MERCOLA
Take Control of Your Health

How Your Microbiome Influences Your Dietary Recommendations

Analysis by Dr. Joseph Mercola | November 1, 2026

STORY AT-A-GLANCE

- Contrary to popular belief among followers, Ray Peat, Ph.D., did not advocate for high consumption of sugar. While sugar is acceptable in moderation, refined sugar, particularly in large amounts, can be problematic due to its impact on the microbiome. There's also a debate over the best source of carbohydrates. Fruit is traditionally favored over starch. However, starch is likely superior, provided you have a healthy gut microbiome, which most people lack
- Efficient mitochondrial function is crucial as it provides the energy needed to maintain an optimal gut environment. Poor mitochondrial function can lead to an imbalance in gut microbiota, favoring pathogenic over beneficial bacteria
- Akkermansia, a highly beneficial bacteria in your large intestine, plays a crucial role in maintaining gut health. However, it is absent in many individuals, likely due to inadequate mitochondrial function and resultant oxygen leakage in the gut. Widespread use of antibiotics can also disrupt the microbiome by killing both beneficial and harmful bacteria, leading to a dominance of pathogenic bacteria which produce harmful endotoxins
- Collagen supports skin health, joint strength, and gut health due to its amino acid profile. Collagen should ideally comprise about 5% of your daily calorie intake. Avoid going above 10% as it can be problematic
- Investigators using a pro-metabolic (energy-enhancing) approach are currently experimenting with vitamins and an aspirin analog to target cancer metabolism by inducing apoptosis through lowering intracellular pH. Preliminary studies in mice show promising results in stopping tumor growth and even regressing tumors

Editor's Note: This article is a reprint. It was originally published April 21, 2024.

In the ever-evolving field of bioenergetic medicine, the relationship between our diet, microbiome, and overall health continues to unveil complex and intriguing connections. At the heart of this exploration is the legacy of Ray Peat, Ph.D., whose theories on sugar intake and metabolic function have sparked widespread debate and interest among researchers and health enthusiasts alike.

In this interview, repeat guest Georgi Dinkov, a bioenergetic medicine researcher and I delve into the nuanced understanding of how our microbiome influences dietary choices, particularly the contentious decision between starch and fruit as preferable sources of carbohydrates. Dinkov also reviews groundbreaking research and innovative treatments that aim to manipulate cellular energy pathways to combat cancer.

My Take on the Fruit vs. Starch Controversy

Many of Peat's followers believe that he advocated large amounts of sugar, but that's not the case. Sugar, or glucose more specifically, is necessary for cellular health. Refined sugar can be a problem, especially in large amounts.

The issue really boils down to your microbiome, which Peat didn't really understand as many technical advances have been made since he was actively learning. He certainly warned about the hazards of endotoxin, but I suspect he may not have fully appreciated the power of the microbiome.

The contention within the bioenergetic medicine community is that it's wise to avoid starch and replace it with ripe fruit. They mostly believe fruit is the ultimate carbohydrate, but I now suspect starch may be the ideal type of carb, but only if your gut microbiome is optimal.

Since most people have poor gut health they don't do well when eating a significant amount of starch. Most also have dysfunctional mitochondria, and if you don't have enough mitochondria, you can't create cellular energy efficiently enough to ensure a healthy gastrointestinal tract.

Your gut contains primarily two types of gram-negative bacteria: beneficial and pathogenic. The beneficial ones include obligate anaerobes, which cannot survive in the presence of oxygen and are essential for health. They do not produce harmful endotoxins and contribute positively by producing short-chain fatty acids, like butyrate, propionate, and glucagon-like peptide-1 (GLP-1).

Proper gut function requires energy to maintain an oxygen-free environment in the large intestine, where 99% of gut microbes reside. Insufficient energy leads to oxygen leakage, which harms obligate anaerobes while not impacting the facultative anaerobes, thereby disrupting the balance of the microbiome.

