What Bananas Do to Your Body
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What is a Banana?

Bananas are believed to have originated 10,000 years ago, and the first bananas are thought to have been grown in the Kuk valley of New Guinea around 8000 BC. Later, bananas spread throughout Southeast Asia and the South Pacific, including the Philippines, and then they dispersed across the tropics in all directions.

Most likely, bananas were introduced by traders and travelers in Australia, Indonesia, India, and Malaysia after domestication. Buddhist scriptures mentioned that traders traveling through the Malaysia region tasted the fruits of banana and brought them back with them to India. In 327 BC, Alexander the Great tasted the banana for the first time in the Indian Valleys, and he introduced them to the Western world.

Banana is a general term encompassing several species or hybrids in the genus *Musa* of the family of flowering plants called Musaceae. More than 300 types of bananas are cultivated throughout the world. Virtually all known edible bananas come from two species: *Musa acuminate* and *Musa balbisiana*, which are native to Southeast Asia.

Bananas are classified as dessert or sweet bananas and cooking bananas or plantains. Plantains, are generally larger and intended for cooking (although they are edible raw when fully ripe). In this report, the focus will be on sweet bananas.

Bananas are a very popular fruit in the world market, ranking next to rice, wheat, and corn in terms of importance as a food crop. Bananas are consumed as a staple food in many countries. They are grown in over 130 countries worldwide, and the banana constitutes the fifth most important agricultural food crop in terms of world trade.

In 2003, world production of bananas was estimated to be 102 million metric tons (MT).
Ten major banana-producing countries accounted for about 75% of total production with India, Ecuador, Brazil, and China accounting for half the total.

Latin America and the Caribbean islands supplied more than 80% of the total world exports, with four leading banana exporter countries (Ecuador, Costa Rica, Philippines, and Colombia) accounting for two-thirds of the world exports. Ecuador is the largest banana exporter, and the United States is the major banana importing country in the world.\textsuperscript{1,2}

**What’s in a Banana?**

According to the United States Department of Agriculture (USDA) National Nutrient Database, one medium banana contains:

- Calories: 105
- Fat: 0.4g
- Carbohydrate: 27g
  - Sugar: 14.4g
    - Glucose: 5.9g
    - Fructose: 5.7g
    - Sucrose: 2.8g
  - Starch: 6.3g
  - Fiber: 3.1g
- Protein: 1.3g

**Vitamins and Minerals:**

- Manganese: 0.3mg (16%)
- Magnesium: 32mg (8%)
- Phosphorus: 26mg (3%)
- Potassium: 422mg (12%)
- Sodium: 1mg (0%)
- Vitamin C: 10mg (17%)
- Vitamin B6: 0.4mg (22%)
- Folate: 24mcg (6%)
- Vitamin A: 76 IU (2%)
Beyond the Nutrition Facts

Believe it or not, bananas have a higher antioxidant capacity than some berries, herbs, and vegetables, and this capacity increases during fruit maturity. For example, bananas are a rich source of health-promoting phytochemicals including phenolic compounds, carotenoids, and phytosterols.

1. Phenolic compounds

Bananas contain various phenolic compounds and flavonols. The phenolic compounds include gallic acid, catechin, epicatechin, tannins, and anthocyanins. It’s the phenolic compounds that give unripe bananas their bitter taste. The main classes of flavonoids found in bananas are the flavonols, which includes quercetin, myricetin, kaempferol, and cyanidin. Phenolic compounds and flavonoids act as protective scavengers (i.e., antioxidants) against free radicals.

2. Carotenoids

Carotenoids provide health benefits due to their unique physiological functions. For instance, they serve as pro-vitamins (i.e., vitamin A) and play key roles as free radical scavenging antioxidants. Carotenoids have been widely studied for their role in reducing the risk of various diseases, including certain cancers and eye diseases.

Orange- and yellow-colored fruits, such as the banana, are rich sources of carotenoids. Bananas specifically have been shown to contain lutein, β-carotene, α-carotene, violaxanthin, auroxanthin, neoxanthin, iso-lutein, beta-cryptoxanthin, and alpha-cryptoxanthin. Consumption of foods rich in carotenoids improves immunity and reduces risk of diseases, such as cancer, diabetes, and heart problems.

3. Phytosterols

Phytosterols are naturally-occurring components of plants that have a wide variety of health-promoting effects, such as lowering blood cholesterol and reducing the absorption of cholesterol in the intestine. Phytosterols also act as immune system modulators. Bananas contain several phytosterols, including β-sitosterol, stigmasterol,
campesterol, cycloeucalenol, and others.

