

Food Chemistry Diet

Part 1

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Introduction to Food Chemistry

Definition and importance

Overview of food components: carbohydrates, proteins, fats, vitamins, and minerals

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The Biochemistry of Nutrition

How nutrients are metabolized

Role of enzymes in digestion

Food Production and Its Impact on Diet

Influence of modern food production on dietary patterns

Role of processed foods and additives

Dietary Patterns and Health

Connection between diet and chronic diseases

Benefits of whole foods and balanced diets

## Analytical Methods in Food Chemistry

Techniques for analyzing food content

Importance of food safety and quality control

Current Trends in Food Chemistry

Innovations in food science

Future directions in diet and nutrition research

## Preface

As I embark on writing the preface to this **Food Chemistry Diet** ebook, I want to incorporate my in-home care experience with seniors on their health and longevity.

In my years of caring for seniors with various health issues, it has provided me together with the caregivers, invaluable insights into the complex relationship between diet, lifestyle, and longevity. Through careful observation of eating habits, food preparation methods, and health outcomes—including some remarkable centenarians—I have gained a unique perspective on the factors that contribute to vitality in later life.

This book represents my journey to uncover the underlying causes of health issues affecting older adults. By exploring the intricate chemistry of foods, examining dietary practices, and investigating other lifestyle factors, my goal is to shed light on the often-overlooked connections between nutrition and age-related diseases.

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My research delves into:

- The impact of food choices and preparation methods on long-term health
- Chemical compositions of foods and their effects on the aging body
- Eating habits and routines that promote wellness
- Environmental and lifestyle factors that interact with diet to influence health outcomes

Drawing from both scientific literature and real-world observations, this book offers a comprehensive look at how nutrition can be leveraged to support healthy aging. Whether you're a senior looking to improve your own health, a caregiver seeking guidance, or a health professional expanding your knowledge, you'll find valuable insights to help navigate the complex world of nutrition for older adults.

By sharing my findings, I hope to empower readers with the knowledge to make informed dietary choices that can enhance quality of life and potentially extend healthy years. This book is not just about adding years to life, but adding life to years through the power of nutrition.

### Introduction

Food chemistry is a fascinating branch of science that explores the composition, properties, and chemical changes of food. As a subdiscipline of food science, it plays a crucial role in understanding how food behaves during processing, storage, and consumption.

Key Aspects of Food Chemistry

Composition and Components

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Food chemistry primarily focuses on studying the major components of food, including:

Proteins

Carbohydrates

Fats

Water

These components are analyzed to determine their structure, function, and interactions within food systems.

Chemical Reactions

Food chemists investigate various chemical reactions that occur in food, such as:

Fermentation

Browning reactions

Oxidation

Understanding these reactions helps in improving food quality, safety, and shelf life.

Applications of Food Chemistry

Food chemistry has numerous practical applications in the food industry and everyday life:

Product Development

Food chemists work on creating innovative products like fat and sugar substitutes that offer similar taste experiences without the negative health effects.

## Blood clots and Erythritol

Recent research has raised concerns about potential cardiovascular risks associated with certain sugar substitutes, particularly erythritol. Here are the key points:

### Erythritol and Blood Clotting Risk

A study led by researchers at the Cleveland Clinic found that erythritol, a popular artificial sweetener, may increase the risk of blood clots. The key findings include:

Participants who consumed erythritol-sweetened drinks showed signs of increased platelet activation, which is associated with blood clot formation.

Blood erythritol levels increased by more than 1,000 times after consumption and remained elevated for several days.

No similar effect was observed in participants who consumed glucose-sweetened drinks.

### Mechanism and Implications

The researchers suggest that erythritol may enhance platelet reactivity, potentially leading to:

Increased risk of blood clot formation

Higher likelihood of cardiovascular events like heart attacks and strokes

This is particularly concerning for individuals already at risk for cardiovascular issues, such as those with diabetes or obesity.

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### Other Sugar Substitutes

While the focus has been on erythritol, another study raised similar concerns about xylitol:

Higher blood levels of xylitol were associated with increased risk of cardiovascular events.

Xylitol also enhanced blood clotting in laboratory and animal studies.

### Recommendations and Caution

Health experts and researchers advise:

Moderation in consuming artificially sweetened products.

Considering natural sweeteners in small amounts (e.g., honey, maple syrup) as alternatives.

Consulting with healthcare providers, especially for those with existing cardiovascular risk factors

### Food Processing

Chemical knowledge is applied to enhance food processing techniques, including:

Refrigeration and freezing

Dehydration

Fermentation

These methods help extend shelf life and improve food quality.

### Nutritional Enhancement

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Food chemistry plays a vital role in fortifying foods with essential nutrients and developing functional foods with specific health benefits.

### Safety and Quality Control

Chemists use their expertise to ensure food safety by developing methods to detect contaminants, additives, and potential allergens.

### Importance in Food Science

Food chemistry is essential for:

- Ensuring the quality and safety of manufactured food products

- Improving nutritional value

- Enhancing culinary presentation

- Developing new food technologies and products

By understanding the chemical nature of food, scientists can better control various aspects of food production, leading to improved consumer experiences and health outcomes.

## Combining foods and processing

### Combining Foods

Pairing Complementary Nutrients

Certain food combinations can enhance nutrient absorption:

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Vitamin C with plant-based iron: Adding lemon juice to spinach salad or apples to lentil dishes improves iron absorption.

Tomatoes and olive oil: The fat in olive oil increases absorption of lycopene from tomatoes.

Turmeric and black pepper: Black pepper enhances absorption of curcumin from turmeric.

### Creating Complete Proteins

Combining incomplete protein sources creates complete proteins with all essential amino acids:

Rice and beans

Hummus and whole wheat crackers

Peanut butter on whole grain bread

### Processing Methods

Minimal Processing

To retain the most nutrients, use cooking methods that minimize heat and water exposure:

Steaming

Microwaving

Grilling

Roasting

Strategic Processing

## Some processing techniques can enhance nutrition:

Quick freezing of fruits and vegetables after harvest preserves nutrients.

Enrichment and fortification add essential nutrients that may be lacking.

Pulsed electric field technology preserves nutrients in juices better than heat pasteurization.

Fermentation

Fermentation can increase nutrient content and bioavailability in foods.

## Other Considerations

Use the outer leaves of vegetables when possible.

Save nutrient-rich cooking water for soups and stocks.

Choose processed foods with more nutrients to encourage and fewer constituents to limit.