Pathogenic bacteria, or facultative anaerobes, can survive in oxygen and are harmful, as they possess endotoxins in their cell walls. Feeding these bacteria with starch can exacerbate their growth, leading to health issues.

The only carbohydrate that does not promote these bacteria is fruit juice, which some people may tolerate better than whole fruit. Polyphenols, found in high amounts in fruits but not starches, also has beneficial effects on the gut microbiome.

In short, enhancing mitochondrial energy production is crucial for maintaining a healthy gut environment. When you do that, it helps suppress the growth of pathogenic bacteria and support beneficial microbial populations.

The bacterium **Akkermansia** is particularly beneficial. However, DNA analyses suggest some people have few to no Akkermansia at all, and I suspect this is due to insufficient energy production (low metabolism) and resulting oxygen leakage in the gut.

Antibiotics Can Worsen an Already Bad Situation

As noted by Dinkov, the high prevalence of antibiotics in our food supply also has a detrimental effect on the microbiome by indiscriminately killing off both good and bad bacteria. Pathogenic bacteria tend to rebound faster, resulting in a predominance of endotoxin-producing bacteria that destroy the intestinal barrier.

A robust intestinal barrier can prevent bacterial fragments from entering the bloodstream, whereas a compromised barrier allows these harmful fragments through while blocking beneficial compounds like short-chain fatty acids (SCFAs).

The overall health impact of the microbiome, therefore, significantly depends on the integrity of the intestinal barrier, and the strength and function of the intestinal barrier, in turn, is determined by the presence or absence of endotoxins.

Considering the adverse effects of antibiotics on gut health, I do not support Peat's recommendation to use antibiotics to kill off pathogenic bacteria. It's not an ideal solution. What you need to do is restructure your microbiome, and the most effective way to do that, I believe, is through eating foods that support Akkermansia and other beneficial bacteria, and avoid foods like linoleic acid that destroy these bacteria.

One of the reasons Akkermansia is so important is because it produces mucin, a thick, protective gel-like substance that lines various parts of the body, including the gastrointestinal tract. Mucin forms a protective barrier on the gut lining, shielding the epithelial cells of the intestinal wall from mechanical damage, chemical irritation from stomach acids and digestive enzymes, and pathogenic organisms like bacteria and viruses.

Mucin also supports the immune system by trapping potential pathogens and other foreign particles, which are then expelled from the body through the digestive process. It also contains antibodies and antimicrobial peptides that help fight off infections.

Lastly, mucin serves as a food source for other beneficial gut bacteria. This relationship is essential for digestive health, as the bacteria fed by Akkermansia aid in digestion, produce essential nutrients, and help maintain an overall balance of gut flora.

Intestinal Motility Is Dependent on Your Metabolic Rate

As noted by Dinkov, there's also a tight relationship between intestinal motility — the frequency and quality of bowel movements — and metabolic rate, particularly in relation to thyroid function. Historically, frequent bowel movements (nearly after every meal) were considered normal and were used as a diagnostic indicator of thyroid health.

Currently, however, the accepted norm for bowel movements has shifted to once a day or even once every two days without concern, unless constipation extends beyond a week. Ideally, you should have at least one or two bowel movements per day.

The composition of your stool can also provide insights into your hydration status and gut fermentation processes, which are indicative of the overall health of the colon and reflect your metabolic rate. Patterns in urination and bowel movements can also serve as indicators of metabolic health, with infrequent bowel movements and excessive urination suggesting a low metabolic rate.

The Importance of Collagen

Another one of Peat's recommendations that I don't think he stressed enough is the value of collagen (or gelatin). Collagen and gelatin are related substances, but they differ in structure and uses due to how they are processed and prepared. Gelatin, I think, is an inferior form of collagen.

They contain the same amino acids, and are known to support skin health, strengthen joints and bones, and improve digestive health. However, because collagen peptides are smaller and more bioavailable, they may be more efficiently absorbed by the body than gelatin.

