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## REVIEW ON CLINICAL EVIDENCES OF FOOD-FOOD INTERACTION: MECHANISM AND SAFETY

Yogesh Chand Yadav<sup>1</sup>, Shashi Dhar Mehta<sup>2</sup>, Chirag Gupta<sup>3</sup>, Amisha Gupta<sup>4</sup>

<sup>1</sup> Associate Professor, Faculty of Pharmacy, UP University of Medical Sciences, Saifai, Etawah UP, India. <sup>2</sup> Department of Pathology, Clinical Research Centre, Vallabhbhai Patel Chest Institute, University of Delhi, Delhi -110007. <sup>3</sup> Msc first Year student, Department of Organic Chemistry, Aligarh Muslim University, Aligarh UP, India. <sup>4</sup> B. Pharm, Pharmacy College Saifai, UP University of medical sciences, Saifai, Etawah UP, India. \*Corresponding author: Yogesh Chand Yadav, Uttar Pradesh University of Medical Sciences, Saifai, Etawah, 206130, Uttar Pradesh, India

### ABSTRACT:

**Background:** Some foods by nature are very beneficial and health promoting when consumed alone but become antagonistic when taken along with other foods. So the ayurveda's perception of not eating improper food combinations prevents us from various diseases and may enhance our life.

**Objective:** Present review is an attempt to illustrate clinical reports of food - food interactions.

**Methods:** Through the search engine "Scopus", literature on recent advances in food and food interactions includes harmful or new effect on human health.

**Results:** Many clinical evidences that have been conducted by various researchers affirm significant food - food interactions across the various food varieties. It has well documented the combined effects of food, milk products, fruit and vegetables, liquid; oil produced various diseases like skin Diseases, indigestion, hepatic diseases, renal diseases etc. The clinical studies on food and food interactions report various harmful effect on body.

**Conclusion:** It is very important to understand the laws of food combinations and to decide proper amalgam of food to prevent the harmful effects of unhealthy food combinations.

**Keywords:** Clinical evidences, foods, interaction

### 1.0 INTRODUCTION

Food-Food interaction is a situation in which one food affects the activity of another i.e. effects are increased or decreased, may be beneficial or harmful or they may produce a new effect that neither produces on its own.

Some foods by nature are very beneficial and health promoting when consumed alone but become antagonistic when taken along with other foods or when taken in a particular season, at a particular time or cooked in a particular container. Some food combinations instead of benefitting health harm the body and become the cause of several diseases. Sometimes, according to you, you may be eating best foods but due to wrong amalgam these become harmful for us rather than beneficial. Hence it is desirable that one must understand the laws of food combination and their scientific basis. When foods having different energy, taste, potency, post digestive effects are combined, *agni* can become overcharge, destroy the enzyme system and resulting in improper digestion i.e. *ama* and also the production of toxins. On the other hand when these foods if eaten separately or in another compatible combination might well stimulate *agni* and even digested well in the enzymatic environment (1).

Eating vegetables, fruits, pickle, curd, sweets, kheer, papad, at a time, chemical reactions start in our body and our digestive system become disturbed. One food at a time is good for our digestive system. In fact, mixture of different foods is not good for our health unless the food

combinations are compatible and foods are of same nature and require same type of digestive environment. The lesser the mixture of food we take, the easier the way our body digest it. Some mixture of foods become poisonous when taken together e.g. mixture of honey and ghee in same amount etc. Food combinations are health conscious approach of eating unless they are compatible with each other. Many weird food combinations may disturb our digestive system and become the cause of most of diseases like hypertension, stomach upset, diabetes, high cholesterol level, obesity, gas, nausea, fatigue, bloating, etc. Everyone has a different body and will experience various levels of sensitivity to incompatible food combinations (2). Unsuitable or incompatible food combinations may be of various kinds like unfavourable in a particular area, unfavourable in particular weather, unsuitable according to person's digestive strength, unfavourable when consumed in a large quantity, unfavourable as person's habit, unsuitable according to cooking tradition i.e., vessels of different metals, unsuitable potency of the food and fruits, unfavourable as per routine and time, sometimes better say many times unsuitable combination of food also play a major role in disturbing person's digestion and creates health related problems (3).

