate hygiene protocols and constantly evolving unreasonable dietary fad pose a threat for an already weakened human host to be readily infected by the pathogen. Meticulous and effective dietary planning can help build a strong immune system to combat EID as well as to maintain a healthy lifestyle with existing comorbidities [12]. Appropriately, planned plant-based diet are nutritionally adequate and beneficial in the prevention and treatment of numerous infectious diseases [13]. Hence, this review explores the possibility of the role of human diet in origin and spread of EID and mitigation of the infection in the affected population.

## Dietary Modification to Reduce Risk of Emerging Infectious Diseases

### A) Animal Food Products: A Concern for Handlers and Consumers

Studies have revealed that a novel zoonotic disease possibly originates by a single interaction between a human and an infected animal which later, within no time turns into a global health crisis by rapid transmission among humans [2]. Animals thus play a vital role in spreading zoonotic infections which could be bacterial, viral or parasitic, or may involve unconventional agents [14].

WHO recommends not consuming raw or undercooked meat and animal based food. Use of raw or soft-boiled eggs in food

preparations should be avoided. Poultry and animal meat should be strictly cooked at temperature of 70°C or above [15,16]. Proper hygiene protocol should be followed while handling and cooking raw meat and animal products to avoid cross-contamination [16]. Thorough hand washing with soap is advised before and after handling of raw meat and other animal products like offal, bones and blood. Working areas, utensils and equipment that have been in contact with animal products should be cleaned properly before and after use [9].

Sick and dead animals should strictly not be butchered for consumption. Dead animals should be buried or destroyed safely. Contact with their body fluids should be avoided. Usage of protective gear is recommended during the burial of animal carcasses [10]. United Nations Children's Fund (UNICEF) stresses on the reduction of intake of ready-to-eat packaged meat and animal products [17]. Imposing a ban on wild animal markets, where various animal species are butchered, stocked up and processed in close constricted spaces could play a pivotal role in control of spread of zoonotic disease.

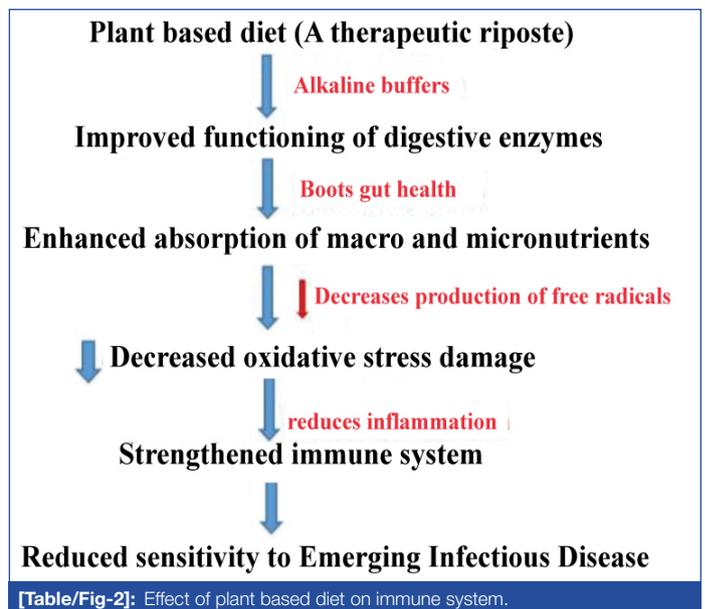
## B) Plant-Based Diet- A Potent Immunomodulator

Diet and nutrition unvaryingly influence the immune system competence and determine the prognosis of infectious diseases [18]. A typical "Western diet" (high in fat and animal products) compared to a "prudent diet" (high in vegetables, fruits, legumes and fish) has been shown to cause immunosuppression and thereby increased susceptibility to infection [13]. Prime role of nutrition in boosting immunity may explain some of the striking differences seen in recent COVID-19 fatalities across the globe. Foods with potent antioxidant activity like uncooked or fermented cabbage and fermented milk products were largely consumed in low-death rate European countries (Bulgaria, Romania and Greece), Korea and Taiwan [19]. Mediterranean-type food patterns as well as traditional Japanese food patterns are reportedly shown to have an anti-inflammatory effect [13]. This could have led to a growing trend for plant-based diet in many western countries.

