Title: Appendix, What is it Good For?

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Article:

        We now know that the human microbiome is essential for human health3. In fact, bacteria and fungal cells outnumber our cells at least 3 to 14.

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The appendix has two functions that help our immune system to keep us healthy: first, it serves as a **reservoir of good bacteria** in case of a gut infection; and second, it contains some important immune cells to help us **fight off infections**.

The Appendix: Host to Good Bacteria

        It was only recently, in 2007, when researchers determined that the appendix plays host to gut bacteria through the formation and protection of bacterial biofilms1. A **biofilm** is made when a group of microbes, like bacteria, stick together and also stick to a surface using mucus (similar to slime). Biofilms are safe houses for bacteria, protecting them from outside elements that might harm them, and allowing bacteria to form stable communities1. Biofilms can cause infection (especially if the biofilm grows on contact lenses or artificial limbs), however, in our appendix, biofilms help us by protecting the beneficial bacteria that normally live in your gut1. While almost all of our gut has some amount of biofilm to prevent pathogenic bacteria from crossing our intestinal barrier, the appendix has the most biofilms in the gut1. If you think of biofilms like houses, the appendix is like the suburbs. The appendix is located toward the end of our colon but it avoids fecal matter and is narrower than other parts of the gut, which helps to keep the appendix safe from infection1. In the course of a gut infection, diarrhea cleans out most of the bacteria, both good and infection-causing, leaving our gut depleted of its protective biofilm layer. The appendix then sheds some bacteria from its biofilms to repopulate the rest of the gut with good bacteria, similar to if a flood washed away the housing, the appendix would send the aid workers to build shelters till the housing could be rebuilt2. This **release and relocation of beneficial gut bacteria after infection** by our appendix helps our immune system keep us healthy and maintain the mutualistic relationship between our cells and our gut bacteria.

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The Appendix: Infection Protection

        Besides functioning as a “safe house” for our gut bacteria, the appendix also contains some immune cells that can **react quickly to fight off infections**1. Your appendix has several types of immune cells including B cells, T cells, macrophages, natural killer T cells, and cells that make antimicrobial peptides2.  B cells are a type of immune cell that make antibodies against pathogens to protect you5. Antibodies are a special type of protein that bind to specific molecules that identify the microbe5. T cells are a different type of immune cell that can protect you from infection in two basic ways:  one way is that some T cells directly kill infected cells; another way is that T cells encourage B cells to make more antibodies to target the infection-causing microbe5.

Natural killer T cells are a rare, special kind of T cell that can only recognize the glycolipid (sugar-fat) or lipid (fat) part of microbes unlike normal T cells which recognize the peptide (protein) part of microbes5. They can react much more quickly than normal T cells to a new microbe threat by releasing a ton of immune boosting molecules called cytokines5. Your appendix has a large concentration of this rare population of natural killer T cells to better protect you from infection from something you ate or from a pathogenic bacteria lurking in your gut2.

Macrophages make up the sentries of our immune system. They destroy infected cells. If macrophages are the sentries of the immune system army, then cytokines are the drummer boys because they are the key messengers that our immune system uses as alerts and as messengers for the rest of the army6. Antimicrobial peptides are the foot soldiers of your immune system and they kill microbes to fight infections and help keep you healthy (<https://thedishonscience.stanford.edu/posts/amp-immune-foot-soldiers/>)7.  Your appendix protects you from infection and keeps you healthy by hosting both beneficial gut bacteria in biofilms and also fast acting immune cells to ward off infection. Your appendix has both the housing repair workers and an army to protect and help you recover from threats.

Appendicitis

        Now that we have established that your appendix does serve a purpose, let’s talk about appendicitis or the reason we’ve discovered that you can live without an appendix.  Appendicitis occurs when your appendix becomes inflamed from a blockage (trapped bacteria) that causes infection1,8.  The blockages that cause appendicitis form because food or feces got stuck in the very narrow appendix8. The blockage can also result from a infection that causes the appendix to swell8. About 1 in 15 people in the United States suffer from appendicitis in their lifetime8. The usual solution to appendicitis is to simply remove the appendix8. The removal of the appendix hasn’t shown any significant effects on health or longevity in developed nations since easy access to clean water and adequate sewage removal help prevent most diarrheal infections1. In a developed nation, you aren’t at high risk of getting a gut parasite or diarrheal infection compared to in a developing nation, because the threat of diarrheal diseases has been greatly reduced by government enforced hygienic practices (waste disposal, clean food and water regulations)1.  Therefore, you don’t need a backup microbiome to swoop in and repopulate your gut frequently because your microbiome is not threatened in the first place.

In regions such as the Middle East and South America where industrialization and westernized hygienic and medical practices are on the rise, so are cases of appendicitis8. The risk of appendicitis increases as the society becomes more industrialized8 . In developing nations where diarrheal diseases are a big risk to quality of life, such as some African nations, the risk of appendicitis is much, much lower since the appendix is in greater demand1. Also, in children under five years of age, the risk of appendicitis is much lower, even in developed nations, since that age group is at the highest risk of dying from diarrheal illnesses1.

Thus, our appendix has a purpose! It helps our immune system defend our bodies from infection (especially diarrheal disease) but we have found that we can survive without it if our risk of getting infected is greatly reduced.

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