4. Antioxidant Activity

The banana is considered one of the most important antioxidant-rich foods. Bananas contain various bioactive compounds that have antioxidant potential, which contributes to their defense active reactive oxygen species (ROS), free radicals, and oxidative stress in the body. The antioxidants in bananas can support healthy aging, promote heart health, and support brain health, which are often compromised with excessive oxidative stress.

Bananas and Carbohydrates

The composition of a banana changes dramatically during ripening, which takes place over the course of eight stages:

1. All green
2. Green with trace of yellow
3. More green than yellow
4. Half green, half yellow
5. More yellow than green
6. Yellow with green tips and necks
7. All yellow
8. All yellow with brown spots

Starch is the principal component of green (unripe) bananas, which undergoes important changes during ripening. The average starch content drops from 70 – 80% to less than 1%. The conversion of starch to sugars involves several enzymes (called amylases). Sugars, mainly glucose, fructose, and sucrose, can reach 16% or higher.

In other words, the riper the banana, the higher the amount of sugar. Conversely, the greener the banana, the higher the amount of starch. As you'll see below, however, this is not just any type of starch.

Note that refrigeration interrupts the ripening process (i.e., inhibits enzymatic activity).
In fact, unripe bananas that are placed in the refrigerator may not be able to resume the ripening process even if they are returned to room temperature. This may be something worth noting given the information that follows.

**Bananas and Resistant Starch**

Resistant starch is so-named because it is a non-digestible carbohydrate (i.e., fiber). Resistant starch has been shown to increase satiety (feelings of fullness and satisfaction) and reduce food intake both acutely and in the long-term.\(^3\)^\(^4\) Research has also shown that consumption of resistant starch increases fat burning, decreases fat storage, and improves insulin sensitivity.\(^5\)^\(^6\) That’s not all; researchers speculate that resistant starch may also increase the thermic effect of feeding (i.e., increases calorie expenditure), and it may also promote weight loss and preserve calorie-burning muscle.\(^7\)

While resistant starch is not digestible by us, it is considered a "prebiotic" fiber that serves as “food” for our beneficial gut bacteria (e.g., probiotics). In other words, gut bacteria feed off resistant starch through the process of fermentation, which results in the production of key chemicals (i.e., short-chain fatty acids) that fuel our immune cells and stimulate the release of key hunger-suppressing hormones.

Several other health benefits have been associated with resistant starch in the GI tract, including enhanced laxation, increased uptake of minerals such as calcium, and reduced symptoms of diarrhea. As a prebiotic, resistant starch has been shown to positively influence the gut bacterial ecosystem, increasing levels of beneficial *Bifidobacteria* and reducing levels of pathogenic bacteria.

A single unripe green banana contains as much as 6 grams of resistant starch.\(^8\) In fact, unripe bananas are known to be the non-manufactured food with the highest resistant starch content.\(^9\) Researchers from Mexico have shown that 8 – 10 grams of resistant starch (from bananas) improves insulin sensitivity, reduces fasting blood sugar, improves glycemic control, and reduces body weight.\(^10\)

**Bananas and Fiber**

Although the ripening process dramatically reduces the amount of resistant starch, ripe
bananas are still a good source of fiber, providing about 3 grams per medium banana. Dietary fiber is a nutrition “all-star,” promoting a healthy digestive tract, regularity, improves carbohydrate management (e.g., slowed gastric emptying), promotes satiety, reduces calorie intake, and enhances weight loss.¹¹,¹²

Bananas contain a type of fiber called pectin, which helps give the fruit its form. Like resistant starch, pectin slows the rate of gastric emptying and improves glycemic control.¹³ Pectin has also been shown to increase satiety, reduce appetite, and decrease food intake at subsequent meals.¹⁴,¹⁵

Bananas also contain a special type of fiber called fructooligosaccharide (FOS), which are unique fructose-containing carbohydrates that are typically not broken down by enzymes in our digestive tract. Instead, they serve as “prebiotics” for the good bacteria in the colon where they help support a healthy balance of friendly bacteria.

**Bananas and Timing**

Before moving on, let’s talk timing. Is there a good time to eat bananas? Is there a not-so-good time to eat them? Yes and yes. You see, because bananas contain a reasonable amount of sugar and starch, it’s ideal to consume them at specific times of the day when the body is best suited to handle carbs.

Specifically, the body is most sensitive to insulin and most carb tolerant at the first meal of the day (e.g., breakfast) and after intense exercise. At these times, your muscles and liver are primed to burn carbs for fuel and store them for energy (as glycogen)—as opposed to storing them as fat.

