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VBMA Educational Scholarship Essay

The animal body is home to trillions of microorganisms that are collectively called the microbiome. Some of these are pathogenic, but most are beneficial for the animals. The beneficial microbes that reside inside or outside of the body of an animal can fight, compete for nutrition with the pathogenic microorganisms, and thus prevent infectious diseases. They also influence the physiological functions like digestion and absorption, growth and development of an animal. In addition, they influence the development of obesity, allergic diseases (cell-mediated immune reactions), inflammatory diseases, and some forms of autoimmune diseases.^[1] In our country, many farmers use excessive antimicrobials (especially tetracycline and colistin) with feed to prevent infectious diseases and to hold optimum growth and production of animals at the same time. Such incidence increases the rate of Antimicrobial Resistance (AMR), which is a great public health concern in modern times. It becomes increasingly mandatory to look for an alternative to antimicrobials. Some research has shown promising results that animal microbiome can kill or reduce infections, and subsequently improve the growth, development, and obviously immune status of an animal. Importantly, this microbiome can be immensely influenced by some plants and plant-derived compounds. Plants can modulate the number and composition of the microbiome in humans and animals; consequently improving immunological health and well-being.

Here, I have selected **Garlic** (*Allium sativum*) and **Purslane** (*Portulaca oleracea*) that can tremendously influence the microbiome and through which influence immunological health and well-being.

Garlic (commonly known as ‘**Rosun**’ in Bangladesh) has been one of the most popular flavoring spices used in cooking in Bangladesh as well as the whole Indian subcontinent. In Bangladesh, it is cultivated commercially and in fallen land around the house. The bulb of garlic contains carbohydrates, protein, dietary fiber, fat, thiamin, pantothenic acid, manganese, phosphorus, calcium, iron, zinc, etc.

Different studies reveal that garlic has some major bioactive components such as allicin, alliin, diallyl-sulfide, diallyl-disulfide, diallyl-trisulfide, ajoene, and S-allyl-cysteine that are responsible for its multiple medicinal properties.^[2]

The influences of garlic on the microbiome and directly or indirectly on immunological health and well-being in both humans and animals are noteworthy. The garlic oil and its diallyl sulfides have a growth inhibitory effect on pathogenic *Escherichia coli*, *Enterobacter cloacae*, *Enterococcus faecalis*, *Citrobacter freundii*, and bactericidal properties against *Helicobacter pylori*, methicillin-resistant *Staphylococcus aureus*, *Pseudomonas aeruginosa* and *Klebsiella pneumonia* in human.^[3] Whereas, the *Lactobacilli* in the gut show a degree of resistance against garlic powder indicating consumption of garlic powder may favor the growth of these (*Lactobacilli*) beneficial bacterial species in the gut,^[4] Whole garlic supplementation in mice increases the number of *Lachnospiraceae* in the gut.^[5] Researches indicate that *Lachnospiraceae* plays an essential role in the maintenance of gut immune homeostasis as the inducer of colonic regulatory T cells.^[6] Furthermore, *Lachnospiraceae* is possibly associated with anti-inflammatory activity,^[7] and linked with host mucosal integrity, bile acid metabolism, polysaccharides decomposition, and protection from colon cancer.^[8] Garlic allicin has broad antimicrobial activity against G(+) and G(-) bacteria, including against antibiotic-resistant bacterial strains and fungus (*Saccharomyces cerevisiae*) in in-vitro testing.^[9] Garlic modulates both the innate and adaptive immune system in monogastric animals and in dairy cows and can increase subtype T cells in peripheral blood (CD4+) related to adaptive immunity.^[10] Various studies in ruminants indicate garlic is an effective prebiotic and useful to modulate the rumen microbiome. I also got some idea about the usefulness of garlic as a prebiotic from our courses GMD(General Medicine) and AVM(Avian Medicine). In fattening lamb, garlic skin (a by-product of garlic) supplementation improved rumen fermentation and altered the ruminal bacterial composition, increasing the genus-level relative abundance of *Prevotella*, *Bulleidia*, *Howardella*, and *Methanosphaera* and decreasing the abundance of *Fretibacterium*.^[11] Another investigation demonstrates that fructooligosaccharides from sugar beet and garlic residues in combination with milk can cause an increase in the number of *Bifidobacterium*, *Enterococcus*, *Lactobacillus*, and *Veillonella* that help in the promotion of growth and health status in neonatal lambs.^[12] Garlic extract act against a large number of yeasts including *Candida* spp, and fungi *Aspergillus* spp.^[13] Moreover, garlic extract is effective against the Herpes simplex virus-I & II.^[14] I have seen my paternal aunty use garlic

