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Gut Microbes Influence How You Handle Stress

Analysis by Dr. Joseph Mercola | April 03, 2026

STORY AT-A-GLANCE

- Gut microbiome composition may influence stress resilience. Research shows a connection between the brain-gut microbiome (BGM) system and mental health, offering new insights into stress management and psychiatric disorders
- A study found that highly resilient individuals had unique gut bacteria characteristics, including more active bacteria in key areas like environmental adaptation and inflammation reduction, as well as distinct brain structure patterns
- Gut dysbiosis (microbial imbalance) is linked to mental health issues. Reduced levels of butyrate-producing bacteria were found in people with depression, highlighting the gut-brain connection in psychiatric disorders
- Oxygen-intolerant gut bacteria play a crucial role in maintaining gut health by producing beneficial short-chain fatty acids. Disruptions in this balance can lead to increased gut permeability and health issues
- Improving gut health enhances mental wellbeing. Strategies include reducing linoleic acid intake, slowly incorporating complex carbohydrates, and consuming fresh fruits to support a healthy gut microbiome

Some people are better able to weather life's storms than others. While factors like genetics, upbringing, and coping skills play a role in stress resilience, scientists are uncovering an unexpected player in this complex equation: the trillions of microorganisms residing in your gut.

In fact, research suggests the composition of your gut microbiome, the vast community of bacteria, fungi, and other microbes inhabiting your digestive tract, may influence how you respond to stress. This emerging field of study is revealing intricate connections between your gut microbes and your mental state, offering new insights into stress management and mental health.

The Brain-Gut Connection — A New Frontier in Understanding Stress Resilience

Research published in Nature Mental Health uncovered a fascinating relationship between our brain, gut and the tiny microbes that call our intestines home.[1] This interconnected system, known as the brain-gut microbiome (BGM), plays a crucial role in your mental health and ability to handle stress.

- **Stress takes a massive toll on health and the economy —** Stress-related health care costs and missed work add up to more than $300 billion lost annually in the U.S., while increased stress resilience may protect against stress-related depression and anxiety, and unhealthy coping mechanisms like alcohol misuse.[2]

  People who are more resilient to stress typically adapt more quickly to challenging situations and recover faster from setbacks, maintaining a more positive outlook even during difficult times.

- **This resilience often translates to better overall physical and mental health —** Resilient people are also more likely to build and maintain strong social connections, are generally more inclined to seek help when needed and often view obstacles as opportunities for growth rather than insurmountable problems, allowing them to learn and become stronger from life's challenges.

- **New study reveals the biological markers of resilience —** In the featured study, scientists used a combination of fecal samples and advanced brain imaging techniques to explore how the BGM relates to resilience. They found some

intriguing patterns, including that people with high resilience tended to have lower levels of depression and anxiety.[3]

- **Resilience is linked to active gut bacteria and unique brain traits —** The highly resilient individuals also showed some unique characteristics in their gut bacteria and brain structure. Their gut bacteria were more active in several key areas, including adapting to their environment, reproducing, converting food into energy and helping to reduce inflammation.

- **Metabolites and microbiome balance play a role in resilience —** The researchers also found higher levels of certain metabolites, small molecules produced during metabolism, in resilient individuals. Resilience was also associated with a "microbiome function supporting eubiosis and gut-barrier integrity."[4] Eubiosis refers to a healthy, balanced state of the gut microbiome.

- **Brain connectivity patterns differ in highly resilient individuals —** When it comes to brain structure and function, reward circuits in the resilient participants were more strongly connected to areas involved in sensory processing and movement. However, they had less gray matter and fewer white matter connections in brain regions associated with emotion regulation.

  "Think about the cognitive part, or the frontal part, of your brain being like the brakes," says UCLA neuroscientist Arpana Church said in a news release. "The highly resilient individuals had really efficient brakes, and less of this hyper-stressed response."[5]

- **This suggests that resilience isn't just about mental toughness —** It's a complex interplay between psychological state, gut microbes and the structure and function of your brain. Interestingly, the activity of gut bacteria was the best predictor of resilience. This hints that your microbiome might be a key player in shaping your ability to cope with stress. It also suggests that we may be able to boost resilience by modifying gut bacteria.