Conversely, later in the day, such as dinner- and bed-time, the body is less sensitive to insulin and less carb tolerant. So, it’s not such a good idea to eat higher-carb foods such as bananas at those times. Insulin puts the brakes on fat burning and cranks up fat storage, so too much of it lingering can be a bad thing. What’s more, insulin curbs growth hormone release, which usually peaks at bedtime.

All that said, it may be optimal to “go bananas” at your first meal of the day or after exercise.
Health Benefits

1. Heart Health

For starters, bananas are a good source of potassium, providing about 12% of the recommended daily intake. Potassium is essential for maintaining normal blood pressure and heart function. Indeed, evidence indicates that diets rich in potassium support healthy blood pressure levels, and higher potassium intakes are associated with a 24% lower risk of stroke.\(^16\)

Unfortunately, most people don’t consume nearly enough potassium. In fact, a study published in *The American Journal of Clinical Nutrition* found that less than 2% of adult Americans meet the daily recommendations for potassium.\(^17\)

As mentioned, bananas also contain various phytosterols, which are plant compounds that are structurally similar to cholesterol. Phytosterols block the absorption of cholesterol in the intestine, and they have been shown to reduce LDL cholesterol.\(^18\) While there are many factors in play, experiments have consistently shown that populations with low LDL levels experience a lower risk of cardiovascular disease, and results from clinical trials have convincingly demonstrated that LDL is dose-dependently linked to cardiovascular disease risk.\(^19\)

Finally, bananas are a good source of fiber, and fiber goes hand-in-hand with heart health. Dietary fiber is thought to affect several cardiovascular disease risk factors. For instance, water-soluble fiber (such as pectin) decreases total and LDL cholesterol and improves insulin sensitivity. Overall, observational studies demonstrate lower incidence of coronary heart disease in folks who consume diets high in fiber.\(^20\) Unfortunately, most people don’t consume nearly enough dietary fiber. According to American Dietetic Association, the average American consumes a paltry 15 grams of dietary fiber per day, 40% less than the recommended daily intake for women and 60% less than the recommended amount for men.\(^21\) While a banana won’t make up the gap by itself, it can be a simple, convenient step in the right direction.
2. Digestive Health and Immune Function

Bananas are a good source of fiber, and dietary fiber is perhaps most well-known for its association with digestive health. The American Gastroenterological Association defines good digestive health as

“…a digestive system that has appropriate nutrient absorption, intestinal motility, immune function, and a balanced microbiota (the community of microorganisms that live in the gut). A balanced diet has an important role in maintaining digestive health and can prevent digestive symptoms. Most people with good digestive health do not regularly experience digestive symptoms such as heartburn, rumbling, nausea, bloating, excessive flatulence, constipation, diarrhea, or abdominal pain, and discomfort.”

Dietary fiber promotes digestive health through its laxative effects, fermentation properties, and effects on the gut microbiota. For instance, fiber increases fecal bulk, increases stool frequency, and reduces intestinal transit time.

As previously discussed, certain non-digestible carbohydrates, such as pectin and resistant starch, are fermented by gut bacteria. Short-chain fatty acids (SCFA, such as propionate, acetate, and butyrate) are a by-product of fermentation. SCFA lower the pH of the colon, which increases the bioavailability of certain minerals and inhibits the growth of pathogenic bacteria (helping balance the microbiota). What’s more, SFCA are taken up by the immune cells of the gut, and they also help regulate the body’s inflammatory response.

Bananas also contain a special type of fiber called fructooligosaccharide (FOS). FOS are unique fructose-containing carbohydrates that are typically not broken down by enzymes in our digestive tract. Instead, they move along through the digestive tract until they reach our lower intestine where they exhibit prebiotic activity. A prebiotic is a substance that selectively stimulates the growth of beneficial gut bacteria. In other words, these fibers act as “food” for healthy gut microbes. This process helps maintain the balance of friendly bacteria (e.g., Bifidobacteria) in the microbiota and supports overall digestive health.
In one study, healthy females eating two bananas a day for two months experienced significant increases in healthy *Bifidobacteria*. What's more, the participants also experienced significantly fewer digestive discomfort symptoms including lower bloating levels compared to women who didn't eat bananas.\(^\text{25}\)

3. Weight Management

While no study has directly assessed whether bananas can help with weight loss, bananas have several features that should make them a weight-management-friendly food. For starters, studies show that folks with higher fiber intakes typically have lower body weights. In the United States, normal-weight folks have consistently higher fiber intakes than obese individuals. Taken as a whole, intervention studies show a significant reduction in weight gain over time with increased fiber intake.