juice in combination with ginger and have a notable positive response against common cold(normal flu) and digestive disorders. One of my cousin's poultry flock was affected by Marek's Disease & Lymphoid leucosis virus, and I saw he was using garlic at a rate of 200gm/100kg feed and getting good results. Garlic is not only a microbiome influencer but also a potent antioxidant, anti-inflammatory, immunomodulatory, cardiovascular protective, anticancer, hepatoprotective, digestive system protective, anti-diabetic, anti-obesity, neuroprotective, and renal protective agent. For its diverse application in many diseases and disease conditions, it is widely accepted as folk medicine.

Purslane is a succulent herb found in the Indian subcontinent as well as most parts of the tropical and temperate regions of the world. Locally, it is known as **Nunia Shak**. Traditionally, Nunia's leaves, flowers, and stems are accepted as vegetables and medicine in many cases. Although it is not being commonly cultivated commercially in Bangladesh, but usually seen growing well on around the paddy fields, driveways, or barren fields with minimum moisture. Purslane is rich in omega-3 fatty acids, protein, vitamins, minerals, and fibers and its bioactive compounds include flavonoids, alkaloids (oleraceins), terpenoids (portulosides), polysaccharides.^[15]

However, Purslane has a significant pharmacological influence on the microbiome in humans and animals that can trigger immunological health and well-being directly or indirectly. Leaves extract of Purslane is antibacterial to commensal *Staphylococcus aureus*, *Streptococcus pyogenes* & *Pseudomonas aeruginosa* in in-vitro.^[16] Other studies describe extract can modulate gut microbiota that helps to alleviate Type-II diabetes,^[17] give relief from functional constipation^[18] in humans & animals, reduce gut microbial imbalance, and suppress proliferation of colorectal cancer cells in mice.^[19] Purslane polysaccharides promote the growth of *Bifidobacteria*, which in turn increase anti-inflammatory cytokine IL-10, reduce TNF- α , and IL-6, and regulate intestinal over immune response. Its polysaccharide also shows potential to inhibit the replication of herpes simplex virus-II and flu (influenza virus type-A).^[20] In broiler, the dietary supplement of purslane increases the number of *Lactobacillus* while decreasing the pathogenic *Escherichia-Shigella* which balances the gut environment and hastens carbohydrate metabolism to improve growth.^[21] Very few conscious farmers in our area follow this practice to get good results instead of using some antibiotics growth promoter. One report

shows that purslane extract acts against hyphal growth of *Aspergillus* and the yeast *Candida*.^[22] Purslane can kill the protozoa *Entamoeba histolytica* residing usually in the intestine.^[23] Moreover, in ruminants, purslane has the potential to inhibit ruminal protozoa *Entodinium*, which inefficiently utilize nitrogen.^[24] I have an experience to share, in my childhood when we had two bulls, my grandfather used to harvest purslane from the roadside slope and serve the finely chopped purslane to the bulls in combination with rice bran every day. In keeping with the beliefs and experiences of my grandfather & the people of our area, the incidence of diseases of the animals used to reduce as well as growth used to increase after the administration of purslane. After completing my PHT(Pharmacology & Therapeutics) course I assume, that might occur owing to the modulation of gut microbiota; although it has no scientific clearance until now. People in our locality still practice it out of belief and experience. Apart from purslane's influence on the microbiome in animals, it also works as a neuroprotective, antidiabetic, antioxidant, anti-inflammatory, antiulcerogenic, and anticancer agent.^[15] Due to its frequent medicinal use in different ailments worldwide in different traditional medicines, it was named 'Global Panacea' by World Health Organization. Above all, Purslane can be a useful influencer of the microbiome resulting in better immunologic condition and well-being in animals and humans.

In summary, different investigations and researches demonstrate that Garlic and Purslane remarkably influence the microbiome in animals and favor the growth of beneficial microbes in the body that can outsmart opportunistic pathogenic microbes. They can also produce different metabolites that make animals immune to many infectious or non-infectious diseases. Thus keeping immunological health well on top. Various plants like garlic and purslane can be used as growth promoters instead of antibiotics that can reduce the risk of AMR. But, surely, more research needs to be done and I want to be a researcher in this respect.

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