Imbalanced Gut Microbiome Contributes to Neuropsychiatric Disorders

When the balance of your gut bacteria gets thrown off, a condition known as dysbiosis, it can make you more vulnerable to mental health issues and psychiatric disorders. Gut dysbiosis is linked to anxiety, depression, and bipolar disorder, for instance.[6]

- **Depression is linked to lower levels of beneficial butyrate-producing bacteria —** A study published in Translational Psychiatry found that gut bacteria known for their ability to produce butyrate, a short-chain fatty acid with various health benefits, were reduced in people with depression.[7]

  Not only do gut microbes help produce neurotransmitters, chemical messengers in your brain, but they influence inflammation and play a role in maintaining the integrity of your gut lining. According to a review published in Frontiers in Immunology:[8]

  > *"Under normal conditions, a healthy microbiome promotes homeostasis within the host by maintaining intestinal and brain barrier integrity, thereby facilitating host well-being.*
  >
  > *Owing to the multidirectional crosstalk between the microbiome and neuro-endocrine-immune systems, dysbiosis within the microbiome is a main driver of immune-mediated systemic and neural inflammation that can promote disease progression and is detrimental to well-being broadly and mental health in particular."*

- **Gut-brain communication occurs through multiple pathways —** Gut-brain communication occurs via multiple avenues, including along the vagus nerve and through transport of short-chain fatty acids (SCFAs).[9]

  In a study published in the journal Cell, researchers with the University of Florida reveal that disruptions to gut flora in very early life may play a key role in the development of neurodevelopmental disorders, including autism spectrum disorder

(ASD), attention deficit hyperactivity disorder (ADHD), communication disorders and intellectual disability.[10]

- **Specific gut bacteria may be linked to Alzheimer's disease —** An analysis published in Scientific Reports[11] even uncovered specific gut bacteria that may be linked to Alzheimer's disease, triggering neuroinflammatory processes via the microbiota-gut-brain axis.

Certain microbes may secrete toxins and SCFAs that make the gut more permeable or alter immune function. It's also been found that people with Alzheimer's may have less diversity in their gut bacteria, promoting disease. Taken together, it's a reminder of just how interconnected our body systems are, and how taking care of your gut health is a key part of taking care of your mental health too.

The Crucial Role of a Balanced Microbiome in Gut Health

The diverse array of microorganisms inhabiting your gut demonstrates resilience and harmony, with countless microscopic life forms working together to safeguard your health. By nurturing beneficial oxygen-intolerant bacteria, such as Akkermansia, which is a keystone species that supports optimal health — you reinforce your intestinal defenses, counteract endotoxin risks and cultivate a thriving inner environment that forms the foundation of your overall health.

- **SCFAs like butyrate help strengthen your gut barrier —** Beneficial oxygen-intolerant bacteria metabolize dietary fibers, producing SCFAs, primarily butyrate. This compound serves as the main fuel for colonic epithelial cells, empowering them to reinforce your intestinal barrier.

  Additionally, SCFAs stimulate goblet cells to produce mucin, a key component of the protective mucus layer covering your colon. This mucus shield defends epithelial cells against pathogenic oxygen-tolerant bacteria.

- **Loss of oxygen-intolerant bacteria can lead to leaky gut —** When the oxygen-intolerant bacterial population diminishes, it can lead to leaky gut syndrome. In this condition, your large intestine's lining becomes compromised, allowing toxins, undigested food particles, and opportunistic microbes to enter your bloodstream.

  Normally, tight junctions in your intestinal wall control what passes through, but when damaged, they fail to contain substances that should remain within your gut. This can trigger systemic inflammation and various chronic illnesses.

- **Modern lifestyle factors may hinder gut health by affecting energy production —** Beneficial gut bacteria thrive in an oxygen-free environment, which requires adequate cellular energy to maintain. However, modern factors like seed oil consumption and toxin exposure may compromise mitochondrial energy production, limiting your ability to maintain a gut environment with little to no oxygen present.

- **A shift toward oxygen-tolerant bacteria increases endotoxin exposure —** This can shift the bacterial population from oxygen-intolerant to more harmful oxygen-tolerant species. This shift is significant because oxygen-tolerant bacteria produce more virulent endotoxins than their oxygen-intolerant counterparts.

  This means individuals with an abundance of oxygen-tolerant bacteria in their gut may experience more severe reactions to plant carbohydrates due to increased endotoxin exposure.