The food we eat must have a proper combination of energies and tastes and effect on our digestive system and the whole body positively. Food combinations with different energetics produce negative effects on our body.

So the ayurveda's perception of not eating improper food combinations prevents us from various diseases and may enhance our life (4).

## **2.0 FOOD COMBINATIONS:**

Food combinations are of two types- Incompatible (unhealthy or harmful) and Compatible (healthy or beneficial).

### **2.1 Incompatible Food Combinations:**

Combining incompatible foods generate *ama*, a toxic substance that is often the root cause of imbalance and diseases. The incompatible foods are poisonous or harmful and can cause either immediate action or will act in future i.e. delayed reactions (5). In Astang Sangrah (Sutra sthanam), chapter 9, deals with incompatible food combinations. For those who would like to know and understand more about the reason how and why these combinations harm our body. Here are some food combinations that one must avoid from their meals:

#### **Milk with salt**

Milk has long been seen as a healthy drink, it is one of the primary sources of nutrition. It is considered as vital source of calcium and vitamin D also contain carbohydrates, protein, omega etc. But it is not advisable to eat milk with salt because milk contains calcium caseinate and protein. When eaten with salt, salt slow down milk's curdling, emulsification and metabolism in stomach. As sodium salt interfere with the calcium ions of calcium caseinate and form calcium chloride (5).

#### **Honey in boiling water**

Honey is an extremely powerful medicine as antibacterial, antioxidant, antiviral etc. According to Maharishi Ayurveda, one should never add honey to boiling water, while warm water is fine. Above 42°C, the all-important 'Medicinal' molecular structure of honey is changed irreversibly, making it indigestible (in a sense ....toxic). So if you are adding honey as sweetener to hot lemon drink or tea, that's fine, but just wait until the water/tea has cooled somewhat. Water for honey should be nicely warm rather than boiling hot (6).

#### **Milk with water-melon**

Milk and melons should not be eaten together. Both are cooling, but melon is diuretic and milk is laxative. As compared with melons milk requires more time for digestion. Moreover the stomach acid required to digest melon causes milk to curdle, this may cause some discomfort and lead to production of more gas than usual. So Ayurveda advises against taking milk with water-melons (1).

#### **Carbohydrates and citrus acids**

Carbohydrates like corn, rice, pasta, wheat, barley, etc. with acids like orange, fruits, tomatoes, etc. are incompatible food combinations because acid damage the enzyme that digest starch. It because digestive problems like bloating, flatulence, distress, nausea, stomach upset, abdominal cramps, etc.

#### **Spinach with sesame seeds**

As per Ayurveda, this combination is disastrous. These when taken together cause severe diarrhea. Spinach contain high amount of oxalic acid, oxalic acid binds with

iron and calcium ions and cause body to absorb less of these important nutrients (7)

#### **Fish with milk**

This combination is harmful. Fish and milk both have sweet taste, but differ in potency, i.e. fish have hot potency while milk has cold potency. Both when eaten together, impair the quality and efficacy of blood and obstruct the channels of circulation. This incompatible combination may also cause white patchy skin or pigmentation on skin (8).

#### **Tea/coffee immediately after meal**

People have tea/coffee with milk after their meal, this combination cause improper digestion of food. It is essential to allow the meal to get digested first before taking any beverage. If one drinks tea/coffee immediately after meal, it causes gas formation, more than normal, in stomach which causes problems in digestion of meal (9).

#### **Starch with protein**

Starch containing foods like potato, corn, breads, muffins, beans etc. and protein containing foods like cereals, cheese, seafood, eggs, etc. should not be taken together. All starches are digested in an alkaline medium while proteins are digested in acidic medium. When we take starches and proteins together, a lot of HCl is produced in stomach to digest the proteins but the digestion of starch comes to an abrupt halt. Undigested starch are then found in stool (10).

#### **Sweets after meal**

It is not a healthy habit to eat sweets just after having meal, as it will not only add to your overall sugar intake but it affects your health in the long run. It increases your risk of obesity and other health related conditions.

Eating sweets after meal will spike your blood glucose level. This sudden spike in blood glucose level, lowers immunity and also increase the risk of suffering from many life style diseases such as diabetes, obesity, kidney diseases, heart diseases (11).

#### **Liquids with solids**

This is saying that, "no liquid should be taken with solids". When liquids and solids are consumed together, liquid pass easily and immediately into intestine which takes away all the digestive enzymes of stomach secretion. Thus, this inhibits the digestion of solids. So, according to ayurveda liquids should be consumed at least 20 minutes before taking meal and never immediately after or along with food (12).

#### **Green or Black tea with milk**

Proteins in milk called catechins present in green or black tea, and reduce the amount of catechins, therefore the beneficial effects of catechins i.e., prevention from risk of heart diseases, disease fighting capacity of catechins and their antioxidant nature, are reduced. So one must avoid green tea or black tea with milk (13).

#### **Banana and milk**

Both of them are challenging to digest together because of different qualities. Milk is a cold substance while banana is a hot substance. On the other hand, banana become sour when break down, so for this our digestive environment has to process a sour substance and milk at the same time (same as when lemon is squeezed in milk). Due to this incompatible combination the balance of digestive fire and intestinal flora disrupt, which results congestion, cold,

cough, allergies, hives and rashes and also the production of toxins (14).

#### **Cheese and night shades**

Solanaceae family members are commonly called as 'night shades', includes potatoes, bell peppers, cayenne pepper, tomatoes, egg plants, tobacco, paprika, datura, belladonna, etc. These contain alkaloids that may be toxic, to humans if taken in large concentrations (15). These alkaloids, complex compounds once digested lead to a cascade of chemical reactions in body i.e., they are difficult to digest, and when these mix with cheese which is itself very heavy, oily, also difficult to digest which may leads to indigestion.

#### **Meals with fruit salad**

Fruits contain simple sugars that require small digestion time. When these are combined with complex substances like grains, meat or other components of proper meal, fruits along with the meal components, stay in stomach for too long and begin to ferment. This can damage intestinal lining and cause other digestive issues (16).

#### **Honey with Ghee**

Honey is complex polysaccharide which requires enzymes like amylase for its break down into simpler sugar. While ghee, on the other hand, is a fatty acid, also complex in nature requires emulsification and action of lipase and some other lipid bio-transforming enzymes which convert it into simple metabolites.

When these carbohydrates breaking and lipid breaking enzymes interact with one another within GI tract leads to indigestion and cause accumulation of free radicals within the GI tract which may be a cause of many diseases including cancer. The ancient ayurvedic books have already against an equal amount of ghee and honey in diet (17).

#### **Cheese with Egg**

Both are dense proteins and takes a long time for their digestion. It leads to the feeling of heaviness and sedation (Drowsiness). The diet with these 2 heavy ingredients should not consume unless one should also be working out accordingly i.e., consuming a large amount of calories, otherwise, two heavy food need to be avoided in diet (18).

### **2.2 Compatible Food Combinations**

According to ayurveda, every food has its own taste (rasa), a heating and cooling energy (virya) and post digestive effect (vipaka). So it is important to combine similar food substances in meal to avoid many physical and mental problems like diarrhea, excess intestinal gas, constipation, digestive fermentation, lethargy, sleep disturbances, anxiety, confused mind, depression- ultimately a decrease in function of entire physiology (2). Here are some combinations that one must include in diet to avoid the above problems and to synergize the effect of meal.

#### **Dates with Milk**

Eating dates with milk is a healthy food combination that benefits the human body. Dates are rich in iron and are suitable for all ages. It increases body activity and energy; strengthen bones, helps in healthy growth of body and cells. Milk with dates contains natural anti-oxidants and high rate of magnesium, phosphorous and calcium, thus it is complete prevention of cancer. It reduces anemia and nerve disorders. It is also highly recommended to patients having typhoid, to flush out bacteria from the body (19).

#### **Dahi with amla powder**

This combination helps to boost immunity and it is also good for health (2).

#### **Banana with lime and cardamom**

Bananas are heavier and harder to digest. On adding two natural digestive aids, banana become lighter and easy to digest.

Cardamom also added a delicious flavor to the banana smoothie. Cardamom's aromatic perfume, open the body pores encouraging to sweat, body's natural way of keeping cool (20)

#### **Green Tea and Citrus fruits**

Green tea have various antioxidant catechins when given along citrus fruits, their vitamin C preserve green tea's catechins and help them to survive throughout the journey of your digestive tract to where your body can absorb them and can produce their effects like lower the risk of infection prevention from various forms of cancer, heart health, boosting immunity, etc. (21).

#### **Spinach with tomato soup**

Spinach is the major source of iron (for those who are veggies). Iron is not absorbed easily from the plant source, so it is essential to eat this plant with a source of vitamin C like lemon, tomato, orange, amla, etc. These sources provide the kick of vitamin C to absorb the iron of spinach and other green vegetables. And iron in body is useful for the formation of haemoglobin and prevent us from anemia (22).

#### **Egg and Milk**

Milk is the major source of calcium, essential for bone health and egg is source of vitamin D. It is hard for body to absorb calcium alone. When it is combined with vitamin D, its absorption increases many times and this is beneficial for the body especially for bones and teeth (23).

#### **Fish and Broccoli**

Sulforaphane is present in vegetables of cabbage family like broccoli, brussels sprouts and cabbage. Sulforaphane slow down the growth of cancerous cells. When it is combined with selenium present in fish, the effect of sulforaphane is 10 times greater which rebuilds in prevention from various concerns (22).

#### **Chicken and carrots**

Our body transforms  $\beta$ -carotene (precursor of vitamin A) into vitamin A (Retinol) efficiently, if it is accompanied by zinc. Vitamin A is good for skin, eyes and immune system. So, eating carrots, source of  $\beta$ -carotene, with chicken, source of zinc, will help transformation of  $\beta$ -carotene into vitamin A efficiently (22).

#### **Pulses and Rice**

Protein are made up of 20 different amino acids, among them 5 are essential while others are non-essential. These 5 are distributed in various plants unevenly. Lentils and other legumes are high in lysine- the amino acid which is missing in rice. Rice and other grains are rich in sulphur based amino acids missing from legumes. Any combination of approximately 80% rice to 20% dal has all the necessary nutrients, making a complete protein diet (24).

#### **Olive oil and tomatoes**

Tomatoes contain lycopene, an antioxidant. The body has trouble in absorbing this antioxidant if the tomato is raw.

Cooking the tomatoes with olive oil, results in maximum absorption of lycopene. Lycopene is powerful antioxidant prevent heart disease and also prevent certain types of cancers like prostate, breast, lung and bladder (22).

#### **Tomatoes and broccoli**

A study by the University of Illinois, USA, found that this food combination is very effective in slowing in the growth of prostate tumors, than when either of it is consumed separately. Tomatoes are rich in vitamin A, vitamin C, lycopene, when combined with broccoli which has phytochemical,  $\beta$ - carotene, isothiocyanates and indoles help in fighting cancer cells and improving immunity (25).

#### **Dark Chocolate and apple**

Quercetin (anti-inflammatory compound) rich apple when combined with flavonoid rich dark chocolate, the antioxidant heavy duo reduces risk of heart diseases and helps prevent blood clots (26).

### **3.0 Effect of timing of food intake on human health**

Sometimes the time at which we take food also affects the health of an individual. Different times are ideal for different foods for different body constitutions (7). Like-Foods that are hard to digest should be eaten in noon when digestive power is high. *Vata* aggravating diets should be avoided after physical activities. *Kapha* aggravating diets should be avoided in morning.