Dietary constituents known to influence anti-inflammatory and antioxidant processes include vitamin A, C and D; minerals like iron, zinc, copper and selenium, as well as a variety of phytochemicals, such as polyphenols, carotenoids and dietary fibre, which are widely present in plant-based foods [20]. Plant based eating pattern can be of 3 types: pesco-vegetarian (consumption of fish, eggs and milk except meat) ovo-lacto-vegetarian (consumption of milk and egg except meat and fish) and vegan (strictly plant-based items; no meat, egg and milk). Amongst these, ovo-lacto-vegetarian and pesco-vegetarian diet being less restrictive can reduce dependence on animal derived sources of protein with more food choices available. Moreover, pro-inflammatory aspects of proteins from animal sources and anti-inflammatory properties of plant derived proteins cannot be overlooked [18].

Plant based diet has been shown to exhibit a positive effect on Body Mass Index (BMI), blood glucose levels, systolic and diastolic blood pressure, total and low-density lipoprotein, cholesterol, triglycerides, uric acid and high-sensitivity C-reactive protein. This could avoid some of the chronic degenerative changes which could put patients with existing comorbidities at a higher risk during the course of infection [21]. However, it is crucial to understand that plant-based diet cannot directly prevent a zoonotic infection.

Host dietary pattern is the pivotal determinant of gut microbiota community, structure and function. Plant based diet comprising of prebiotic fibres, probiotics and polyphenols and promote the healthy diverse microbiota which in turn promotes healthy immune response [12] [Table/Fig-2]. Though plant-based diet can meet most of the nutrient requirements, the use of supplements and fortified



food provides an expedient protection against deficiency [12].

## Recommendation(s)

Cultivated meat production and adaptation of plant-based diet can go a long way in reducing the food insecurity and zoonotic disease concerns inherent in animal-based food. A nutritionally adequate home cooked plant-based meal prepared using a variety of techniques like soaking, fermentation and germination can be adapted as a lifestyle choice to enhance immune response. Healthy, fresh whole foods should be made readily accessible to individuals in the area of outbreak of an infectious disease.

Large number of people who recover from EID may lead to a spike in chronic medical conditions that could be further exacerbated by unhealthy diet in vulnerable populations. The anti-inflammatory plant-based diet strategy is a viable option to control long-term degenerative changes which could result in chronic morbidity in patients. Furthermore, a change in dietary pattern can also contribute by increasing the efficacy and outcome of vaccines against EIDs.

## CONCLUSION(S)

Zoonotic spill over is the transmission of an infectious pathogen from vertebrate animals to human beings. Once a contagion is identified, it is difficult to control its spread and eventually, it emerges as a global public health burden. Although, there is no direct link between the consumption of animal products and EID; it is still advised to avoid the consumption of raw or undercooked meat or poultry to forestall the disease. Diversifying methods of meat production would not only offer an opportunity to scale back pandemic risk by thinning out the quantity of live animals raised for food, but also help mitigate numerous other hazards. A food system that is highly resilient and that puts less stress on the environment and public health is essential. With a balanced plant-based diet and optimal food hygiene habits, the spread of EIDs of zoonotic origin can be prevented or at least slowed down. The recent COVID-19 pandemic has made to think radically about the consumption of food and shown the path of a healthy plant-based diet world.

## REFERENCES

- [1] Managing public health risks at the human-Animal-environment interface; World Health Organization. (2020). Accessed: 17/04/2020. <https://www.who.int/zoonoses/en/>.
- [2] Plowright RK, Parrish CR, McCallum H, Hutson PJ, Ko AI, Graham AL, et al. Pathways to zoonotic spillover. *Nat Rev Microbiol.* 2017;15(8):502-10.
- [3] Field HE. Bats and emerging zoonoses: Henipaviruses and SARS. *Zoonoses Public Health.* 2009;56(6-7):278-84.
- [4] Rajagopal S, Treanor J. Pandemic (avian) influenza. *Semin Respir Crit Care Med.* 2007;28(2):159-70.
- [5] Poovorawan Y, Pyungporn S, Prachayangprecha S, Makkoch J. Global alert to avian influenza virus infection: From H5N1 to H7N9. *Pathog Glob Health.*