Be mindful of added sugar, salt and saturated fats when processing foods at home

## Processed sugar

Refined sugar, commonly found in many processed foods, is derived from natural sources such as sugar cane, sugar beets, and corn. The extraction process involves cleaning and cooking these plants to extract sugary juices, which are then processed to create sugar crystals. This refined sugar, primarily in the form of sucrose, is prevalent in various products, including soft drinks, baked goods, and sauces, contributing to a significant portion of the American diet, where average consumption can reach up to 34 teaspoons per day.

## Health Implications

The consumption of refined sugars is linked to several health issues, including obesity, type 2 diabetes, cardiovascular disease, and potentially even some cancers. These sugars provide "empty calories," meaning they offer little to no nutritional value, lacking essential vitamins, minerals, and fiber that are typically found in whole foods containing natural sugars, such as fruits and vegetables.

Refined sugars can cause rapid spikes in blood glucose levels, leading to increased hunger and cravings shortly after consumption. This contrasts with natural sugars, which are digested more slowly due to their presence in whole foods, providing a more sustained energy release and greater satiety.

## Types of Refined Sugars

Common forms of refined sugars include:

Table Sugar (Sucrose): Extracted from sugar cane or beets.

High-Fructose Corn Syrup (HFCS): A sweetener made from corn that is widely used in processed foods.

Brown Sugar: A type of sugar that contains molasses, giving it a distinct flavor and color.

Other Sweeteners: Includes agave nectar and various syrups, which, despite being marketed as healthier alternatives, are still processed and can have similar health effects as traditional refined sugars

## Fermented foods and the intestines

Fermented foods can have several beneficial effects on intestinal health:

Increased microbiome diversity: Consuming fermented foods enhances the diversity of gut microbes, which is associated with better digestive function and overall health.

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**Reduced inflammation:** Fermented foods can decrease molecular signs of inflammation in the body. A study found that a diet rich in fermented foods led to decreased levels of 19 inflammatory proteins, including interleukin 6.

**Improved gut barrier function:** Fermented foods may help strengthen the walls of the intestines, reducing "leaky gut syndrome" and preventing harmful substances from entering the bloodstream.

**Enhanced digestion:** The probiotics in fermented foods can aid in the breakdown of nutrients, particularly lactose in dairy products, making them more digestible.

**Support for the immune system:** About 70% of the immune system resides in the gut. Probiotics from fermented foods can modulate immune responses and support defenses against pathogens.

**Potential benefits for gastrointestinal disorders:** Some fermented foods like kefir have shown promise in managing conditions like lactose malabsorption and *H. pylori* infections.

**Production of beneficial compounds:** The fermentation process can produce bioactive peptides, biogenic amines, and convert phenolic compounds into biologically active substances that may benefit health

## Carbohydrates

Carbohydrates are an essential macronutrient that provide energy for the body. Here are some key points about carbohydrate-rich foods and their importance:

### Carbohydrate-Rich Foods

Healthy sources of carbohydrates include:

Whole grains (brown rice, oatmeal, quinoa, whole wheat bread/pasta)

Fruits (apples, bananas, berries, oranges)

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Starchy vegetables (sweet potatoes, corn, peas)

Legumes (beans, lentils, chickpeas)

Dairy products (milk, yogurt)

### Importance of Carbohydrates

Carbohydrates play several important roles in the body:

They are the body's main source of energy, providing glucose for the brain, muscles, and other organs.

Fiber, a type of carbohydrate, aids digestion and helps maintain gut health.

Complex carbohydrates help regulate blood sugar levels.

Carbohydrates are essential for the production of serotonin, which regulates mood.

Adequate carbohydrate intake helps prevent the breakdown of muscle tissue for energy.

### Choosing Quality Carbohydrates

It's important to focus on the quality of carbohydrates consumed:

Complex carbohydrates from whole grains, fruits, and vegetables are generally healthier choices than simple carbs from refined grains and added sugars.

Foods with a lower glycemic index cause a slower rise in blood sugar and are preferable for managing weight and diabetes risk.

Aim to get 45-65% of daily calories from carbohydrates, focusing on nutrient-dense sources

## Magnesium

Magnesium is an essential mineral that plays a crucial role in various bodily functions, including muscle and nerve function, blood sugar control, sleep, pain, and bone health. Many foods are rich in magnesium, making it relatively easy to meet daily requirements through diet. Here are some of the top magnesium-rich foods:

### Top Magnesium-Rich Foods

#### Pumpkin Seeds

Content: 156 mg per ounce (roasted)

Pumpkin seeds, also known as pepitas, are an excellent source of magnesium and can be added to salads or eaten as a snack.

#### Spinach

Content: 157 mg per cup (cooked)

This leafy green is not only high in magnesium but also packed with other nutrients like iron and vitamins A and C.

#### Dark Chocolate

Content: 65 mg per ounce (70% cocoa or higher)

A delicious way to boost magnesium intake, dark chocolate also contains antioxidants.

#### Almonds

Content: 76.5 mg per ounce (dry roasted)

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Almonds are a nutritious snack that provides healthy fats along with magnesium.

Black Beans

Content: 120 mg per cup (cooked)

These legumes are rich in fiber and protein, making them a great addition to various dishes.

Avocado

Content: 58 mg per medium avocado

Besides magnesium, avocados are high in healthy fats and fiber.

Quinoa

Content: 118 mg per cup (cooked)

This grain is not only high in magnesium but also a complete protein, making it a great choice for vegetarians.

Cashews

Content: 83 mg per ounce

Cashews are another nut that provides a good amount of magnesium along with healthy fats.

Tofu

Content: 37 mg per 100 grams

A versatile meat substitute, tofu is rich in protein and magnesium, making it a staple in vegetarian diets.

Chia Seeds

Content: 95 mg per ounce

These tiny seeds are packed with nutrients, including omega-3 fatty acids and fiber, in addition to magnesium

## Magnesium and Calcium balance

Magnesium and calcium play essential roles in the body and maintaining a proper balance between them is crucial for optimal health. Here are some key points about the relationship between magnesium and calcium:

### *Importance of Balance*

The balance between calcium and magnesium is critical for several physiological functions:

- Skeletal muscle function and contractility
- Bone health and structure
- Heart muscle contraction and nerve cell communication
- Regulation of blood pressure and blood clotting

### *Optimal Ratio*

Many experts recommend maintaining a calcium-to-magnesium (Ca:Mg) ratio of approximately 2:1:

- A ratio between 1.7 and 2.6 may be ideal for health benefits
- Ratios above 2.6:1 or below 2:1 may increase risks of heart disease and other health issues

*Intake Patterns and Concerns*

- Most people get enough calcium through diet, but many are deficient in magnesium
- The typical Western diet often has a Ca:Mg ratio above 3:1, which may be too high
- Increased calcium intake in recent decades, especially through supplements, has raised concerns about potential negative health effects

*Health Implications*

An imbalanced Ca:Mg ratio or deficiencies in either mineral may contribute to:

- Increased risk of cardiovascular disease
- Higher cancer risk
- Insulin resistance and inflammation
- Fatigue, muscle cramps, and in severe cases, cardiac arrhythmias (for magnesium deficiency)

*Recommendations*

- Focus on obtaining both minerals through a balanced diet rich in fruits, vegetables, and nuts
- Be cautious with calcium supplementation, especially if magnesium intake is low
- Consider the Ca:Mg ratio when supplementing, aiming for around 2:1
- Increase magnesium intake for those with typically high calcium consumption

### *Factors Affecting Balance*

- High calcium intake may impair magnesium balance when magnesium intake is low
- Phosphate intake may influence the interaction between calcium and magnesium absorption
- Vitamin D status can affect the relationship between these minerals and health outcomes

### Story

Magnesium glycinate helped my gf lower her blood sugar and helps me with my sleep. Taken every 4 hrs, at 400 mg tab.

### Chloride

Chloride is an important electrolyte that is found in many foods, often alongside sodium.

### Chloride and nerve health

A lack of chloride-rich foods in the diet can potentially impact nerve health, as chloride plays an important role in nerve function. Here are some key points about the relationship between chloride intake and nerve health:

1. Chloride is essential for proper nerve function. It helps regulate the transmission of electrical signals along nerve cells.
2. Adequate chloride levels are necessary for maintaining the proper balance of fluids inside and outside of nerve cells, which is crucial for nerve signaling.
3. Chloride deficiency, though rare, can potentially lead to nerve-related symptoms like muscle weakness, fatigue, and difficulty breathing.

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4. Severe chloride deficiency (hypochloremia) may cause more serious neurological issues like confusion or seizures in extreme cases.
5. While outright chloride deficiency is uncommon in healthy individuals with varied diets, certain conditions or medications can lead to low chloride levels that may impact nerve function.
6. Foods rich in chloride include table salt, seaweed, tomatoes, lettuce, celery, and olives. Ensuring adequate intake of these foods can help maintain proper chloride levels for nerve health.
7. Chloride often works in conjunction with other electrolytes like sodium and potassium to support proper nerve and muscle function.
8. For most people, a balanced diet provides sufficient chloride. However, those with certain health conditions or on specific medications may need to pay extra attention to their chloride intake

Here are some chloride-rich foods:

### Top Sources of Chloride

Table salt (sodium chloride)

Sea salt

Processed and cured meats (ham, bacon, sausages, etc.)

Canned vegetables and soups

Salted snack foods (chips, pretzels, etc.)

Cheese

Bread and baked goods

Canned fish (tuna, salmon, etc.)

Olives and pickles

Soy sauce and other salty condiments

## Natural Food Sources

While processed foods tend to be highest in chloride due to added salt, some natural foods also contain chloride:

Seaweed

Tomatoes

Celery

Lettuce

Olives

Seafood Sources

Many types of seafood are good sources of chloride:

Shrimp

Scallops

Crab

Oysters

## Mackerel

### Considerations

It's important to note that most people get sufficient chloride through their regular diet, especially if consuming processed foods. The adequate intake for chloride is about 2.3 grams per day for adults. Excessive chloride intake often comes from high sodium consumption, which can lead to high blood pressure and other health issues. Therefore, it's generally recommended to focus on whole, unprocessed foods and limit added salt rather than specifically seeking out chloride-rich foods.

When aiming for a balanced intake of electrolytes, including chloride, it's best to consume a variety of whole foods like fruits, vegetables, lean meats, and dairy products, which provide a range of essential minerals in appropriate amounts.

### Sulfur biochemistry and food sources

Sulfur is an essential mineral that plays important roles in human health and metabolism. Here are some key points about the biochemistry of sulfur-rich foods:

#### Sources of Dietary Sulfur

The main dietary sources of sulfur include:

- Animal proteins like meat, poultry, fish, eggs and dairy products
- Allium vegetables like garlic, onions, leeks and shallots
- Cruciferous vegetables like broccoli, cauliflower, cabbage and kale
- Legumes like beans, lentils and peas
- Nuts and seeds

## Forms of Sulfur in Foods

Sulfur is present in foods in different forms:

- Amino acids methionine and cysteine in proteins
- Organosulfur compounds like allicin in garlic and glucosinolates in cruciferous vegetables
- Inorganic sulfates in some drinking water

## Biochemical Roles

Dietary sulfur plays several important biochemical roles:

- Building and repairing DNA and proteins
- Synthesizing glutathione, a major antioxidant
- Maintaining the integrity of connective tissues
- Supporting immune function
- Controlling inflammation
- Detoxification processes

## Metabolism

The body metabolizes dietary sulfur compounds in various ways:

- Methionine and cysteine are used to synthesize proteins
- Organosulfur compounds are broken down and absorbed
- Sulfur is incorporated into important biomolecules like glutathione

## Health Effects

Consuming sulfur-rich foods may have health benefits like:

- Reduced inflammation
- Improved joint health
- Enhanced detoxification
- Potential cancer-protective effects (though more research is needed)

However, excessive sulfur intake can potentially cause gastrointestinal issues in some people

## Sources

Animal-Based Sources

Meat, especially beef and organ meats

Poultry (chicken, turkey, duck)

Fish and seafood (shrimp, scallops, crab, most types of fish)

Eggs

Dairy products (milk, cheese, yogurt)

Plant-Based Sources

Allium vegetables: garlic, onions, leeks, chives, shallots

Cruciferous vegetables: broccoli, cauliflower, Brussels sprouts, cabbage, kale

Other vegetables: asparagus, mushrooms

Legumes: soybeans, black beans, kidney beans, lentils

Nuts and seeds: almonds, Brazil nuts, peanuts, walnuts, sesame seeds

Whole grains

Other Sources

Dried fruits (raisins, apricots, figs)

Certain beverages (beer, wine, cider)

Condiments like horseradish and mustard

Sulfur is found in proteins containing the amino acids methionine and cysteine, as well as in certain compounds like glucosinolates in cruciferous vegetables. The main dietary sources tend to be animal proteins and certain vegetables, especially those in the allium and cruciferous families. Including a variety of these foods in the diet can help ensure adequate sulfur intake.

## Potassium rich foods

### Fruits

Bananas: A medium banana contains about 451 mg of potassium.

Dried fruits: Apricots, prunes, raisins, and dates are particularly high in potassium.

Cantaloupe: This melon is a refreshing source of potassium.

Oranges: Fresh oranges and orange juice are good sources.

Avocados: Half an avocado contains approximately 345 mg of potassium.

### Vegetables

Potatoes: A medium baked potato with skin has over 900 mg of potassium.

Sweet potatoes: One medium sweet potato contains around 500 mg.

Leafy greens: Spinach, Swiss chard, and kale are excellent sources.

Tomatoes: Fresh tomatoes and tomato products (like puree and juice) are rich in potassium.

Winter squash: Varieties like butternut and acorn squash provide significant potassium.

### Legumes and Nuts

Beans: Kidney beans, black beans, and lentils are high in potassium.

Soybeans: Edamame and other soy products are good sources.

Nuts: Almonds and cashews contain moderate amounts of potassium.

## Dairy and Protein Sources

Dairy products: Milk and yogurt are good sources of potassium.

Fish: Certain types of fish, like salmon and tuna, also provide potassium.

## Beverages

Coconut water: This natural drink is rich in potassium.

Vegetable juices: Tomato juice and other vegetable juices can help boost potassium intake.

**Figs** contain the following amounts of potassium:

One raw fig has about 2.5% of the recommended daily amount of potassium.

Six dried figs contain approximately 680 mg of potassium, which is about 7% of the daily value.

One medium fresh fig (about 2.25 inches in diameter) contains approximately 232 mg of potassium.

1 medium fresh fig: 232 mg potassium

6 dried figs: 680 mg potassium

The exact amount can vary slightly depending on the size and variety of the fig, but these values give a good general estimate of the potassium content in figs. Overall, figs are considered a good source of potassium, especially in their dried form.

Incorporating a variety of these foods into your diet can help you meet the recommended daily intake of potassium, which is about 4,700 mg for adults.

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For people with chronic kidney disease (CKD), the recommended potassium intake is typically lower than for those with healthy kidneys. Here are the key points about potassium limits for people with kidney issues:

### Recommended Potassium Intake for CKD patients:

For people with mild to moderate CKD (stages 3-4), the general recommendation is to limit potassium intake to 2-4 grams (2000-4000 mg) per day.

For those with advanced CKD or on dialysis, a stricter limit of less than 3 grams (3000 mg) per day is often recommended.

Some guidelines suggest an even lower limit of 2-2.5 grams (2000-2500 mg) per day for those prone to hyperkalemia.

### Factors Affecting Recommendations

The exact limit depends on the individual's kidney function, medications, and other health factors.

Potassium restrictions often become more stringent as kidney function declines.

Patients should work with their nephrologist and renal dietitian to determine their personalized potassium limit.

### Monitoring and Management

Regular blood tests are needed to check potassium levels.

The safe range for blood potassium is typically 3.5-5.0 mEq/L.

Dietary changes, medications, and other interventions may be used to manage potassium levels.

## Rice

Rice is primarily composed of carbohydrates, mainly in the form of starches such as amylose and amylopectin. These carbohydrates are critical in determining the texture and cooking properties of rice. Amylose is a straight-chain molecule, while amylopectin is highly branched, affecting rice's stickiness and firmness when cooked. Rice also contains about 7% protein, with a high digestibility rate, and provides essential nutrients like B vitamins, vitamin C, iron, magnesium, and zinc. The grain consists of three main parts: the bran, endosperm, and germ, each contributing to its nutritional profile.

## Rice and Corn

The combination of rice and corn in various applications shows interesting chemical interactions. Substituting rice for corn in animal feed does not negatively affect rumen fermentation, suggesting rice as a viable alternative energy source. Nutritionally, colored rice and corn varieties contain richer essential nutrients and amino acids compared to their white counterparts. Rice and corn can also be combined in food products like vermicelli, where a mixture of 75% rice flour and 25% corn flour with carrageenan produces a favorable texture and taste. Additionally, rice and corn are used in fermented foods like 'calugi,' highlighting their versatility in different culinary traditions.

## Refrigerating Rice and potatoes

Refrigerating cooked potatoes and rice affects their starch chemistry by increasing resistant starch content. When these foods are cooled after cooking, some of the gelatinized starch retrogrades, forming resistant starch (RS3), which resists digestion in the small intestine and is fermented in the colon. This process can reduce the glycemic response, making these foods potentially healthier. For example, cooling rice increases its resistant starch content, lowering its glycemic impact when reheated. However, reheating boiled potatoes can reduce resistant starch content back to levels similar to freshly cooked potatoes

## Cassava

Cassava, also known as manioc or tapioca, is a starchy root crop rich in carbohydrates, primarily starch, with low protein and fat content. It contains cyanogenic glycosides, which can release cyanide if consumed raw, making proper preparation essential. Cassava leaves, in contrast, are high in protein, vitamins, and minerals. The root is a significant energy source, providing high caloric yield per hectare. Cassava is versatile, used in various food products like tapioca and garri, and is a staple in many tropical regions

## Sweet potatoes

Sweet potatoes are rich in various bioactive compounds and nutrients, contributing to their health benefits. They contain macronutrients like starch, dietary fiber, and protein, along with micronutrients such as vitamins B, C, E, provitamin A (carotenoids), anthocyanins, flavonoids, and minerals like potassium, magnesium, and iron. Different parts of the plant, including tubers and leaves, offer diverse nutrients and bioactive compounds like phenolic acids and anthocyanins, which have antioxidative and anti-inflammatory properties. Cooking methods can affect the phenolic content, with some methods like steaming increasing it.

## Lentils

Lentils (*Lens culinaris*) are nutritionally rich legumes, containing approximately 25% protein and 60% carbohydrates, along with essential amino acids like lysine and arginine. They are also a source of polyphenols, such as phenolic acids, flavan-3-ol, flavonols, and anthocyanins, which have antioxidant properties. Lentils contain significant minerals, including iron, zinc, magnesium, and phosphorus, which are crucial for various biological functions. Additionally, they have low fat content, with a composition of saturated, monounsaturated, and polyunsaturated fatty acids. Lentils are valued for their health benefits, including cardiovascular and metabolic improvements.

## Basil

Basil, particularly *Ocimum basilicum*, is rich in essential oils and secondary compounds that contribute to its distinctive aroma and potential health benefits. Key chemical constituents include methyl cinnamate, linalool, estragole (methyl chavicol), and eugenol, which vary among different basil cultivars and growing conditions. These compounds are responsible for basil's aromatic properties and have been studied for their antimicrobial, antifungal, and potential anticancer activities. Basil is also used in traditional medicine for various ailments and as a flavoring in culinary applications

## Fish

The chemistry of fish encompasses various aspects, including their composition and the environmental factors affecting them. Fish contain amino acids like glycine and glutamate, which contribute to their flavors. Ocean fish accumulate bromophenols from algae, giving them a characteristic "seacoast smell." The compound trimethylamine (TMA) is responsible for the "fishy" odor, formed from trimethylamine oxide (TMAO) after fish die. Additionally, fish are often subject to chemical contamination, with mercury and polychlorinated biphenyls (PCBs) being common concerns in fish consumption advisories

## Ginger

Ginger, scientifically known as *Zingiber officinale*, contains a variety of chemical compounds, including phenolic compounds like gingerols and shogaols, and terpenes such as zingiberene. Gingerols, the primary pungent compounds, can transform into shogaols when ginger is dried or heated, increasing its pungency. These compounds contribute to ginger's characteristic flavor and aroma, and they have been studied for their antioxidant, anti-inflammatory, and potential anticancer properties. Ginger also contains zingerone, which is less pungent and forms during cooking.

Ginger has shown potential in alleviating neuropathic pain through its anti-inflammatory properties. Gingerol-enriched ginger supplementation can reduce pain sensitivity and neuroinflammation by modulating the gut-brain axis. Studies in

animal models have demonstrated that ginger can decrease hypersensitivity and emotional responses associated with neuropathic pain, potentially by improving intestinal permeability and reducing neuroinflammation markers in the brain and gut. Additionally, hot ginger soaks have been suggested as a home remedy for painful neuropathy. However, more research is needed to confirm these effects in humans.

Ginger has several benefits for gastrointestinal (GI) tract health. It is known for its ability to relieve nausea and improve digestion by accelerating gastric emptying, which can help alleviate symptoms of indigestion and constipation. Ginger's anti-inflammatory and antioxidant properties also contribute to its gastroprotective effects, potentially soothing the gut lining and reducing inflammation. Additionally, ginger can modulate gut microbiota composition, which may further support digestive health. Despite these benefits, more extensive studies are needed to fully understand the optimal dosages and mechanisms of ginger's effects on the GI tract.

Drinking hot water with boiled ginger and honey may have several effects on metabolism. Ginger is known to increase thermogenesis, which enhances calorie burning and boosts metabolism. It can also improve digestion by increasing enzyme production, thereby aiding nutrient absorption and reducing bloating. Ginger's appetite-suppressing properties may help control hunger and reduce calorie intake.

### Stories of my grandma using ginger internally and externally

My grandma died at 94 yrs of age due to poor nutrition and raising a big family. During her lifetime, she had used ginger internally and added in her massage oil. She has no medications, using only ginger and garlic for everyday use internally and externally. She would boil ginger and garlic for her drink and add ginger and garlic in her massage oil of coconut oil base.

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Additionally, ginger has anti-inflammatory and antioxidant properties, which can support overall metabolic health. However, while ginger shows promise in weight management, more research is needed to confirm its efficacy.

Ginger boosts thermogenesis in the body by activating transient receptor potential vanilloid 1 (TRPV1) channels, which are involved in the body's heat production process. This activation leads to increased energy expenditure and calorie burning, contributing to a higher basal metabolic rate. Ginger's thermogenic effect is also linked to enhanced satiety and reduced hunger, which can help in weight management. Additionally, gingerols and shogaols, compounds found in ginger, play a role in stimulating these thermogenic pathways.

Ginger may support nerve health through several mechanisms. It contains choline, which is crucial for the production of neurotransmitters that facilitate nerve signaling. Additionally, ginger's anti-inflammatory properties can help reduce neuroinflammation, which is beneficial for nerve function. Gingerol, a key compound in ginger, has been shown to penetrate the blood-brain barrier, potentially aiding in protecting nerve cells and improving brain health. These properties suggest that ginger could play a role in maintaining and enhancing nerve health.

## Seaweed

Seaweeds are marine macroalgae that contain a diverse array of chemical compounds, making them valuable for nutritional, industrial, and biomedical applications. Here's an overview of the key chemical components found in seaweeds:

### Carbohydrates

Carbohydrates are the most abundant component in seaweeds, typically comprising 50-80% of their dry weight. The main types include:

**Polysaccharides:** These complex carbohydrates are the primary structural and storage compounds in seaweeds. Key polysaccharides include:

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Carrageenans and agars (red seaweeds)

Alginates, fucoidans, and laminarins (brown seaweeds)

Ulvans (green seaweeds)

Monosaccharides: Common simple sugars found in seaweeds include mannose, glucose, fructose, galactose, fucose, xylose, and arabinose.

Oligosaccharides: These shorter chain carbohydrates have shown potential prebiotic and bioactive properties.

Proteins and Amino Acids

Seaweeds contain varying amounts of protein, typically ranging from 10-47% of dry weight. Red and green seaweeds generally have higher protein content than brown seaweeds. Seaweed proteins contain all essential amino acids, making them a valuable nutritional source.

Lipids

While generally low in lipids (0.1-15% of dry weight), seaweeds are rich in polyunsaturated fatty acids (PUFAs), particularly omega-3 and omega-6 fatty acids. The lipid content and composition vary among species and are influenced by environmental factors.

Minerals and Trace Elements

Seaweeds are excellent sources of minerals, with ash content typically ranging from 15-40% of dry weight. They are particularly rich in:

Iodine

Calcium

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Magnesium

Potassium

Sodium

Iron

Zinc

The mineral composition varies among species, with some seaweeds accumulating specific elements at higher concentrations.

### Vitamins

Seaweeds contain various vitamins, including:

Vitamin C (ascorbic acid)

Vitamin B1 (thiamine)

Vitamin B2 (riboflavin)

Vitamin B12 (cobalamin)

Folic acid

Bioactive Compounds

Seaweeds produce numerous secondary metabolites with potential health benefits:

Phenolic compounds: These antioxidants are particularly abundant in brown seaweeds.

**Pigments:** Including chlorophylls, carotenoids, and phycobiliproteins, which vary among different seaweed groups.

**Terpenes:** Found in various seaweed species, with potential antimicrobial and anti-inflammatory properties.

The chemical composition of seaweeds is highly variable, depending on species, environmental conditions, season, and geographical location. This diversity in chemical constituents contributes to the wide range of potential applications for seaweeds in food, pharmaceuticals, and other industries.

## Caramelyzed foods and carcinogenicity

Caramelization is a complex process that can produce a variety of compounds, some of which have raised concerns about potential carcinogenicity. Here's an overview of the key points regarding caramelized foods and cancer risk:

### 4-Methylimidazole (4-MEI)

The main compound of concern in caramel coloring is 4-methylimidazole (4-MEI):

4-MEI can form during the manufacturing of certain types of caramel coloring, particularly those made with ammonia.

Animal studies have shown 4-MEI to be carcinogenic in mice and rats at high doses.

The International Agency for Research on Cancer (IARC) has classified 4-MEI as "possibly carcinogenic to humans".

### Regulatory Status and Safety Assessments

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California has listed 4-MEI as a carcinogen under Proposition 65, requiring warning labels on products exceeding certain levels.