About 30% of your bone is collagen, making it an essential dietary component to prevent osteoporosis (age-related bone loss). Your muscle fibers also contain loads of collagen, not to mention your tendons and ligaments, so you can't build muscle if you don't have enough collagen. Collagen intake may also affect your insulin response. As noted by Dinkov:

> *"Several studies have demonstrated that if you ingest collagen with a very large amount of glucose, it doesn't trigger nearly the same insulin response because the collagen can fill in for a lot of the insulin. Some of the peptides are very similar in structure. So, it's like you're ingesting insulin and you don't have to trigger your pancreas to produce as much. So, you directly improve your insulin sensitivity with every meal."*

Unfortunately, many who are following a carnivore diet fail to realize that about a third of protein should be in the form of collagen, not just red meat. An all-meat diet can work against you over time, as several of the amino acids concentrated in muscle meat — methionine, histidine, tryptophan and cysteine — promote inflammation and suppress thyroid function and metabolism.[1]


amino acid

Collagen, meanwhile, contains radically higher levels of glycine, proline, hydroxyproline and alanine, which are essential for health. Dinkov comments:

> *"Glycine is an actual neurotransmitter. It's the major inhibitory neurotransmitter in the spinal cord and one of the major neurotransmitters that regulates gastrointestinal motility. So, without sufficient amounts of glycine in the body, you'll have problems with digestion even if you don't have an inflamed gastrointestinal tract."*

Bone Broth Is an Ideal Source of Collagen

The best source of collagen is homemade bone broth, which you can whip up in four hours using a pressure cooker, such as the Instant Pot. Simply place the bones in the pressure cooker, fill the pot with pure, filtered water — just enough to cover the bones — add salt and other spices to taste, then set it to cook on high for two hours if the bones are CAFO (from animals raised in a concentrated animal feeding operation), and four hours if organic and grass fed.

Organic grass fed beef bones are the best. Using bones from CAFO beef can be problematic due to potential heavy metal contamination. When cooking these bones in a pressure cooker, it's best to limit the time to two hours to avoid introducing heavy

metals into your broth.

If you're using beef bones from grass fed organic sources, you can safely cook them for four hours. I recommend chilling the bone broth before you eat it. This will allow the fat to rise to the top so you can skim it off. While some beef fat is good, excess can be problematic.

On a side note, if you have a dog, you can carve off the loose cartilage around the joints after two hours and feed the cartilage to your pet. If you cook the bones for four hours or longer, most of the collagen will be dissolved in the broth, so there won't be anything left to pick off. More importantly, you never want to give your dog cooked bones as they can splinter during chewing and cause great damage to the esophagus.

Another delicious way to get more collagen into your diet is to make homemade ice cream. My homemade healthy ice cream recipe done in a Ninja Creami includes one scoop of my collagen protein powder, three tablespoons of maple syrup, two egg yolks, and a cup of goat milk. It tastes almost identical to store-bought ice cream but is much healthier.

How Much Protein and Collagen Do You Need?

So, just how much collagen do you need? As noted by Dinkov, in studies conducted on rodents, researchers have discovered that adding 1% to 2% collagen to the diet can effectively mimic the life-extending effects observed from the depletion of certain amino acids such as cysteine, tryptophan and methionine.

This finding is particularly intriguing as it suggests a possible direct translation of these benefits to humans due to the metabolic nature of the intervention. When considering overall dietary protein, the consensus among nutritionists is that it should ideally comprise about 15% of your total daily calories.

Approximately one-third of this protein, or about 5%, should ideally be collagen. This recommendation is based on achieving the optimal balance for health benefits without adverse effects. It's probably safe to increase the proportion of collagen up to

10% of total calorie intake.

Dietary fat can range from roughly 5% to 30% of calories. The remainder of your daily calories would then come from healthy carbs, mostly fresh fruits (if you can tolerate them) and fruit juice if you're mitochondrially impaired, or starches like white rice and cooked potatoes if your metabolism is high (which is indicative of healthy mitochondrial energy production).

