

(REVIEW ARTICLE)



A review on food-food interactions

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Magna Scientia Advanced Research and Reviews, 2023, 08(01), 123–127

Publication history: Received on 18 April 2023; revised on 03 June 2023; accepted on 06 June 2023

Article DOI: <https://doi.org/10.30574/msarr.2023.8.1.0072>

Abstract

Food-food interactions referred to as the dynamic and complex relationships between different food components when consumed together. Understanding these interactions is crucial for optimizing nutrient absorption, bioavailability, metabolism and overall health outcomes. This article provides a concise overview of the various aspects and implications of food-food interactions.

Keywords: Food-food interactions; Inhibition; Synergism; Health outcomes

1. Introduction

The effect of food on a person may be different than expected because that food interacts with another nutrient the person is taking, food, beverages, dietary supplements the person is consuming. A drug interaction is a situation in which a substance affects the activity of a drug, i.e., the effects are increased or decreased, or they produce a new effect that neither produces on its own. These interactions may occur out of accidental misuse or due to lack of knowledge about the active ingredients involved in the relevant substances. These interactions, known as food-food interactions, include a complex interplay of nutritional, physiological, chemical, and sensory factors. Understanding the dynamics of these interactions is vital for optimizing nutrient digestion, absorption, bioavailability, metabolism and overall health outcomes [1-2].

2. Types of interactions:

The different types of food interactions that can be encountered are:

- Complementary interactions
- Conflicting interactions
- Enhancing interactions
- Inhibitory interactions
- Synergistic interactions

2.1. Complementary interactions

When two or more meals are combined, they can improve the nutritional value of the meal by offering a balance of necessary nutrients or complementary ingredients. This form of food-food interaction is known as a complementary interaction. By supplying a balance of necessary nutrients or complimentary ingredients, complementary interactions can improve the nutritional content of the meal. Optimising nutrient intake and general health can be accomplished by consuming a variety of nutrient-rich meals and mixing them in various ways. [3]

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Following are a few instances of complimentary interactions in food:

- Legumes and Grains: Consuming grains like rice, quinoa, and barley along with legumes like beans, lentils, and chickpeas can offer a balanced intake of protein and important amino acids. While grains are high in methionine, legumes are high in lysine. Together, these meals can offer a full amount of protein and boost nutritional intake.
- Spinach and Lemon: Consuming spinach along with lemon can improve the body's ability to absorb iron. Iron is abundant in spinach, but it is present in a form that the body cannot readily absorb. Iron's bioavailability can be increased by converting it into a more soluble state with the aid of the vitamin C in lemons.
- Avocado with tomato: Lycopene, a carotenoid with antioxidant characteristics present in tomatoes, can be better absorbed when consumed with avocado. Lycopene's bioavailability and absorption can both be enhanced by avocado's beneficial lipids.
- Salad with Nuts and Seeds: Eating a salad with nuts and seeds can give you a good mix of protein, healthy fats, and minerals. Healthy fats, protein, fibre, and micronutrients like vitamin E, magnesium, and zinc are all abundant in nuts and seeds. A meal that is nutrient-dense and balanced can be made by eating them along with a variety of vegetables and leafy greens.
- Muesli with Berries: Including berries in your muesli can help you get the right amount of complex carbs, fibre, and antioxidants. Berries are a wonderful source of antioxidants like anthocyanins, while muesli is a good supply of complex carbs and fibre. Together, these can make for a well-rounded and nutrient-rich dinner.

2.2. Conflicting interactions

Some foods can conflict with each other and alter the body's ability to utilize a particular food or drug, or cause serious side effects. Contradictory interactions may prevent some nutrients or substances from being absorbed, used, or metabolically processed, which may result in nutrient shortages or other adverse health consequences. For nutrients to maximise their absorption and overall wellness, it is of the utmost importance to be conscious of these interactions and consume nutrient-rich foods as a component of a balanced and varied diet. For example, consuming milk and citrus fruits together can cause curdling and upset stomach due to the acidity in the fruits. [4] The following are a few examples of conflicting food interactions:

- Calcium and Iron: Consuming calcium-rich foods beside foods which contain iron can prevent the body from absorbing iron. For individuals who have low iron levels, calcium's ability to bind to iron and prevent absorption can be problematic. It is advised to consume foods that are rich in calcium and foods abundant in iron separately to optimise the absorption of both minerals.
- Coffee and Calcium: Consuming coffee in conjunction with foods high in calcium may hinder the body from properly absorbing the mineral. Caffeine can decrease calcium's absorption and increase calcium excretion in the urine. To maximise calcium absorption, it is advised to reduce coffee consumption and consume calcium-rich foods separately.
- Copper and zinc: Consuming copper- and zinc-rich foods simultaneously may hinder the body from absorption and utilisation of both of them. High intakes of zinc can prevent copper from being absorbed and cause a deficiency in copper, whereas high intakes of copper can prevent zinc from being absorbed and cause a deficiency in zinc. To optimise their absorption, it is advised to consume foods that contain copper and zinc in moderation and in a balanced diet.
- Alcohol and Nutrient Absorption: Drinking alcohol can prevent certain vitamins and minerals, including thiamine, folate, and vitamin B12, from being absorbed and utilised by the body. Alcohol can increase these nutrients' excretion in the urine and reduce their absorption in the small intestine. Nutrient deficits and general health problems might result from chronic alcohol use.
- Grapefruit with Medications: Consuming grapefruit or grapefruit juice with certain medications can alter their metabolism and elevate blood levels, which may cause unwanted consequences. Medications including statins, calcium channel blockers, and immunosuppressants can be metabolised by enzymes that are inhibited by compounds found in grapefruit. When using drugs, it is advised to either avoid grapefruit or grapefruit juice altogether.

2.3. Enhancing interactions

Enhancing interactions are a form of food-food interaction when the combination of two or more foods results in an increase in the bioavailability or potency of a specific nutrient or chemical. Enhancing interactions can increase the

potency or bioavailability of particular nutrients or chemicals and offer more health advantages. Optimising nutrient absorption and utilisation can be accomplished through consuming a variety of food that contain nutrients and incorporating them in different ways. [5] Here are some essential insights about enhancing interactions:

- Vitamin D and calcium: Combining calcium- and vitamin D-rich food may enhance both minerals' absorption and absorption. Together, calcium and vitamin D consumption can strengthen bones and reduce the possibility of osteoporosis since vitamin D improves the body's capacity to absorb calcium.
- Iron with vitamin C: Iron can be more effectively absorbed by the body if utilised together with foods that are rich in vitamin C. Iron that's found in plant-based meals, referred to as non-heme iron, is easier for the body to absorb with the help of vitamin C. Foods that contain vitamin C, such as citrus fruits or bell peppers, ought to be consumed together with foods rich in iron, such as spinach or lentils.
- Turmeric with Black Pepper: The bioavailability of curcumin, the active ingredient in turmeric, can be enhanced by combining turmeric with black pepper. Piperine, a substance found in black pepper, can enhance curcumin's absorption and enhance its anti-inflammatory and antioxidant benefits.
- Tomatoes with Olive Oil: Lycopene, a carotenoid with antioxidant characteristics present in tomatoes, might be better absorbed when consumed with olive oil. Healthy fats included in olive oil can enhance lycopene absorption and boost its bioavailability.
- Green Tea and Lemon: When green tea and lemon are combined, the catechins—a class of chemicals in green tea with antioxidant and anti-inflammatory properties—are more easily absorbed. Vitamin C, which can be found in lemons, can enhance the body's ability to absorb catechins.

2.4. Inhibitory interactions

Inhibitory food-food interactions refer to the interactions that occur between specific foods or food components, resulting in a reduction in the absorption, metabolism, or effectiveness of certain nutrients or bioactive compounds. These interactions can impact the overall nutritional value of a meal and affect the body's ability to utilize and benefit from the ingested nutrients. [6] Here are some important notes on inhibitory interactions:

- Antinutrients: Certain compounds found in food, such as phytates, oxalates, and tannins, can bind to minerals and inhibit the body from absorbing them. For instance, the phytates in seeds, nuts, and legumes can bind to and impede the absorption of minerals like iron, calcium, and zinc. Antinutrient concentrations can be lowered and mineral absorption improved by cooking, soaking, and sprouting.
- Protein inhibitors: certain foods include proteins that may hinder other proteins from being effectively metabolised and absorbed, such as the trypsin inhibitors found in soybeans and other legumes. The levels of protein inhibitors can be reduced and protein digestion enhanced through cooking, soaking, and fermenting.
- Food and drug interactions: Some foods and drugs can interact, reducing the effectiveness or absorption of the former. For instance, dairy products' calcium and magnesium might hinder the absorption of antibiotics like tetracycline and ciprofloxacin.
- Food intolerances and allergies: Consuming certain foods could lead to intolerances or allergies, which may hinder the body from absorbing and using nutrients. For instance, individuals with lactose intolerance may have difficulties with digestion and have having difficulty absorbing calcium and other nutrients from dairy products.
- Fibre interactions: Consuming a lot of fibre, particularly that derived from whole grains, could hinder certain nutrients, like iron and zinc, from being absorbed. However, ingesting fibre along with other foods can also delay the breakdown and absorption of carbs and increase feelings of satiety.
- Nutrient Binding: Certain foods contain compounds that can bind to nutrients to form complexes that are difficult for the body to absorb. For instance, the phytic acid in nuts, legumes, and whole grains can bind to minerals like calcium, iron, and zinc, preventing their absorption. Similar to oxalates, calcium can bind to oxalates in foods like spinach and rhubarb to create insoluble crystals, which inhibit calcium absorption.
- Enzyme Inhibition: Certain foods consist of natural substances that can hinder some digestive enzymes from activating effectively, inhibiting the absorption and digestion of nutrients. For example, the tannins in tea and coffee can prevent the action of digestive enzymes like amylase and protease, which will alter the manner in which carbohydrates and proteins are digested out.
- Competitive Absorption: In the gastrointestinal tract, specific nutrients use similar absorption pathways. They may compete for absorption when ingested in significant quantities combined, resulting in lower uptake of one

or more nutrients. One such is the rivalry for absorption between zinc and iron. Zinc absorption might be hampered by high dietary iron levels and vice versa.

2.5. Synergistic interactions

Synergistic food-food interactions are those between particular foods or food components that produce increased or amplified health benefits as compared to consuming the individual foods independently. The combined effect of the foods in these interactions is greater than the sum of each food's individual effects. It can be advantageous to promote general health and wellbeing to comprehend and take advantage of synergistic food-food interactions. Synergistic interactions can improve protein quality, increase antioxidant effects, improve flavour and texture, and support glycaemic regulation. [7-8] Here are some significant aspects regarding synergistic interactions:

- **Nutrient Enhancement:** Certain dietary combinations can improve the bioavailability and absorption certain nutrients. Consuming foods that contain vitamin C, such as citrus fruits, together with foods abundant in plant-based iron, such as spinach, can, for instance, improve the absorption of non-heme iron. Iron is more easily absorbed by the body when it undergoes transformation to a more absorbable form through the presence of vitamin C. The absorption of fat-soluble vitamins, such as vitamin D, can be improved by consuming foods high in healthy fats.
- **Antioxidant Synergy:** Certain meals contain substances with antioxidant capabilities that combine to offer increased defence against oxidative stress. For instance, pairing foods high in vitamin E, like nuts and seeds, with foods rich in vitamin C, like berries, might increase the meal's overall antioxidant capacity. Together, vitamins E and C help other nutrients thrive, enhancing their antioxidant properties.
- **Phytochemical Interactions:** Phytochemicals, such as polyphenols and carotenoids, are found in many foods and have an array of health benefits. These phytochemicals can interact synergistically when ingested together, boosting their unique benefits. For instance, eating tomatoes with olive oil improves the bioavailability of the carotenoid lycopene, which is more readily absorbed when there is dietary fat present.
- **Protein Complementation:** By combining several plant-based sources of protein, a full protein profile that includes all necessary amino acids can be produced. For instance, combining legumes with grains or seeds can result in a more well-balanced amino acid profile, guaranteeing an adequate intake of protein.
- **Glycemic control:** Consuming a combination of nutrients that have different glycemic index values can help regulate blood sugar levels and promote satiety. Consuming carbohydrates along with fibre, good fats, or protein, for instance, might delay the digestion and absorption of carbohydrates and provide an enduring source of energy.

3. Conclusion

In conclusion, food-food interactions encompass a wide range of effects on nutrient absorption, glycaemic response, bioactive properties, and sensory experiences. Recognizing and harnessing these interactions can contribute to improved dietary choices, nutrient utilization, and overall well-being. Further research is necessary to unravel the intricate mechanisms and implications of food-food interactions, enabling evidence-based recommendations for optimal nutrition and overall well-being.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest.

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