The FDA has not prohibited the use of caramel coloring containing 4-MEI, but continues to study its potential effects.

The European Food Safety Authority (EFSA) has concluded that caramel colors are not carcinogenic based on available evidence.

### Exposure and Risk

Levels of 4-MEI in foods and beverages vary widely depending on the manufacturing process.

Some studies have estimated cancer risks from 4-MEI exposure through soda consumption, but the actual risk remains uncertain.

The overall cancer risk from 4-MEI in caramel coloring is likely low for most people, especially compared to other dietary factors.

### Recommendations

While the evidence for carcinogenicity in humans is limited, some experts and organizations recommend:

Reducing consumption of foods and beverages containing caramel coloring, especially those with higher levels of 4-MEI.

Manufacturers should work to minimize 4-MEI formation in caramel coloring production.

Further research to better understand the long-term health effects of 4-MEI exposure in humans

## Baking soda/bicarbonate and blood carbon dioxide

Bicarbonate and blood carbon dioxide are closely related components that play a crucial role in maintaining the body's acid-base balance. Here's an overview of their relationship and importance:

### Bicarbonate and CO<sub>2</sub> in the Blood

Bicarbonate (HCO<sub>3</sub><sup>-</sup>) is the primary form of carbon dioxide (CO<sub>2</sub>) in the blood, accounting for about 95% of the total CO<sub>2</sub> content. When healthcare providers measure CO<sub>2</sub> levels in the blood, they are essentially measuring bicarbonate levels.

### Functions and Regulation

#### pH Balance

Bicarbonate acts as a buffer, helping to maintain the proper acid-base balance (pH) in the blood. This is crucial for various bodily functions and overall health.

#### Transport and Excretion

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The blood carries bicarbonate to the lungs, where it is converted to CO<sub>2</sub> and exhaled. The kidneys also play a role in regulating bicarbonate levels by excreting or retaining it as needed.

### Testing and Normal Ranges

#### Bicarbonate Blood Test

This test is often part of an electrolyte panel or basic metabolic panel. It measures the amount of bicarbonate in the blood, which reflects CO<sub>2</sub> levels.

#### Normal Range

For adults, the normal bicarbonate range is typically between 23 and 29 milliequivalents per liter (mEq/L) or millimoles per liter (mmol/L).

## Clinical Significance

### Low Bicarbonate Levels

Low levels may indicate conditions such as:

- Kidney disease
- Diabetic ketoacidosis
- Metabolic acidosis
- Addison's disease
- Certain poisonings (e.g., ethylene glycol, aspirin overdose)

### High Bicarbonate Levels

Elevated levels can be associated with:

- Lung diseases like COPD
- Cushing's syndrome
- Metabolic alkalosis
- Dehydration
- Certain medications (e.g., diuretics)

### Importance in Kidney Function

The kidneys play a crucial role in maintaining bicarbonate levels. In chronic kidney disease (CKD), the kidneys may have difficulty removing acid from the blood, leading to a condition called metabolic acidosis.

### Use of Baking Soda in Meat Preparation

Baking soda, or sodium bicarbonate, is a versatile ingredient in cooking, particularly for preparing meats and beans. Its primary functions include tenderizing proteins and speeding up the cooking process for legumes.

When used in meat cooking, baking soda raises the pH level, which prevents proteins from bonding excessively. This results in more tender and moist meat. For instance, when preparing ground beef, adding about 1/4 teaspoon of baking soda per 12 ounces of meat can significantly enhance tenderness and browning. The process involves mixing the baking soda with a small amount of water, coating the meat, and allowing it to sit for about 15 minutes before cooking. This method helps the meat retain moisture and develop a better sear, minimizing the typical juice loss during cooking.

In stir-frying, baking soda can be particularly effective. A common technique involves marinating beef with baking soda and water for a brief period before cooking, which results in a tender and flavorful dish.

## Use of Baking Soda in Bean Preparation

Baking soda is also beneficial for cooking dried beans. When added to the soaking or cooking water, it creates an alkaline environment that breaks down pectin in the cell walls of the beans, allowing them to absorb water more effectively. This results in softer beans that cook faster. For example, adding about 1/8 teaspoon of baking soda to the cooking water can reduce cooking times significantly—black beans may become tender in as little as 30 minutes when treated this way. A study found that beans soaked in a solution of salt and baking soda yielded superior texture and reduced cooking time compared to those soaked in plain water or acidic solutions. The combination of salt and baking soda was particularly effective, making it a recommended practice for cooking kidney and black beans.

## Common Food Sources of Bicarbonate

1. **Baked Goods:** Sodium bicarbonate is widely used as a leavening agent in baked products. It helps dough rise by producing carbon dioxide when it reacts with acidic ingredients. Common baked goods that contain bicarbonate include:
  - Bread
  - Cakes
  - Cookies
  - Muffins
  - Pancakes and waffles.
2. **Effervescent Beverages:** Bicarbonate is used in the production of fizzy drinks. When mixed with acids in the beverage, it creates carbon dioxide, resulting in effervescence. This application is common in sodas and flavored drinks.

3. **Food Colorants:** Sodium bicarbonate is often included in food colorants due to its stabilizing properties. It helps maintain the color of processed foods.
4. **Digestive Aids:** Bicarbonate can be used in cooking beans and legumes to help soften them and make them easier to digest. Soaking beans in a bicarbonate solution can reduce cooking time and improve digestibility.
5. **Processed Foods:** Many processed foods, including snacks and convenience items, may contain sodium bicarbonate as a leavening or pH-regulating agent.

#### Nutritional Considerations

While bicarbonate is beneficial in food preparation, it is important to be mindful of sodium intake, especially for those on low-sodium diets. One teaspoon of baking soda contains over 1,250 milligrams of sodium, which can contribute significantly to daily sodium consumption

### Canned foods and pH blood balance

1. The pH of blood is tightly regulated by the body and stays within a narrow range of 7.35 to 7.45, regardless of diet. Eating acidic or alkaline foods does not significantly alter blood pH.
2. While some canned foods may be acidic, there is no evidence that consuming them disrupts blood pH balance or causes health issues related to acidity.
3. The alkaline diet, which promotes eating more alkaline foods and fewer acidic foods (including many canned goods), is not scientifically proven to alter blood pH or provide the claimed health benefits.
4. Canned foods can be part of a healthy diet and provide important nutrients. Many canned fruits, vegetables, and legumes are nutritious options.

## Some concerns with canned foods

- Potential BPA exposure from can linings, though this is being phased out
- Added sodium or sugar in some canned products
- Slight nutrient losses during the canning process, though many nutrients are well-preserved

## Killing parasites in food during preparation

### Cooking

Thorough cooking is one of the most effective ways to kill parasites in food:

- Cook meats, especially pork, to safe internal temperatures (at least 145°F/63°C for whole cuts, 160°F/71°C for ground meat).
- Cook fish to an internal temperature of at least 145°F/63°C.
- Avoid eating raw or undercooked meat, fish, or shellfish.

### Freezing

Freezing can kill many parasites, but effectiveness varies:

- Freeze pork less than 6 inches thick at 5°F (-15°C) for at least 3 weeks to kill Trichinella.
- Freeze fish at -4°F (-20°C) or below for 7 days, or -31°F (-35°C) for 15 hours, to kill parasites.

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- Note that freezing may not kill all parasites in wild game meats.

### Other Methods

- Thoroughly wash fruits and vegetables under clean running water.
- Avoid cross-contamination by using separate cutting boards and utensils for raw meats.
- Use safe, treated water for washing and preparing foods.
- Properly clean meat grinders and other equipment used for raw meats.

### Ineffective Methods

Some methods are not reliable for killing parasites:

- Smoking, curing, drying, and pickling do not reliably kill parasites.
- Microwave cooking is not recommended, as it may not heat evenly.

By following proper food safety practices and cooking methods, you can significantly reduce the risk of parasitic infections from food. When in doubt, thorough cooking to recommended temperatures is the most reliable method for killing parasites.

## Parenteral nutrition

Parenteral nutrition (PN) involves complex biochemistry to provide essential nutrients intravenously. Here are some key aspects of the biochemistry of parenteral nutrition:

### Components

The main components of PN formulations include:

- **Carbohydrates:** Typically provided as dextrose, supplying 3.4 kcal/g.
- **Lipids:** Usually as 20% lipid emulsions, providing 2 kcal/mL.
- **Amino acids:** Supply 4 kcal/g and are the protein source.
- **Electrolytes:** Sodium, potassium, calcium, magnesium, chloride, acetate, phosphate.
- **Vitamins:** Both fat-soluble and water-soluble vitamins.
- **Trace elements:** Including zinc, copper, selenium, manganese.

### Biochemical Monitoring

Careful biochemical monitoring is essential for safe PN administration:**Electrolytes and Minerals**

- Sodium, potassium, calcium, magnesium, phosphate: Monitored daily initially, then at each follow-up.
- Helps assess hydration, renal function, and electrolyte balance.

## Metabolic Parameters

- Glucose: To monitor for hyperglycemia.
- Triglycerides: Checked weekly initially, then every 3 months to assess lipid metabolism.

## Liver Function Tests

- Monitored regularly as PN can affect liver enzymes.
- Sepsis, medications, and underlying liver conditions can also impact results.

## Trace Elements and Vitamins

- Zinc, copper, selenium, manganese, vitamins A, D, E, B12, folate: Checked at baseline and every 3 months for long-term PN.
- Serum levels may be affected by inflammation, requiring cautious interpretation.

## Biochemical Complications

Several biochemical imbalances can occur with PN:

- **Hyperglycemia:** Due to high dextrose content.
- **Electrolyte disturbances:** Imbalances in sodium, potassium, calcium, magnesium.
- **Refeeding syndrome:** Rapid shifts in phosphate, potassium, and magnesium when initiating PN in malnourished patients.
- **Hypertriglyceridemia:** From lipid components of PN.

## Stability Considerations

The stability of PN solutions is critical:

- Mixing order and compatibility of components affect stability.
- Vitamins may be added just before administration to prevent degradation.
- Light protection is important to prevent peroxide formation, especially in neonatal PN

## Water

### Chemical Structure and Properties

Water (H<sub>2</sub>O) has a bent molecular structure with an oxygen atom bonded to two hydrogen atoms. This structure gives water several important properties:

- **Polarity:** Water is a polar molecule, with a slight negative charge near the oxygen and positive charges near the hydrogens. This polarity allows water to act as a solvent for many substances.
- **Hydrogen bonding:** Water molecules can form hydrogen bonds with each other and other polar molecules. This gives water unique properties like high boiling point and surface tension.

### Solvent Properties

Water is often called the "universal solvent" due to its ability to dissolve many substances:

- It can dissolve polar and ionic compounds by surrounding them with water molecules.
- Even some nonpolar molecules can dissolve in water to a limited extent.

This solvent ability is critical for biochemical reactions to occur in aqueous solutions inside cells.

### Role in Biochemical Reactions

Water is directly involved in many biochemical reactions:

- It participates in hydrolysis reactions that break down larger molecules.
- It is a reactant or product in many metabolic reactions.
- About one-third to one-half of known enzymatic reactions consume or produce water.

### Structural Importance

Water helps maintain the structure and shape of biomolecules:

- It forms hydrogen bonds with proteins and nucleic acids, influencing their 3D structure.
- Hydrophobic interactions in water drive the folding of proteins and formation of biological membranes.

### Cellular Environment

Water makes up the bulk of the cellular environment:

- It accounts for 99.4% of metabolites in *E. coli* cells by molar concentration.
- Most eukaryotic organisms are about 90% water, while prokaryotes are about 70% water.

### Regulation of Temperature

Water's high heat capacity helps regulate temperature in cells and organisms:

- It can absorb or release heat with minimal temperature change.
- This property helps maintain a stable internal environment for biochemical processes.

## Water and heart health

Water plays a crucial role in maintaining heart health and preventing cardiovascular issues. Here's an overview of the relationship between hydration and heart health:

### Benefits of Proper Hydration

Staying well-hydrated is essential for overall heart health:

- It helps the heart pump blood more efficiently through the body.
- Proper hydration reduces strain on the heart, allowing it to work less hard.
- It supports blood vessel function and circulation.

### Risks of Dehydration

Dehydration can negatively impact heart health in several ways:

- It reduces blood volume, causing the heart to beat faster and increasing blood pressure.
- Dehydration makes blood thicker and more sodium-rich, making circulation more difficult.
- It can lead to increased heart rate, dizziness, and fatigue.

### Long-Term Heart Benefits

Research suggests that maintaining good hydration over time may have long-term cardiovascular benefits:

- A study found that those who drink enough water may have a reduced risk of developing heart failure in the future.

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- Adults who drank 5 or more glasses of water per day had about half the risk of dying from coronary heart disease compared to those who drank less.

### Recommended Intake

While individual needs vary, general guidelines for daily fluid intake include:

- 6-8 cups (1.5-2.1 liters) for women
- 8-12 cups (2-3 liters) for men

However, those with heart failure may need to limit fluid intake to 6-9 cups (1.5-2 liters) per day, as advised by their healthcare provider.

