Indigenous Bacteria from the Gut Microbiota Regulate Host Serotonin Biosynthesis

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Background Reading:
https://www.scientificamerican.com/article/gut-second-brain/
http://www.medicalnewstoday.com/kc/serotonin-facts-232248
https://www.youtube.com/watch?v=dO6C_xVbqbo

Background Information:
-Serotonin, also called 5-hydroxytryptamine (5-HT), is a neurotransmitter mainly found in the gastrointestinal (GI) tract, the central nervous system, and platelets. It is synthesized endogenously using tryptophan as a precursor. 90% of the body's serotonin is found in the gut, where it is primarily produced by enterochromaffin cells. In the gastrointestinal tract, serotonin primarily interacts with enterocytes, enteric neurons, and immune cells. It is transported to the rest of the body from the GI tract via blood platelets. Because of this, serotonin has been linked to an array of physiological processes including gut motility, immune response, clotting, cardiac function, and bone development. Serotonin is also an important neurotransmitter in the central nervous system, where it is involved in regulating mood, sleep, and appetite.[1]

-The gut microbiota refers to the non-human organisms colonising the human gastrointestinal tract. The gut microbiota vastly outnumbers human cells in the body, and most bacteria found therein share a mutualistic relationship with humans, producing various important metabolites and playing an important role in the gut-brain axis. While many of the organisms in the gut microbiota have been identified, the exact relationships between them are still not fully understood. Furthermore, the gut microbiota is found to influence gut motility, mood, and immune function, but the exact mechanisms of this are still not completely understood.

-The enteric nervous system (ENS) is a cluster of neurons that innervate and control the gastrointestinal system via bidirectional signaling; however interestingly, most of the information flows from the gut to the brain. There are five times as many neurons in the enteric nervous system as the spinal cord, and it is capable of autonomously controlling movement of the bowels leading people to nickname it "the second brain." Some of its functions include controlling peristalsis, digestive enzyme expression, and reflexes. The ENS is connected to the central nervous system via the vagus nerve but is capable of functioning successfully even when the vagus nerve is severed.[2]

References

1) Mohammad-Zadeh, L. F., Moses, L., & Gwaltney-Brant, S. M. (2008). Serotonin: a review. *Journal of Veterinary Pharmacology and Therapeutics, 31*(3), 187-199. doi:10.1111/j.1365-2885.2008.00944.xFurness, J. B., Callaghan, B.
2) P., Rivera, L. R., & Cho, H. J. (2014). The enteric nervous system and gastrointestinal innervation: integrated local and central control. *Adv Exp Med Biol, 817*, 39-71. doi:10.1007/978-1-4939-0897-4_3

Overview:

- The microbiota
    - There are more cells in the microbiota than human cells in the body
    - The most cells in the microbiota reside in human intestines
    - What is the relationship between the microbiota and humans?
    - What areas about the microbiota need to be explored more?
    - How does the microbiota vary from person to person?
    - Where do these cells in the microbiota come from?
- Serotonin
    - Up to 90% of serotonin is produced in gut by enterochromaffin cells
    - It regulates systemic functions: bowel motility, appetite, assists in clotting by vasoconstriction
    - It affects cognitive functions such as mood, anxiety, and satiety
    - How can serotonin act as a bridge between the microbiota and the body?
    - What are potential effects of low serotonin production?
- The gut-brain axis and the enteric nervous system
    - The enteric nervous system is connected to the rest of the body via the vagus nerve
    - More neurons innervate the gut than are present in the spinal cord
    - Serotonin can act as a neurotransmitter on these nerves
    - How can the gut-brain axis be utilized to help treat systemic diseases or mood disorders?
    - What are some implications for general antibiotic treatment on normal physiological functioning?