In addition to fiber, unripe bananas are one of the best food sources of resistant starch. Research has shown that consumption of resistant starch increases fat burning, decreases fat storage, and improves insulin sensitivity.\(^\text{5,6}\) Resistant starch may also increase the thermic effect of feeding (i.e., increases calorie expenditure), and it may also promote weight loss and preserve calorie-burning muscle.\(^\text{7}\) One study specifically found that folks consuming 8 grams of resistant starch from bananas daily for 4 weeks lost significantly more weight than the control group.\(^\text{26}\)

As mentioned above, certain non-digestible carbohydrates (like pectin, FOS, and resistant starch) are fermented by the good bacteria in the gut, a process that results in the production of SCFA, which may help suppress appetite. Specifically, SFCA stimulate the release of two key satiety hormones, GLP-1 and PYY.\(^\text{27,28}\)

What's more, bananas are considered a low-energy-dense food (which are foods that supply 0 – 1.5 calories per gram, by weight). Researchers have found that when folks consume low-energy-dense foods, they feel satisfied earlier and those feelings of fullness persist for relatively longer periods of time—despite reductions in calorie intake.\(^\text{29}\) Several studies have demonstrated that diets rich in low-energy-dense foods promote satiety, reduce hunger, and decrease overall calorie intake.\(^\text{29–33}\) Studies lasting longer than 6 months show that folks who eat more low-energy-dense foods experience THREE TIMES greater weight loss than people who simply opt to reduce calories.\(^\text{34}\)
4. Glycemic Control

Both fiber and resistant starch (unripe bananas) may help promote healthy blood sugar levels. Indeed, among the well-documented effects of resistant starch are improved insulin sensitivity and glycemic control after a carbohydrate-containing meal. As mentioned, research has shown that 8 – 10 grams of resistant starch (from bananas) improves insulin sensitivity, reduces fasting blood sugar, and improves glycemic control.10 What’s more, soluble fiber (e.g., pectin) slows gastric emptying and lowers the glycemic response.35

According to The University of Sydney, the average glycemic index (GI), which is a measure of how much a food raises blood sugar, score for ripe bananas is 51, which is considered to be “low.” That said, under-ripe bananas (not surprisingly) have an even lower GI of 30. The glycemic load (GL) of ripe bananas is 13 (medium), while the GL of under-ripe bananas is 6 (low).

Of course, folks with poor carbohydrate tolerance and subpar glycemic control may be best off restricting carbohydrate intake, which may include avoiding well-ripened bananas. On the other hand, unripe green bananas may help support healthy blood sugar levels and insulin sensitivity.

5. Healthy Aging

Excessive oxidative stress has long been thought to play a central role in biological aging (i.e., cellular senescence).36,37 Antioxidants slow down the aging process in the body by binding to and neutralizing free radicals that can damage cellular structures. The body’s antioxidant defense system is markedly effective at scavenging free radicals, which steal electrons from other molecules through a process called oxidation.

In order to operate at top form, the body’s antioxidant defense system is highly dependent upon a continuous dietary supply of nutrient-dense, antioxidant-rich foods. Often overlooked, bananas are a rich source of antioxidants. Not surprisingly, researchers have repeatedly found that high fruit and vegetable intakes are positively correlated with antioxidant intake and healthy aging.38
That’s a Wrap (or Peel)

Speaking generally, it seems pragmatic to conclude that bananas can be considered a weight-management-friendly food and included as part of an overall healthy weight-loss program. It may also be reasonable to conclude that unripe bananas may even be more advantageous for weight loss and glycemic control. Because bananas contain a reasonable amount of sugar and starch, it’s best to consume them at the first meal of the day and after exercise when the body is most sensitive to insulin and most carb tolerant.

Sure, if you have poor glycemic control, then it seems to be a good idea to stick to under-ripe/unripe bananas. (Perhaps even better may be to consider a carbohydrate-restricted diet.) What seems absurd, outrageous, and nonsensical, however, is to blacklist the banana as a “fattening” food, a “bad” food, or the “worst” food for weight loss.

We agree that most folks would benefit from limiting their intake of added sugars, which, when consumed in excess, may contribute to obesity, diabetes, and cardiovascular disease. However, it seems unlikely (at best) that a banana (which contains a small amount of naturally-occurring sugar) every once in a while would have anything but positive effects on an otherwise healthy body.
References:


