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# GROWING HEALTHIER CHICKENS BY FEEDING THEIR GUT MICROBES

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All living things need nutrients to grow and stay healthy. Like humans, animals get most of their nutrients from food. Supplements added to animal feed to boost its nutritional value are called feed additives and they come in various forms to suit an animal's unique needs. Despite their differences, feed additives have one common purpose: to improve an animal's health. One way to promote animal health is by helping good gut microbes to grow. Feed additives that support good microbes are called pre-biotics. Plant-based pre-biotics are commonly used in the poultry industry. Some examples of plant-based pre-biotics are essential oils, fruit peels, and herbs. This article focuses on these plant-based feed pre-biotics and explores how they improve the health of chickens by changing the microbial diversity in their digestive system.

**FEED ADDITIVES**

Chemical or natural compounds added to animal feed to provide many benefits, such as maintaining and enhancing an animal's general health.

**MICROBES**

Tiny living organisms found all around and within us that can be good or harmful. Some examples include fungi, bacteria, and viruses.

**PROBIOTICS**

Live microbes that help maintain the health and function of the digestive system and the overall health of an animal. An example is the bacterium *Lactobacillus* in yogurt.

**PRE-BIOTICS**

Non-living compounds that maintain or improve an animal's overall health. Plant-based pre-biotics include herbs, fruit peels, essential oils, or plant compounds called polyphenols.

**MICROBIOME**

A group of microbes (harmful and good) that can be found in its natural environment such as the gut.

**PATHOGEN**

A microorganism that causes disease.

**MICROBIOTA**

All the microorganisms (good and harmful) that live in a certain habitat, like the gut.

## FEED ADDITIVES HELP ANIMALS STAY HEALTHY

Nutrients are necessary for the health and growth of humans and other animals. All animals get the majority of their nutrients from food. **Feed additives** are substances that are added to animal feed to boost the nutritional value of the feed and improve animal health. Feed additives can be non-living compounds, like minerals, or living organisms, like **microbes**. Microbes are living organisms that are so small we only can see them using a microscope. **Probiotics** are feed additives that improve human and animal health by directly adding good microbes to the digestive tract. **Pre-biotics** are feed additives that contain substances that can be used by the good microbes that are already in the digestive tract, and help them to stay alive and improve their growth [1]. Both probiotics and pre-biotics improve the health of humans and animals because they help to maintain the "good" microbes that live in the body. The collection of all microbes living in an organism is called the **microbiome**. Probiotics and pre-biotics can help microbes that grow anywhere in and on the body, but they are usually used to improve the microbiome of the digestive system.

Did you know that many of us already add probiotics to our diets? Eating yogurt and other dairy products, which contain live bacteria, is a great way to add healthy microbes to our guts. Many of us also regularly eat plant-based pre-biotics, such as guar gum and inulin, that increase the number of complex sugars that serve as food for good gut microbes. Prebiotics help good microbes to grow and inhibit the growth of disease-causing microbes, called **pathogens** [2]. In our research, we explored plant-based pre-biotics that can be used to support a healthy chicken gut microbiome.

## WHY ARE MICROBES IMPORTANT FOR CHICKENS?

Have you ever wondered how chickens can produce delicious eggs and meat while they are eating mostly grains and seeds? To do so, chickens need a healthy digestive system that can convert complex plant fibers into simple sugars. Gut microbes are responsible for this conversion. The simple sugars produced by the gut microbes can be used by the chickens to grow and produce proteins, which result in eggs and meat. Currently, more than 600 microbial species have been identified by analyzing microbial DNA extracted from chicken gut contents. The dominant bacteria in a chicken's microbiome belong to bacterial groups called Proteobacteria, Firmicutes, Actinobacteria, and Bacteroidetes [3]. Since most chicken gut microbes have not been successfully grown in the lab, their exact roles in chickens are still not understood.

To better understand the role of a chicken's gut **microbiota**, we must first understand the digestive system in which they live. The microbiota

within the chicken's gut affect the chicken's health because it has good and harmful microbes. The main purpose of the digestive system is to break down food into smaller molecules. The crop and the gizzard are important features of a chicken's digestive system (Figure 1). A chicken's crop stores water and food until it is digested further. The gizzard is also known as the "mechanical stomach" and its job is to use two pairs of muscles to grind food. Scientists have found that microbes living in the digestive systems of animals, including chickens, play a crucial role in the health of those animals. Microbes can help digest food and can protect animals from diseases, including those caused by pathogenic microbes.

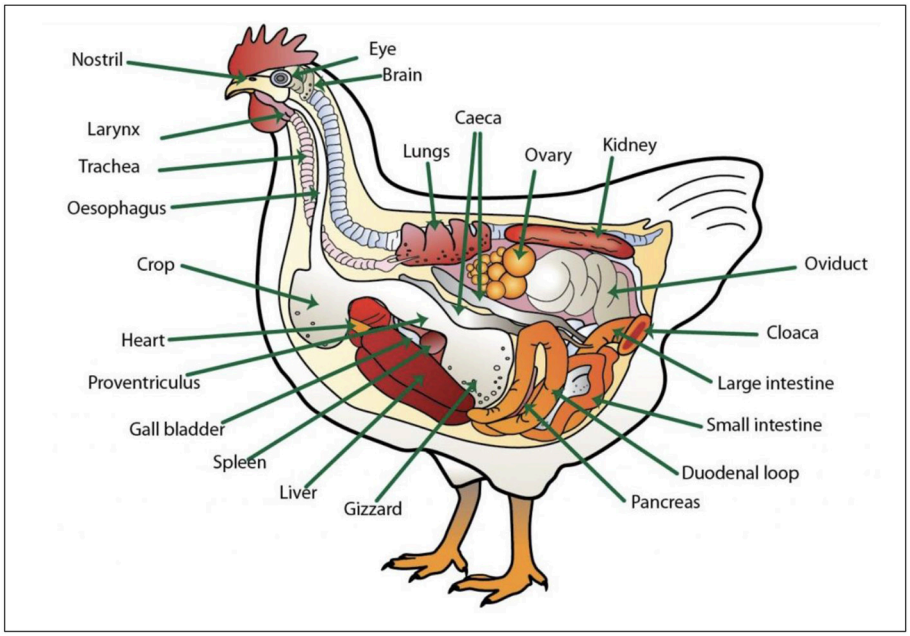


**Figure 1**

Overview of the internal organs of a female chicken (Figure credit: Poultry Hub, University of New England, Armidale, Australia). The crop, gizzard, duodenal loop, small and large intestine, and the cloaca are part of the digestive tract of chickens.

Where do these good microbes that help chickens stay healthy come from? When chicks are raised with their mother hen, chicks obtain the good microbes by eating some of their mother's droppings (poop). However, in large farms, chicks are often raised without the mother hen. When this is the case, good microbes are added to the chicks' feed.

## PLANT-BASED PRE-BIOTICS

Plant-based pre-biotics are substances that come from plants that, when eaten, increase the growth of good microbes and inhibit pathogens [2]. Plant-based pre-biotics come in many forms, including essential oils, herbs, chemical compounds isolated from plants, and fruit peels. They support a healthy microbiome and have many benefits for a chicken's overall health. A healthy microbiome keeps chickens

healthy and allows them to produce high-quality eggs and meat (Figure 2).

**Figure 2**

Plant-based pre-biotics added to chicken feed can help the good gut microbes of chickens to be healthier. Healthy chickens can grow larger and produce more eggs.

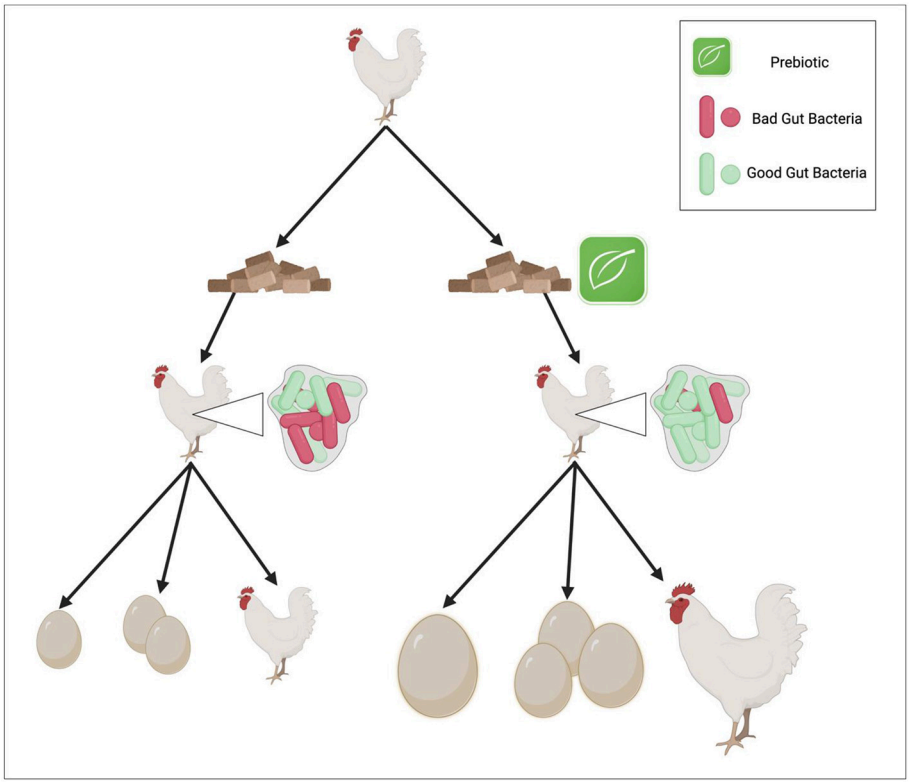


Figure 2

Several harmful types of bacteria are known to reside in the digestive tracts of chickens. *Clostridium perfringens*, for example, can cause an infection that leads to tissue damage and even death [4]. Researchers found that when chickens were given a blend of two essential oils called thymol and carvacrol, it decreased tissue damage caused by *C. perfringens* [4]. A different blend of essential oils (thymol, cinnamaldehyde, and eucalyptus oil) was found to decrease the number of chickens infected with *Clostridium perfringens* [4].