- **Supporting mitochondrial health helps sustain microbial balance —** Grasping the interconnected relationship among cellular energy generation, oxygen distribution in your gut and microbial diversity is essential for peak wellness, both physical and mental.

  Enhancing mitochondrial function and preserving a well-balanced intestinal ecosystem can foster the growth of beneficial oxygen-intolerant bacteria while reducing the negative effects of harmful endotoxins.

With this understanding of the gut microbiome's delicate balance, it's crucial to consider how you can actively support beneficial bacteria. One key player in maintaining gut health is Akkermansia muciniphila, a beneficial bacterium known for its positive effects on metabolism and intestinal health.

How to Heal Your Gut to Help Akkermansia Thrive

While Akkermansia is a keystone bacterial species for gut health, it needs an oxygen-free environment to thrive. This requires adequate cellular energy to maintain. However, modern factors like seed oils, which are rich in **linoleic acid** (LA), and exposure to other mitochondrial poisons compromise mitochondrial energy production, limiting your ability to maintain a gut environment with little to no oxygen present.

- **Reducing exposure to mitochondrial toxins is crucial before supplementing —** This is why it's important to reduce your exposure to mitochondrial poisons like LA, endocrine-disrupting chemicals, including **xenoestrogens** in plastics, and electromagnetic fields (EMFs) before supplementing with Akkermansia.

  In fact, I recommend eliminating all seed oils, which are found in most ultraprocessed foods, from your diet for at least six months before starting an Akkermansia supplementation program.

- **Limiting linoleic acid intake helps create a supportive gut environment —** It would be wise to keep your LA intake below 5 grams from all sources. If you can get it below 2 grams, that's even better. To help you track your LA intake, make it a habit to enter all your foods into an online nutrition tracker.

Tips for Optimal Carbohydrate Consumption

The other part of the equation is carefully modulating your carbohydrate intake. Initially, restrict your carbohydrates to white rice and whole fruits, giving your body efficient fuel for your mitochondria while allowing your gut to heal.

- **Complex carbs are beneficial but may pose issues for compromised guts —** Complex carbs have long been considered beneficial for the gut microbiome, whereas simple carbs (sugar) have been linked to aging. However, I don't recommend you jump right into eating foods made of complex carbohydrates, as it's problematic if your gut health is impaired.

  Research shows that complex carbohydrates nourish your gut microbiome, especially the ones living in your large intestine. These include plant cell wall polysaccharides, such as cellulose, which are then fermented in the gut by your microbiota.[12]

- **Pathogenic bacteria may feed on complex carbs in an unhealthy gut —** However, if your gut health isn't already optimized, complex carbohydrates also feed pathogenic bacteria. They thrive in your gut when you're exposed to metabolic poisons. As a result, mitochondrial energy production is impaired. The lack of energy allows oxygen into your large intestine, creating the ideal setting for pathogenic bacteria to grow.

  As harmful bacteria continue feeding on the complex carbohydrates you just ate, they multiply further. Once enough of them die, they leave behind an endotoxin called lipopolysaccharide that further impairs cellular energy production.

- **Digestive discomfort may indicate poor complex carb tolerance —** Signs that your gut is home to an excess of pathogenic bacteria producing endotoxin include gas, bloating and abdominal discomfort when you consume complex carbohydrates. If you're experiencing these types of bowel issues, then it means your gut isn't well-equipped to digest complex carbs.

- **Begin with the gentlest carbs —** If your gut health is compromised, focus on easily digestible carbohydrates like white rice and whole fruits. For severe gut dysfunction, try dextrose water, sipping it slowly to avoid rapid blood sugar spikes.

However, this is not a long-term solution but a stepping stone toward a healthier gut. After you've accustomed yourself to rice and whole fruits, add more complex carbohydrates, such as custom pasta, pulp-free fruit juice and root vegetables, but slowly.

- **Gradually transition from simple to complex carbs —** The most complex carbs, nonstarchy veggies, starchy veggies, beans and legumes, and whole grains, are the last step and should be consumed gradually as your gut begins to heal. Even then, some people have difficulty handling these foods, and you should carefully consider proper cooking methods.