- 2013;107(5):217-23.
- [6] Dotis J, Roilides E. H1N1 influenza A infection. *Hippokratia*. 2009;13(3):135-38.
- [7] Ito T, Couceiro JN, Kelm S, Baum LG, Krauss S, Castrucci MR, et al. Molecular basis for the generation in pigs of influenza A viruses with pandemic potential. *J Virol*. 1998;72(9):7367-73.
- [8] Ebola virus disease; World Health Organization. (2020). Accessed: 17/04/2020. <https://www.who.int/csr/don/archive/disease/ebola/en/>.
- [9] Food Safety Focus- Incident in Focus. Ebola Virus Disease and Food Safety; Centre for Food Safety. The Government of the Hong Kong Special Administrative Region. (2020). Accessed: 17/04/2020. [https://www.cfs.gov.hk/english/multimedia/multimedia\\_pub/multimedia\\_pub\\_fsf\\_98\\_01.html](https://www.cfs.gov.hk/english/multimedia/multimedia_pub/multimedia_pub_fsf_98_01.html).
- [10] Origin of SARS-CoV-2; World Health Organisation. (2020). Accessed: 16/04/2020. [https://apps.who.int/iris/bitstream/handle/10665/332197/WHO-2019-nCoV-FAQ-Virus\\_origin-2020.1-eng.pdf](https://apps.who.int/iris/bitstream/handle/10665/332197/WHO-2019-nCoV-FAQ-Virus_origin-2020.1-eng.pdf).
- [11] Mackenzie JS, Smith DW. COVID-19: A novel zoonotic disease caused by a coronavirus from China: What we know and what we don't [published online ahead of print, 2020 Mar 17]. *Microbiol Aust*. 2020;MA20013.
- [12] Gasmi A, Noor S, Tippairote T, Dadar M, Menzel A, Björklund G. Individual risk management strategy and potential therapeutic options for the COVID-19 pandemic [published online ahead of print, 2020 Apr 7]. *Clin Immunol*. 2020;215:108409.
- [13] Watzl B. Anti-inflammatory effects of plant-based foods and of their constituents. *Int J Vitam Nutr Res*. 2008;78(6):293-98.
- [14] Zoonoses; World Health Organization. (2020). Accessed: 17/04/2020. <https://www.who.int/topics/zoonoses/en/>.
- [15] No bird flu risk for consumers from properly cooked poultry and eggs; World Health Organization. (2005). Accessed: 17/04/2020. <https://www.who.int/mediacentre/news/releases/2005/pr66/en/>.
- [16] New influenza A (H1N1); European Food Safety Authority. (2010). Accessed: 17/04/2020. <https://www.efsa.europa.eu/en/topics/topic/new-influenza-h1n1>.
- [17] Easy, affordable and healthy eating tips during the coronavirus disease (COVID-19) outbreak; The United Nations Children's Fund (UNICEF). (2020). Accessed: 16/04/2020. <https://www.unicef.org/coronavirus/easy-affordable-and-healthy-eating-tips-during-coronavirus-disease-covid-19-outbreak>.
- [18] Medawar E, Huhn S, Villringer A, Veronica Witte A. The effects of plant-based diets on the body and the brain: A systematic review. *Transl Psychiatry*. 2019;9(1):226.
- [19] Bousquet J, Anto JM, Iaccarino G, Czarlewski W, Haahtela T, Anto A, et al. Is diet partly responsible for differences in COVID-19 death rates between and within countries? *Clin Transl Allergy*. 2020;10:16.
- [20] Butler MJ, Barrientos RM. The impact of nutrition on COVID-19 susceptibility and long-term consequences [published online ahead of print, 2020 Apr 18]. *Brain Behav Immun*. 2020;S0889-1591(20)30537-37.
- [21] Lynch H, Johnston C, Wharton C. Plant-based diets: Considerations for environmental impact, protein quality and exercise performance. *Nutrients*. 2018;10(12):1841.

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