

**INTERNATIONAL JOURNAL OF ADVANCES IN PHARMACY,  
BIOLOGY AND CHEMISTRY****Review Article****Toxic Level of Soft Drinks and Sports Drink on  
Health Status****Sanjita Das and Sunita Singh Rajput\***Department of Pharmacology, Noida Institute of Engineering and Technology, Greater Noida,  
Uttar Pradesh, India.**ABSTRACT**

The study was taken into consideration to estimate and compare the toxic levels of soft and sports drinks on health. Previous investigation reflects the toxic level of these two important drinks. This study established the toxic level of soft and sport drinks and will be helpful to aware the public about the hazardous effect of these drinks.

**Keywords:** Sports drinks, Soft drinks, Toxicity.

**INTRODUCTION**

A soft drinks (also called soda, pop, fizzy drink, tonic, mineral or carbonated beverage) (Voux et al., 2011) is a beverage that typically contains water (often, but not always carbonated water), a sweetener, and a flavoring agent. The sweetener may be sugar, high-fructose corn syrup, or a sugar substitute (in the case of diet drinks). A soft drink may also contain caffeine, fruit juice, or both. A sports drink beverage is designed to help athletes to rehydrate when fluids are depleted after training or competition. Electrolyte replacement promotes proper rehydration, which is important in delaying the onset of fatigue during exercise. As the primary fuel utilized by exercising muscle, carbohydrates are important in maintaining exercise and sport performance. An effect of drinking sports drinks with carbohydrates without prolonged exercise is weight gain (Deborah Cohen., 2012).

Sports drinks can be split into three major types:

1. Isotonic sport drinks contain similar concentrations of salt and sugar as in the human body.
2. Hypertonic sport drinks contain a higher concentration of salt and sugar than the human body.
3. Hypotonic sport drinks contain a lower concentration of salt and sugar than the human body.

**Purpose and effectiveness of sports drinks**

Athletes actively training and competing, lose water and electrolytes by sweating, and expend energy. An appropriate drink can replenish

these, with water (for fluid recovery), carbohydrates (sugars to replenish glycogen—energy—stores) and electrolytes (which speed rehydration). Sodium in drinks can help to avoid hyponatraemia (low sodium) after sustaining athletic activity for more than four hours; a sports drink containing sodium is appropriate for recovery from intense and prolonged training or competition (Sara Cogan., 2013)

**Toxicity of additives in the soft drinks**

Carbonated (and some non-carbonated) soft drinks contain a multitude of harmful substances, any one of which should be enough to convince anyone to stop drinking them. Beyond the fact that they have no nutritional value whatsoever, these drinks can lead to long-term medical problems, increased health care costs for society, and a variety of social problems, not the least of which is the "pushing" of these harmful substances unto children in public schools, in exchange for making up for budget shortfalls.

**1. Bisphenol A or BPA**

A known hormone disruptor, bisphenol A, a chemical used to line soda cans for the sake of preservation, has been linked to a number of public health and medical problems, including a negative effect on fetuses and the proper development of children.

**2. Phosphoric acid**

Among other things, phosphoric acid interferes with the body's ability to use calcium, possibly

leading to osteoporosis (weakening of teeth), and works to neutralize hydrochloric acid in the stomach, thus interfering with the proper digestion of nutrients in food.

### 3. Caffeine

Caffeine in carbonated drink is more readily absorbed than any other drink (like coffee, chocolate etc.). Caffeine disturbs sleep by stimulating nervous system. It also makes premenstrual syndrome worse, causes dehydration and induces stomach to produce acids, aggravating hyperacidity. Since caffeine disturbs sleep, the body is more likely to produce C - reactive protein, which plays an important role in heart disease. Caffeine has been linked to birth defects, some forms of cancer, insomnia, irregular heartbeat, high blood pressure, high cholesterol, breast lumps, and depletion of some nutrients.