  Potatoes, for instance, contain water-soluble oxalates, which can be problematic once they accumulate in your body. So, make sure to boil them to lower their oxalate content. You can also increase the amount of resistant starch, which doesn't spike your blood sugar, by cooking, refrigerating or reheating the food before eating.

Once your gut is healthy, adding a high-quality Akkermansia supplement is often useful. However, simply consuming Akkermansia isn't enough, you need to ensure it survives the journey to where it's needed most.

Delivering Live Akkermansia Is Crucial

It's also crucial to understand that Akkermansia bacteria need to reach your colon before their protective capsule disintegrates. If the capsule breaks down prematurely, the bacteria will be exposed to high oxygen concentrations in your upper digestive tract and die. Therefore, it's essential to ensure that your Akkermansia supplement survives the minimum two-hour transit time from ingestion to arrival in your colon.

- **Taking the supplement on an empty stomach helps prevent early breakdown —** The most effective way to achieve this is by taking the supplement on a completely empty stomach. This approach helps prevent the capsule from dissolving too early

in the digestive process. If you consume the supplement with food or shortly after eating, the capsule is likely to break down long before it reaches your colon, rendering most of the beneficial bacteria ineffective.

- **Delayed-release supplements and timing are key to effectiveness —** So, when selecting an Akkermansia supplement, look for products specifically designed with delayed-release technology to withstand the journey through the upper digestive tract.

  Remember, the goal is to deliver live, active Akkermansia bacteria to your colon, where they can colonize and provide their beneficial effects. Proper timing and an empty stomach are key factors in achieving this goal and optimizing the supplement's effectiveness.

  Keep in mind that there are pasteurized Akkermansia products on the market, and while there are several studies purporting to show their benefits,[13,14,15,16,17,18,19,20] common sense tells you that killed bacteria are not going to repopulate your gut.

- **Pasteurization kills bacteria and eliminates metabolic activity —** Pasteurization involves heating bacteria to a temperature that kills them, ensuring they are no longer metabolically active. This process effectively renders the bacteria dead. As such, you may see pasteurized Akkermansia advertised in Total Fluorescent Units (TFUs), which is the total number of cells in the sample, including bacteria that are alive, damaged and dead.

The effectiveness of probiotics is often linked to their ability to colonize the gut and exert beneficial metabolic activities. TFUs do not provide information about the metabolic activity or viability of the bacteria, which are critical for assessing probiotic effectiveness. The same goes for active fluorescent units or AFU, which measures enzymatic activity.

Consumers are easily misled to believe that higher TFU or AFU counts indicate a more effective probiotic product, even though these measures are not representative of the number of live bacteria in the product.

Probiotic Potency Explained — CFU, AFU, and TFU

When evaluating the potency of probiotics, three units of measurement often come into discussion: Colony Forming Units (CFUs), Active Fluorescent Units (AFUs), and Total Fluorescent Units (TFUs). Understanding the distinction between these units is important for both consumers and health care professionals to assess the effectiveness and quality of probiotic supplements accurately.

- **Colony Forming Units (CFUs) —** This is the most widely recognized and utilized metric for quantifying the number of viable bacteria or fungal cells in a probiotic product. One CFU represents a single microorganism capable of dividing and forming a colony under specific laboratory conditions. This measure is important because the therapeutic benefits of probiotics are directly related to the number of live microorganisms that reach your gut.

  Probiotic manufacturers typically list CFU counts on product labels, indicating the number of live organisms per serving. Higher CFU counts are often marketed as more potent, though the optimal CFU dosage varies depending on the specific strains and the health outcomes targeted.

  It's important to note that not all CFUs are equal; the efficacy of a probiotic also depends on the strains used and their ability to survive the acidic environment of the stomach to colonize the intestines.

- **Active Fluorescent Units (AFUs) —** This unit is a less conventional and not widely standardized measure in the context of probiotics. While CFU shows the number of bacteria that are alive, AFU refers to the total number of bacteria present, both dead and alive. It is primarily a unit used to measure enzymatic activity.

  For instance, AFU could be used to evaluate the activity levels of specific enzymes produced by probiotics, which contribute to their health benefits, such as breaking down lactose or producing vitamins. In some specialized applications, AFU is also used to assess the metabolic activity or functional potency of probiotic strains beyond mere viability.