Amino Acids and Their Role in Fatigue

Interestingly, cheese is also high in tryptophan, significantly more than egg white. However, according to Dinkov, the casein in the cheese basically acts as a tryptophan blocker. Calcium also has tryptophan-buffering effects. He also goes on to explain how different types of amino acids interact in the body, particularly in relation to brain function and fatigue.

A key point to remember though is that most cheeses today are made with genetically modified rennet, so make sure you're buying cheese made from raw, organic, grass fed milk and natural animal-based rennet only.

Amino acids are building blocks of proteins that have various functions in the body. Among them, branched-chain amino acids (BCAAs) and aromatic amino acids like L-tyrosine and phenylalanine are important. BCAAs include leucine, isoleucine, and valine. The blood-brain barrier is a filter that controls what substances can enter the brain from the bloodstream.

BCAAs and aromatic amino acids such as L-tyrosine and tryptophan compete to cross this barrier, and if you consume large amounts of BCAAs alone, they outcompete L-tyrosine and tryptophan at the blood-brain barrier. This results in lower levels of L-tyrosine and tryptophan in the brain, which in turn can decrease the levels of neurotransmitters like serotonin.

Dinkov cites animal research showing that fatigue during exhaustive exercise isn't primarily caused by a lack of energy but rather by an increase in serotonin in the brain. Administering BCAAs and L-tyrosine seemed to mitigate this type of fatigue

without significantly adding calories, suggesting the importance of amino acid balance over sheer energy intake.

He also reviews some of the natural ways to influence amino acid absorption and serotonin levels, such as consuming foods rich in BCAAs, aspirin, cheese, and fruits containing salicylic acid, such as blackberries and apricots. All of these have an inhibitory effect on the absorption of inflammatory amino acids from food.

Results of a Personal Experiment

Biomolecular biologist **Brad Marshall**, whom I interviewed, argues that starches are a more ideal carb than fruit, but again, the caveat is that you need to have a healthy microbiome. If you don't, starches can pose problems.

Since my gut health is good and my metabolism high, I make 6 cups of white rice cooked in bone broth for my dog and I each day, along with an egg yolk or two. I think these three foods — bone broth, white rice and **low-linoleic acid egg** yolk — make for a close to optimal meal, both for humans and dogs. I also eat about half a pound of organic, grass fed cheese each day.

After eating this amount of cheese, rice and bone broth for one month, I did a **SECA test** to assess my bone mass and body fat percentage. I'd grown half an inch in height, gained 4 pounds in total body weight yet my body fat decreased from 8.5% to 5.3%. Basically, I gained 4 pounds of pure muscle.

I attribute the increase in height to improved structural integrity of my vertebral discs. They get crushed with time, which is why you tend to shrink with age. The bone broth supplies loads of collagen, which strengthens those vertebra. An increase in connective tissue also increases intracellular water, and at the time that I did this test, my intracellular water had increased by half a liter.

Vitamins and Cancer Metabolism

Dinkov also discusses the findings of experimental studies he's involved in, in which they're using vitamins and pharmaceutical agents to target the metabolism of cancer cells in mice subjects. Vitamins studied include B1 (thiamine), B3 (niacinamide), and B7 (biotin). These vitamins were chosen based on historical studies, some nearly a century old, that connect them to cancer metabolism.

As explained by Dinkov, thiamine (B1) acts as a cofactor for pyruvate dehydrogenase, a crucial enzyme in cellular energy production. Thiamine also inhibits pyruvate dehydrogenase kinase (PDK), which itself inhibits pyruvate dehydrogenase (PDH). Thus, B1 indirectly supports energy production by keeping PDH active.

Niacinamide (B3) converts to NAD+ in your body, thereby affecting the NAD+ to NADH ratio, which is vital for metabolic processes like the functioning of another enzyme, alpha-ketoglutarate dehydrogenase. NAD+ also inhibits lipolysis, reducing fat availability to cancer cells which can use fat as fuel.