Here are some food items with their best and worst eating time-

#### **Rice**

Best time to eat rice is in lunch. As the metabolism during the day is higher, giving you a complete chance to use up the carbohydrates. Taking the rice during dinner only increases the body fat.

#### **Banana**

Banana is highly fibrous, so it is recommended to consume it at noon, as it helps in digestion. Moreover, banana works as a natural antacid and soothe heart burn.

While eating banana at night leads to mucus formation and cold. Eating banana on an empty stomach can upset the stomach since it's a good source of Magnesium.

#### **Sugar**

Insulin, present in our body, is more effective in fighting sugar in the morning. The best time to take sugar is in morning, as the body is active throughout the day in daily activities.

At night, sugar will not only increase your body fat, but also send your digestive system into a fizzy, leading to uncomfortable sleep.

#### **Apple**

Apple peel contains the fibre pectin that helps in bowel movement and prevents constipation. Moreover, it also eliminates carcinogens when consumed in morning. The organic acids of apple will increase the acid level in stomach leading to discomfort at night.

#### **Curd**

The best time to eat curd is in day time, as it helps in digestion and soothes the digestive system. Eating at night will leads to mucus formation and could be the cause of cold.

If you are eating it during day, have it without sugar, but while eating at night, have it with sugar or black pepper, it will assist in digestion and calm your digestive system.

### **Pulses and Beans**

Pulses are rich in fiber content; Lentils and beans help in digestion and reduces cholesterol level. Moreover, they have been proven to assist in good sleep, therefore, they works best when consumed during lunch time.

#### **Cheese**

Cheese is an excellent substitute for meat for vegetarians. If taken early morning, can prevent weight gain and bloating. It leads to fat accumulation and indigestion while eating at night, as it is heavy.

#### **Meat**

Meat is highly rich in protein, while consuming at time it leads to indigestion and fat accumulation. It helps in gaining physical strength and improves concentration level, if consumed during the day time.

#### **Walnuts**

Walnuts are rich in beneficial compounds such as omega-3 fatty acid and antioxidants, so it recommended consuming in evening. It also helps in improving brain health.

#### **Milk**

Milk should be consumed at night, as warm milk soothes the body and helps in getting good sleep. Milk is heavy to digest and mess with the meal timings when consumed during the day.

#### **Guava**

It helps in improving digestion process and also relieves constipation, when consumed after the lunch along with rock salt.

### **Conclusion**

Finally, it is concluded that 'food combining diets which is have different digest rates in the body and require different digestive environments. Therefore, the food needs to be eaten in compatible combination and at particular time that compliment these factors.

The proposed benefits of food combining or eating foods that combine together efficiently is that it will assist digestion so that your digestive tract does not have to work as hard to absorb the nutrients from meal that your body requires for energy, as well as alleviating any symptoms associated with poor digestion such as gas, bloating, constipation, diarrhea, reflux and fatigue.

Many people have also reported weight loss, clear glowing skin, improper digestion, fatigue, diarrhoea, bloating etc. by eating incompatible food combinations. So it is advisable in Ayurveda that one must take meal with a proper food combination to increase your life.

Each macronutrients digests at a different speed, also require release of different digestive enzymes and juices for their digestion, therefore it is advisable in food combining rules that one must eat foods of same potency or nature at a time.

If you eat foods that have opposite digestive requirements in combination they are considered at incompatible food combinations and can result in intestinal "traffic jam". Unhealthy food combinations can also "confuse" the body, by demanding many types of digestive environments at one time. This may slows down your digestion and cause various digestive issues.

**"The best diet we can eat combines a wide variety of nutritious foods from all the food groups, and there's**

## no reason why we shouldn't enjoy foods together in the same sitting” -Jemma O'Hanlon

One major flaw with the food combining diet is that digestion doesn't happen only in the stomach -- it's much more complex than this diet proclaims and actually begins in the mouth. Other big error with this food combining way of thinking is that in our bodies, digestion is a process. Hence why we have a digestive tract, not a digestive sack where everything is dumped and expected to undergo all processes of digestion.

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