However, because AFU is not a standardized metric in the probiotic industry, its use can lead to confusion and inconsistency in product labeling and efficacy claims.

- **Total Fluorescent Units (TFUs) —** This unit measures the total bacterial mass including both live and dead cells through fluorescent labeling and is typically used only for pasteurized products. Like AFU, TFU values are higher than CFU counts for the same sample since they include both viable and non-viable cells.

The primary difference between CFU, AFU, and TFU lies in what they measure: CFU quantifies the number of live microorganisms; AFU assesses the functional activity of those microorganisms; and TFU measures the total bacterial mass, regardless of their functional activity.

While CFUs provide a clear indicator of the potential for colonization and survival of probiotics in the gut, AFUs could offer additional insights into the functional capabilities of the probiotic strains.

However, due to the lack of standardization and widespread recognition of AFUs in the probiotic market, CFUs remain the gold standard for assessing probiotic potency. Consumers are generally advised to focus on CFU counts and the specific strains included in a probiotic supplement to ensure they are selecting a product with proven efficacy for their health needs.

Current Akkermansia Clinical Trials — Dosages and Applications

As research advances, numerous clinical trials are underway to evaluate the efficacy and safety of Akkermansia-based interventions.[21] Clinical trials investigating Akkermansia muciniphila employ a range of dosages to determine optimal therapeutic effects.

- **Trials use a broad range of daily CFU doses —** The typical dosages being tested span from 100 million to 10 billion CFUs per day. This wide range allows researchers to assess both the minimum effective dose and the potential benefits of higher bacterial concentrations.

- **Higher doses are common in metabolic health studies —** For human trials focusing on metabolic health and obesity, a dosage of 10 billion CFUs is often used.[22] For example, a trial examining the impact of Akkermansia on insulin sensitivity in insulin resistant overweight and obese volunteers administered 10 billion CFUs daily.[23]

  After three months, the treatment group had improved insulin sensitivity, reduced insulinemia and lower total cholesterol compared to the placebo group. They also lost 1.37 kilos (about 3 pounds) of body fat and reduced their hip circumference by 2.63 centimeters compared to baseline measurements.

- **Liver function and inflammation markers improved as well —** Blood markers of liver dysfunction and inflammation were also reduced, causing the researchers to conclude that "this proof-of-concept study shows that the intervention was safe and well-tolerated and that the supplementation with A.muciniphila improves several metabolic parameters."

  Research exploring Akkermansia's role in strengthening the gut barrier and preventing leaky gut syndrome and liver cirrhosis[24] often employs a dosage of 1 billion CFUs per day.

- **Future trials aim to refine dosing and combine therapies —** As the body of evidence grows, future clinical trials are expected to refine dosage recommendations and explore combination therapies involving Akkermansia and other probiotics or prebiotics. Additionally, personalized approaches based on an individual's existing gut microbiota composition may enhance the effectiveness of Akkermansia supplementation.

These studies are crucial in establishing Akkermansia as a viable probiotic therapy, offering novel solutions for managing metabolic disorders, obesity and inflammatory diseases, and improving overall gut health.

Akkermansia Clinical Trials

Clinical trials published in 2024 investigating Akkermansia have yielded promising results,[25] highlighting its potential across a range of health conditions, including infectious disease,[26] immune-related disease,[27] liver fibrosis,[28] stress management,[29] intestinal-related diseases,[30] metabolic health,[31] and brain function.[32]

- **Dosages in studies vary based on the condition treated —** These studies, which include both animal and human trials, have primarily used therapeutic doses ranging from 100 million to 10 billion CFUs per day. The dosage selected often corresponds to the specific health condition being targeted, ensuring optimal therapeutic effects.

- **High doses are commonly used for metabolic conditions —** Again, for metabolic conditions such as obesity, diabetes, and metabolic syndrome, doses of 10 billion CFUs per day have been commonly administered. This elevated dosage aims to significantly influence gut microbiota composition and enhance metabolic functions, leading to improvements in insulin sensitivity, glucose metabolism and overall metabolic health.