Biotin (B7), meanwhile, has been studied in neurological disorders including multiple sclerosis and Huntington's disease. It also appears to enhance the Krebs cycle, a key component of cellular respiration, as shown by increased carbon dioxide production in cell cultures.

A combination of all three were found to completely stop tumor growth but didn't trigger regression. The research used the JEKO-1 cell line, which is a type of human mantle cell lymphoma.

This cell line is described as being highly malignant and fatal when transplanted into immunocompromised animals, showing a 100% mortality rate and 0% chance of tumor regression, whether through treatment or spontaneously. This indicates the aggressive nature of the tumor and the challenge it presents for therapeutic intervention.

Seeking additional treatment options, the researcher then added aspirin. This led to the full regression of tumors in three experimental mice.

After the tumors regressed, the mice were monitored for recurrence. One mouse showed signs of potential tumor recurrence, but this subsided, and after 70 days — a significantly extended period compared to the usual two-week lifespan due to the lethality of the tumors — all mice remained tumor-free.

With the success of aspirin, the focus shifted to a more potent analog, 2,6-dihydroxy benzoic acid, known for its stronger acidic properties and better lipophilicity, which can lower the intracellular pH of cancer cells more effectively. This shift in pH is crucial because cancer cells typically avoid apoptosis (programmed cell death) by maintaining an alkaline internal environment. Lowering the pH is thought to trigger apoptosis.

This compound, 2,6-dihydroxy benzoic acid, which Dinkov says was used in the past to treat rheumatoid arthritis at doses significantly lower than those required for aspirin, showed promising results in further lowering the dose required for treatment compared to aspirin. The initial results from using this compound in conjunction with vitamins showed that tumors not only regressed but the treatment was effective at much lower doses.

So, in summary, a combination of vitamins and an aspirin analog showed activity against tumors in these animal experiments, at lower doses than conventional aspirin. This shows how a combination of dietary supplements and pharmaceutical agents can target the metabolic vulnerabilities of cancer cells, specifically through the manipulation of intracellular pH to induce apoptosis.

Low PUFA Linked to Cancer Prevention

Dinkov also reviews other experimental approaches aimed at understanding and manipulating cancer cell behavior through dietary and pharmacological means. In a fascinating dietary experiment, mice were fed a fat-free diet for two weeks prior to tumor implantation attempts.

Remarkably, these mice exhibited resistance to tumor growth, suggesting that a deficiency in essential fatty acids, particularly polyunsaturated fats (PUFAs), could prevent cancer formation. This finding radically challenges existing theories on the

benefits of ketosis and the use of high-fat diets as a way to manage cancer.

Dinkov's team is now working on the transition from animal models to human cancer protocols. He's confident this will happen because the pharmacokinetics — how the body absorbs, distributes, metabolizes, and excretes a drug — of the involved chemicals are well-understood.

This includes the acidic analog of aspirin (2,6-dihydroxy benzoic acid), which, although less familiar, has some historical human data supporting its use. The process involves translating dosage from mice to humans based on body surface area and metabolic differences, which are generally well-documented and allow for relatively straightforward adjustments.

He also notes that in the 1950s and 1960s, they used high doses of natural desiccated thyroid for terminal cancer cases, which aligns with Otto Warburg's theories on cancer metabolism. Warburg hypothesized that cancer growth is caused by the energy generated from glucose fermentation; hence, a pro-metabolic (energy-enhancing) approach such as what Dinkov's team is working on, rather than an anti-metabolic (energy-reducing) therapy, might be more effective.

More Information

For more details on the topics summarized here, be sure to listen to the interview in its entirety. Also check out Georgi's blog at **haidut.me** or **follow him on Twitter**. He also has hundreds of videos on **YouTube** on a plethora of topics.

This article is for informational purposes only and does not constitute medical advice. Consult a qualified healthcare provider before making changes to your health regimen.

Sources and References

- [1] Optimising Nutrition, December 18, 2022