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*RESEARCH ARTICLE*

# CHEMISTRY OF COLD DRINKS/ SOFT DRINKS.

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## *Abstract*

Cold drinks have become a necessary part of our daily lives, No meal is considered complete without these fizzy drinks. A few reported incidence of negative aspects of these drinks have raised concerns regarding the toxicity and hence the chemistry. The purpose of this article is to describe the composition of cold drinks, the purpose of their use and their potential effect on health.



## Introduction:-

We all love to have a sip of our favorite soft drinks (aka cold drinks, carbonated water or just soda water) when we are thirsty, especially in summers. And we also love to have a little fizz in it. This fizz is the bubbly effervescence that is produced by adding pressurized carbon dioxide gas to water. The aim of this article is to highlight the composition of cold drinks, the purpose of uses of its ingredients and their impact on human health and the chemistry behind these effects.

Joseph Priestley was the first person to invent soda water. He suspended a bowl of water over a beer vat in a brewery and patiently waited to see what happened. Soon the bowl of water was fizzing with carbon dioxide released from the fermentation of beer. And that was how soda water was born. However, it was only in the later part of the $19^{th}$ century that soda water was introduced as a popular soft drink. Today, soda water is made by sending pressurized carbon dioxide through water. The high pressure allows more carbon dioxide to dissolve than it would normally be possible. The soda is then packed into an airtight bottle. When this pressurized bottle is opened, the gas rises to the top bubbling. And if you shake the bottle before opening, the soda will spill out splashing all over, when opened.

The era of cold drinks/soft drinks began in early 1950s but as this industry was quite luring as well as profitable, many multinational companies launched their products in different flavours with various brand names such as Sprite, 7up, Pepsi, Coka cola, Mountain Dew, Fanta, Miranda, etc. People take these drinks according to their temperaments and moods, e.g. it is generally believed that Miranda, Fanta and especially Sprite give a feeling of lightness where as Pepsi & Coka Cola activate pulse and brain.

Often a distinction is made between a soft drinks and a cold drink. A soft drink is a non-alcoholic drink which may or may not include fizzy drinks. Examples of such drinks include lemonade or fruit juices. Whereas, the cold drinks (pepsi, Miranda, Fanta, spirite, etc) are majorly composed of alcohol, carbohydrates, carbon dioxide, phosphate ions, sodium benzoate, acesulfame potassium (Ace-K) and caffeine. These ingredients are responsible for the feeling of

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warmth, lightness and tangy taste which is liked by everyone. But unfortunately, these soft / cold drinks not only provide taste and a little energy but also cause some severe effect on our health which most probably we forget when we take such drinks. It has becomes a big dilemma of our society that we grew up on such diets which has high consumption of soft drinks and its worse tragedy that we are a nation/ people who are becoming addicted to soft drinks day by day.

**Chemical ingredients present in soft drinks:-**
Let's talk about the little chemistry of the cold drinks. But before describing the chemistry of ingredients, it is essential to know about the term called "pH".

**The pH, pH-scale & body health:-**
The acidity of any substance is measured by means of a pH scale which ranges from 0-14. A lower pH value means high acidity; a higher pH values suggests an alkaline solution whilst a value of 7.0 indicates a neutral solution. The pH has quite a defining effect on the health of any individual. In humans, a normal pH-level of all tissues fluids of the body (except the stomach) is slightly alkaline. Blood is one of the fluid systems that are constantly trying to maintain a pH level of 7.4 (slightly alkaline). Being slightly alkaline means the blood cells and body tissues are highly oxygenated, and in optimal state to neutralize and detoxify the metabolic waste and toxins and you will be in a state of:

1. Vibrant healthy body
2. Enhanced immunity
3. High energy level
4. Sharp mind & brain performance
5. Shining & healthy looking skin
6. Positive emotional state