- **Lower doses support liver and gut-specific conditions —** Conversely, lower doses of 1 billion CFUs per day have proven effective for gut-specific conditions like leaky gut syndrome, as well as liver health, by promoting intestinal and immune homeostasis, improving intestinal barrier function and alleviating inflammation.[33]

This lower dose is sufficient to leverage Akkermansia's anti-inflammatory properties and support gut barrier integrity without the need for higher bacterial concentrations. The studies have shown that even at these reduced levels, Akkermansia effectively reduces intestinal inflammation and enhances the mucosal lining, contributing to improved gastrointestinal health.

Why Mitochondrial Function Is Key to Successful Akkermansia Supplementation

Aside from selecting a high-quality supplement, another key to successful Akkermansia supplementation is to simultaneously work on your mitochondrial function. As mentioned, when your cellular energy decreases, your body struggles to effectively eliminate oxygen from your colon. This has serious consequences for the normal inhabitants of your colon, which can be killed when oxygen levels rise. This is why Akkermansia supplementation alone is not a complete solution.

It is crucial to commit to a program designed to decrease mitochondrial toxins and optimize cellular energy production. This is because reduced mitochondrial function must be compensated for to ensure oxygen can be removed from the colon. If you fail to address this issue, even the best Akkermansia supplement with the most effective delivery system will have limited benefits.

The newly introduced Akkermansia bacteria will likely be killed soon after arriving in your oxygen-rich colon environment.

Again, this is one of the primary reasons why it's vital to eliminate all seed oils from your diet for at least six months before starting an Akkermansia supplementation program. This preparatory period allows your body to recover mitochondrial function and create a more hospitable environment in your colon for the beneficial bacteria.

By taking these steps, you maximize the benefits of Akkermansia supplementation and support overall gut health. Remember, addressing the root cause, mitochondrial function and colon oxygenation, is essential for the success of any gut health intervention.

Frequently Asked Questions (FAQs) About Gut Microbes

Q: How does the gut microbiome influence stress resilience and mental health?

A: The brain-gut microbiome (BGM) system plays a critical role in stress resilience. Research shows that people with higher resilience have more active gut bacteria that help reduce inflammation, support energy production, and adapt to

environmental changes.

These individuals also display distinct brain structure patterns, including stronger reward system connections and better emotional regulation. Gut bacterial activity was found to be the strongest predictor of resilience, suggesting that supporting the microbiome could improve stress response and mental well-being.

Q: What is gut dysbiosis and how is it linked to psychiatric and neurological disorders?

A: Gut dysbiosis is a microbial imbalance that contributes to mental health disorders like depression, anxiety, and Alzheimer's. Depressed individuals often have lower levels of butyrate-producing bacteria, which are essential for gut integrity and inflammation control.

Dysbiosis disrupts gut-brain communication, triggering immune and neural inflammation. This imbalance can impair neurotransmitter production and brain barrier function, promoting psychiatric and neurodegenerative disease progression. Supporting a healthy microbiome may reduce these risks.

Q: Why is mitochondrial function important for Akkermansia supplementation?

A: Akkermansia thrives in a low-oxygen colon environment, which requires healthy mitochondrial function to maintain. When mitochondrial energy is compromised — due to factors like seed oil consumption — oxygen accumulates in the colon, killing beneficial bacteria like Akkermansia.

Supplementing alone isn't effective unless you first restore mitochondrial health. Eliminating seed oils for at least six months can help create the right environment for Akkermansia to survive, colonize, and provide its gut health benefits.

Q: What are the best practices for supporting gut health through diet and supplementation?

A: Start with easily digestible carbs like white rice and fruits to support healing. Avoid complex carbs initially if experiencing gas or bloating. Gradually introduce more complex carbs like root vegetables and legumes, using proper cooking methods to reduce antinutrients.

Choose delayed-release Akkermansia supplements and take them on an empty stomach to protect the bacteria through digestion. Avoid pasteurized probiotics, as dead bacteria cannot colonize or improve gut function effectively.

Q: What do clinical trials say about Akkermansia's effectiveness and dosage?

A: Clinical trials show Akkermansia benefits metabolic health, gut integrity, and inflammation. Dosages range from 100 million to 10 billion CFUs per day. Higher doses (10 billion CFUs) improve insulin sensitivity, cholesterol, and body fat in people with metabolic issues.

Lower doses (1 billion CFUs) support gut barrier function and reduce inflammation in liver and intestinal conditions. Future studies aim to personalize dosing and combine Akkermansia with other probiotics for enhanced outcomes.

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