**POLYPHENOLS**

Chemical compounds from plant-based foods such as onion and garlic.

Plant-based pre-biotics such as onion and garlic contain substances called **polyphenols**. A study found that feeding onions or garlic to chickens led to a healthier gut microbiome:—numbers of good bacteria increased while numbers of harmful bacteria decreased. Onions also increased the height and depth of the chicken's small intestine, which could help to support improved nutrient uptake. Citrus peels and ginger are other great examples of plant-based pre-biotics. Citrus peels were shown to increase energy and growth while lowering cholesterol in chickens [5], while adding ginger to chickens' diet reduced cholesterol in their egg yolks.

**INFLAMMATION**

An immune system response caused by injury or pathogens, with symptoms including heat, pain, redness, and swelling.

The beneficial effects of plant-based pre-biotics also extend to the immune system. For example, they can lower **inflammation**. Symptoms of inflammation, such as pain and swelling, can lead to

decreased appetite and lower body weight in chickens [6]. You have probably heard someone tell you to eat fruits because they are good for you. Fruits are good for chickens too! Researchers fed grapes to chickens, and this led to an increase in antioxidants, which are substances that aid in fighting inflammation [6].

Chickens are often kept in extreme weather conditions—from the scorching sun to harsh winters. During the winter, low temperatures can lead to cold stress, which can negatively affect growth performance and welfare of chickens. When thyme and peppermint oil were added to the feed of chickens raised under cold stress, those chickens laid heavier eggs with thicker shells for protection. They even produced more eggs overall! This suggests that these two pre-biotic feed additives are especially useful in the winter [4]. Figure 3 summarizes the effects of some plant-based pre-biotics on chicken growth and egg production.

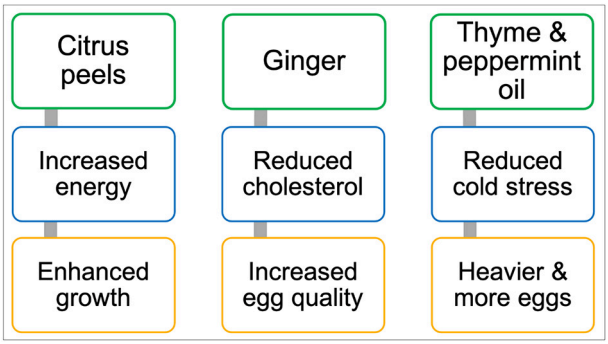


Figure 3

**Figure 3**

Effects of some plant-based pre-biotics on chickens. Plant-based pre-biotics come in many forms, such as peels, powders, and oils. The main goal of plant-based pre-biotics is to enhance the health of chickens. Health benefits vary depending on the pre-biotic.

## ADDITIONAL BENEFITS OF PREBIOTICS IN CHICKENS

Did you know that using plant-based pre-biotics can also reduce food waste? Every year, about 140 million tons of bananas are produced, and about 40% of them are thrown away due to damage or small size. Since banana peels can increase chicken growth, discarded bananas could be fed to chickens instead. This would not only reduce food waste but could also improve the health of chickens [5]. Researchers also suggested that poultry feed additives can help the economy. Adding ginger to chicken feed led to increased growth at a lower cost. That means that farmers can make more money for the same amount of chicken meat or eggs produced.

## CONCLUSION

The microbiome is complex and important for keeping humans and other animals, including chickens, healthy. Many of us already eat pre-biotics and they can be included in a chicken's diet as well.

Plant-based pre-biotics are an excellent way to maintain the health of a chicken's gastrointestinal tract and its microbiome—which ultimately helps to improve the health of chickens! Plant-based pre-biotics have several health benefits for chickens, including increased growth, lower cholesterol, improved egg production, decreased inflammation, and protection from cold stress. While this article focused on chickens and their gut microbiome, other animals like cows and pigs could benefit from plant-based pre-biotics too. There is still much to learn about the potential of plant-based pre-biotics, but their future role in animal health is bright!

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My name is Siri. I am in the sixth grade. Some things that I enjoy doing are reading, soccer, science, computer science, cooking, and baking. I like to read a series called Warrior Cats, and novels, non-fiction, and scientific novels. I played piano for a few years, but then changed to violin. I love animals and have two dogs and six chickens, and am getting ready to adopt two kittens. I love learning more about animals and plants and have my own succulents. I am trying to learn how to propagate its clippings.

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