The body makes constant adjustments in tissue fluids' pH to maintain this very narrow pH range in the blood. All other organs and body fluids will fluctuate in their range in order to keep the blood at a strict pH range (between 7.35 and 7.45 i.e., slightly alkaline). This process is called ***homeostasis***.[1] The pH balanceisoneofthe initial and mostimportantmeasurestoavoiddiseaseand to ensure astrongfunctioningimmunesystem.The pH-balance or Yin-Yang balance (in terms of Traditional Chinese Medicine) of the body is critical to optimal health. It is said that *Taoists, Qigong masters and Yogis all live a balanced, harmonized and* ***alkaline*** *life*. Forexample the blood pH of cancer patients is always acidic (withoutexemption) either due to eating the wrongfoodandhavingemotionalstressorotherstress related issues. In an alkaline cell-environment cancer cells can't live or grow. The immune system will boost up and is able to fight viruses, infections, bacteria and parasites better and stronger. The instance of ZamZam is worth mentioning here. The ZamZam well is located at Masjid Al-Haram in Mecca, Saudi Arabia. The ZamZam water (considered to be the miraculously generated water by God) was once believed to the cure of almost all diseases and the same has been proven now. To our surprise, this sacred and health restoring water has a surprisingly alkaline pH (which is 7.9-8.0).

It has been observed that high intake of coffee, white bread, Cola, soft drinks, beer, meat, nuts, eggs, vinegar, ascorbic acid, cheese, white sugar and medicines causes a significant decrease in blood pH which has been found to be associated with many diseases including the so far incurable cancer. Also the factors such as overwork, anger, fear, jealousy and physical/emotional stresses causes an acidic blood pH. On the other hand, the food items such as ripe fruits, vegetables, bean sprouts, water, milk, onions, figs, carrots, beets, etc causes an alkaline blood pH and therefore promote better health.

There are many chemical ingredients involved in the soft drink composition depending upon their brands however, the ingredients that form the essential part of all cold/soft drinks are discussed here.

**Water:-**
First of the entire basic ingredient, water, is mostly taken from a safe source like municipal supply. Water is usually processed before use in order to remove some organism and plankon by superchlorination and coagulation processes. In this process water is treated with large amount of chlorine. Afterwards, it passes through a sand filter and activated carbon.

**Carbon dioxide:-**
Carbon dioxide, added to the cold drinks for the fizziness /formation of froth upon shaking the bottle. The process of adding $CO_2$ into water is called ***carbonation***. When carbon dioxide combines with water, it forms a new chemical called the carbonic acid. This carbonic acid is actually responsible for the tangy taste of soda water drinks and it is also one of the chemicals responsible for the acidic pH of these drinks.

**Phosphoric acid:-**
The phosphate ions are present in the cold/soft drinks in the form of phosphoric acid ($H_3PO_4$) which is quite a strong acid (pH = 2.8). This is used because $H_3PO_4$ creates an acid medium that enhances the absorption of carbon dioxide (which is also forms carbonic acid in water), thus reducing the pressure required and allowing the mixture to be bottled with a metal cap. The carbon dioxide bubbles are released more slowly, particularly if the mixture is chilled. The sour taste of the phosphoric acid is complemented by adding lots of sugar.

**Biological effects of $H_3PO_4$:-**
$H_3PO_4$ has the ability to dissolve a nail in just about 4 days. Furthermore, it can damage our teeth enamel and causes cavities and other dental problems. The phosphoric acid in soda water hits your lower intestine and binds with magnesium, zinc and calcium. Instead of those minerals reaching your bones, you pass them out of your system when you urinate, leaving your body depleted with these metal.[2] Regular soda contain high levels of $H_3PO_4$, so switching to the "healthier" variety of soda isn't healthier after all.

**Acesulfame Potassium (Ace-K):-**
Acesulfame Potassium (Ace-K) is a derivative of acetoacetic acid and was approved for use by the FDA as a safe artificial sweetener in July, l988.

**Biological effects of Ace-K**:-
Unfortunately, several potential problems associated with the use of Ace-K have been raised. They are based largely on animal studies since testing on humans remains limited. The findings showed the following:

1. Ace-K stimulates insulin secretion in a dose dependent fashion thereby possibly aggravating reactive hypoglycemia ("low blood sugar attacks").[3]
2. Apparently produced lung tumors, breast tumors, rare types of tumors of other organs (such as the thymus gland), several forms of leukemia and chronic respiratory disease in several rodent studies, even when less than maximum doses were given.

**Sodium benzoate:-**
Sodium benzoate is added in cold drinks because of its ability to keep soft drinks fresh and prevent harmful bacteria from growing. It's suspected that sodium benzoate, in addition to artificial food color, may increase hyperactivity in some children. Sodium benzoate in soft drinks may also react with added vitamin C to make benzene, a cancer-causing substance.[4]

**Caffeine:-**
Caffeine is an addictive stimulant found in coffee, tea, colas, cocoa and chocolate. It is also in some prescribed and over-the-counter drugs. Caffeine drives the adrenal glands to produce stress hormones like cortisol and adrenaline. While some people feel comfortably alert and awake as a result, others are sensitive to this adrenaline rush and experience the flight-or-fight response: fast pulse, rapid heartbeat, quick breathing and muscle tension. These physiological responses typify anxiety states. The affected person feels shaky, nervous, irritable, anxious, restless and can experience insomnia.

After consumption of caffeinated foods, a few people may experience sneezing, an itchy mouth, hoarseness, difficulty breathing, hives, swollen throat/tongue/lips/face, difficulty swallowing, eczema, fainting, heart palpitations, pain in the chest or hyperventilation. Caffeine destabilizes our nervous system in other ways. As diuretic caffeine speeds elimination of many minerals and vitamins, such as potassium, zinc, magnesium, calcium, vitamin C and the B vitamins (especially the anti-stress vitamin B1). This can lead to deficiencies, which increase anxiety, panic, mood swings and fatigue. The problem is compounded as caffeine causes blood sugar to rise in the first hour after consumption, creating an initial buzz, and then drops to subnormal levels, causing an energy crash. The overtake of caffeine is associated with many psychological dysfunctions such as psychosis.[5]

**Miscellaneous ingredients:-**

Some other food ingredients like Carbohydrates and sugars /artificial flavors are also added to the add taste or energy to the drink. Carbohydrates are added as an energy source while a regular soda contains up to 11 teaspoons of sugar per can. The sugar causes your blood sugar to spike, which results in a release of insulin. All cold drinks/soft drinks have significant amount of sugar and therefore, are responsible for type-II diabetes. In past mostly drinks contain aspartame (an artificial low-calorie sweetener) as an additive but now it is banned by Food and Drug Administration (FDA) because it causes migraines, dizziness and more over it reduce memory. In addition to this, these drinks cause weight gain as they interfere with body's natural ability to suppress the feeling of hunger. Acidified body, mineral imbalance and physical weakness caused by poor diet and soft drinks, stress and toxic environment are very common among present generations. Quite recently, a research has pointed out that soft/cold drinks especially those with caramel coloration contain a carcinogenic (cancer causative) agent known as 4-methylimidazole, or 4-MEI.[6] The only reason for adding 4-MEI is to impart brownish color to such drinks and it has no other role.

Almost everyone knows that soda isn't a healthful drink, but you might not realize how much it can damage your health. Evidence backs up the detriments of this fizzy drink, and once you understand what it does to your bones, you might never look at soda the same way again. It is important to point out here the corrosive properties of these drinks which can be easily understood from the fact that for transportation of these drinks, the commercial trucks are bound to bear the label of "hazardous material". These drinks have been found to cause damage to blood cells. In addition to their use as entertainment drugs, these soda drinks can be used as drain openers/cleaners, for removing rust, corrosion from metal surfaces and can be used as detergents to remove grease from clothes. Cola drinks can cause constipation, calcium loss, hypertension, nausea, vomiting, headaches, and kidney damage by interaction with antacids.

## Conclusion:-

Instead of drinking soda, quench your thirst with something that supplies calcium instead of taking it away. For example, a water supply with a small amount of added calcium hydrates your body and is the healthiest thing you can drink. Milk is another excellent option to nourish your body and provide a bit of calcium. Unsweetened tea and black coffee, provided you drink them in moderation, can also stand in as healthier alternatives to soda.

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