### Monitoring Hydration

To ensure proper hydration:

- Pay attention to urine color - pale and clear indicates good hydration.
- Be aware of thirst, but don't rely on it exclusively as an indicator.
- For those with heart conditions, serum sodium levels can be a useful clinical measure of hydration status

## Water and blood health

Water plays a crucial role in maintaining blood health and overall cardiovascular function. Here are some key points about the relationship between water intake and blood health:

### Effects on Blood Pressure

- Proper hydration helps maintain normal blood pressure levels. When you're dehydrated, blood volume decreases, which can lead to a drop in blood pressure.
- However, drinking water doesn't necessarily lower blood pressure unless you are dehydrated. For most people, staying adequately hydrated helps normalize blood pressure rather than lowering it further.

### Blood Volume and Circulation

- Water makes up a large portion of blood volume. Adequate hydration helps maintain proper blood volume, allowing the heart to pump blood more efficiently throughout the body.
- Good hydration keeps blood less viscous, making it easier for the heart to circulate blood.

### Kidney Function

- Proper hydration supports kidney function, which plays a key role in regulating blood pressure and filtering waste from the blood.
- When well-hydrated, the kidneys can more effectively remove excess sodium and other waste products from the bloodstream.

## Electrolyte Balance

- Water intake helps maintain the proper balance of electrolytes like sodium in the blood. Severe dehydration or overhydration can disrupt this balance.

### Recommendations

- Most healthy adults need about 11.5-15.5 cups of fluids per day, including water and other beverages.
- Individual needs may vary based on factors like activity level, climate, and overall health.
- Listen to your body's thirst signals and aim for pale yellow urine as signs of good hydration

## Best Times to Drink Water

### 1. **Upon Waking Up:**

- Drinking a glass of water first thing in the morning helps activate internal organs and flush out toxins accumulated overnight. This can also boost energy levels and improve mood.

### 2. **Before Meals:**

- Consuming water about 30 minutes before meals can aid digestion and promote a feeling of fullness, which may help in weight management. However, it's advisable to avoid drinking water immediately before or after meals to prevent dilution of digestive juices.

### 3. **During and After Exercise:**

- Hydration is crucial during physical activities. It's recommended to drink water before, during, and after workouts to replace fluids lost through sweat and maintain performance.

4. **Mid-Afternoon:**

- A glass of water in the afternoon can help combat fatigue and prevent the common energy slump that occurs around 3 PM.

5. **Before Bedtime:**

- While it's beneficial to drink water before bed to replenish fluids, it's best to limit intake to small amounts to avoid nighttime bathroom trips. Drinking a small glass about an hour before sleeping can aid in hydration without disrupting sleep.

Summary of Suggested Schedule

- **7:00 AM:** 1st glass after waking up
- **9:00 AM:** 2nd glass, about an hour after breakfast
- **11:30 AM:** 3rd glass, 30 minutes before lunch
- **1:30 PM:** 4th glass, an hour after lunch
- **3:00 PM:** 5th glass during a break
- **5:00 PM:** 6th glass before dinner
- **8:00 PM:** 7th glass, an hour after dinner
- **10:00 PM:** 8th glass, small amount before bed

## Breakfast for those with poor blood health

For those with poor blood health, a nutritious breakfast can help improve their condition. Here are some healthy breakfast options that can be beneficial:

1. Oatmeal with berries and nuts  
Oatmeal is high in fiber and can help lower cholesterol levels. Adding berries provides antioxidants, while nuts offer healthy fats and protein. This combination supports heart and blood health.
2. Eggs with whole grain toast and avocado  
Eggs are rich in protein and nutrients like vitamin B12, which is important for red blood cell formation. Whole grains provide fiber, and avocado offers healthy fats to support cardiovascular health.
3. Greek yogurt with fruit and chia seeds  
Greek yogurt is high in protein and calcium. Fruits add vitamins and antioxidants, while chia seeds are rich in omega-3 fatty acids that support heart health.
4. Smoothie with spinach, banana, and nut butter  
Leafy greens like spinach are high in iron and folate, which are crucial for blood health. Bananas provide potassium, and nut butter adds protein and healthy fats.
5. Whole grain toast with almond butter and sliced apple  
Whole grains offer fiber, almond butter provides protein and healthy fats, and apples add fiber and antioxidants to support overall health.

6. Overnight oats with milk, chia seeds, and berries

This easy make-ahead option combines the benefits of oats, chia seeds, and berries for a nutrient-rich breakfast that supports blood and heart health.

When preparing these breakfasts, it's important to:

- Include a good source of protein to help maintain stable blood sugar levels
- Choose whole grains over refined grains for more fiber and nutrients
- Incorporate fruits and vegetables for vitamins, minerals, and antioxidants
- Add healthy fats from sources like nuts, seeds, or avocado

## Iron Absorption and Calcium

While it's true that calcium can affect iron absorption, the relationship between these two essential minerals is more nuanced than simply canceling each other out.

Calcium can inhibit the absorption of both heme and non-heme iron, but this effect is generally short-term and doesn't significantly impact overall iron status when consumed in normal dietary amounts. However, it's still wise to consider timing and food combinations to maximize iron absorption.

Recommendations for Food Preparation

Timing of Meals

1. Separate calcium-rich foods from iron-rich meals by a few hours when possible. **More iron-rich meals in the morning and afternoon for calcium-magnesium-rich meals.**

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2. Consume coffee and tea between meals rather than with iron-rich foods, as they contain polyphenols that can inhibit iron absorption.

### Enhancing Iron Absorption

1. **Pair iron-rich foods with vitamin C sources:** Add lemon juice to spinach salads or include orange slices with lentil dishes.
2. **Cook with cast iron:** This can increase the iron content of foods, especially acidic dishes.
3. **Include meat, fish, or poultry** in meals with plant-based iron sources to enhance absorption.

### Calcium Considerations

1. If taking supplements, consume calcium and iron supplements at different times of the day.
2. For dairy lovers, consider having milk or yogurt as a snack between meals rather than with main iron-rich meals.

### Balanced Approach

It's important to note that recent research suggests the impact of calcium on iron absorption may be less significant than previously thought:

1. A study found that consuming milk with meals or an equivalent amount of calcium from fortified foods did not decrease non-heme iron absorption.
2. Another study showed that calcium does not inhibit the absorption of 5 mg of non-heme iron.

### Practical Tips

- **Diverse diet:** Include a variety of iron-rich foods in your diet, such as lean red meat, poultry, fish, legumes, and leafy greens.

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- **Moderate calcium intake:** If consuming less than 50mg of calcium, it has little to no effect on iron absorption.
- **Vitamin C boost:** Incorporate vitamin C-rich foods like citrus fruits, bell peppers, or strawberries into iron-rich meals.