### 4. Harmful sweeteners

Whether it is high fructose corn syrup or unnecessarily-high amounts of sucrose, carbonated sodas provide more calories than are generally needed by the average drinker. All this sugar can cause people to gain weight, to develop a high number of cavities, and, in the case of people with ADD or ADHD, to exhibit out-of-control behavior.

### 5. Rat pee

Although most people do not realize it, rat urine is often found on canned foods and drinks, including cans of carbonated soda. Rats are known to urinate often; their urine poses significant danger, especially ingested by the consumers.

### 6. Carbon dioxide

The gas used to make soda bubbly is the same poison we eject out of our bodies through our lungs. This gas is great for plants but it is bad news for human beings.

### 7. Citric acid

This component of some sodas may contain monosodium glutamate a known neurotoxin.

### 8. Artificial flavors

These somewhat mysterious (since we are not told enough about them by the people who produce them, thanks to special arrangements they have with the US government) substances may also contain traces of MSG and other chemicals.

### 9. Contaminated water

The carbonated-drink-producing industry uses huge amounts of water; like all other industries, they use product-ingredient sources that are least expensive.

### 10. Dangerously-high acidity

In addition to phosphoric acid, sodas can contain acetic, fumaric, and gluconic acid. High acidity in processed foods and drinks erodes the enamel on teeth, worsens the effects of GERD (gastroesophageal reflux disease), and leads to gastric lining erosion.

### 11. Sugar

When it comes to teeth, Tufts University says it isn't how much sugar is eaten, but how long it is in contact with teeth. There are naturally occurring bacteria in everyone's mouths. The bacteria feed on sugar, forming acids that can harm teeth. Fructokinase activity is not regulated by metabolism or hormones and proceeds rapidly after intake of fructose. While the intermediates of fructose metabolism are similar to those of glucose, the rates of formation are excessive. This fact promotes fatty acid and triglyceride synthesis in the liver, leading to accumulation of fat throughout the body (Fred Fletcher., 2011).

### 12. Acid

In addition to the acids formed by bacteria in the mouth when they feed on sugar, the Pediatric Dental Health site advises most carbonated beverages contain phosphoric acid, citric acid or carbonic acid. Any of these can erode tooth enamel. According to Delta Dental, the calcium in saliva works to remineralize teeth after exposure to small amounts of eroding acid, but with the increased consumption of carbonated beverages, it's not enough. Even diet soft drinks contain damaging acids. People often consume many soft drinks over the course of a day, which means tooth enamel is exposed to the acids over several hours. (Fred Fletcher., 2011).

### 13. pH

All soda is 100% acid forming regardless of the type or brand. It has a pH balance of 2. This is a very low pH number. Our bodies were made to have a natural pH balance of 7.3, which is slightly alkaline. A pH of 6 is ten times more acidic than a pH of 7. A pH of 5 is 100 times more acidic than a pH of 7. A pH of 4 is 1,000 times more acidic than a pH of 7. A pH of 3 is 10,000 times more acidic than a pH of 7. A pH of 2 means that a person would have to drink 32 eight ounce glasses of alkaline water just to neutralize the effect of one can of soda.

### 14. Solutions

People who find themselves addicted to soda pop should replace the soda with cider. There are many carbonated ciders that taste comparable to soda. Cider is far better for your health than any brand of soda pop.

## Pharmacological effects of soft drinks

### a. Malnutrition

Some people who are addicted to soft drinks deprive themselves from food until they become victims of malnutrition. Since gastrointestinal disturbance of these drinks lead to poor appetite thus surviving on soft drinks and little amount of food will cause malnutrition, retarded growth and other physiological problems.

### b. Effect on Gastro-Intestinal System

When you open the bottle of a soft drink, bubbles and fizz are immediately emitted out. This is due to phosphoric acid and carbon dioxide (CO<sub>2</sub>) content, which make these drinks highly acidic. The pH of soft drink ranges from 2.5-3.4 which generates a highly acidic environment in the stomach. Throughout the digestive system, that starts from the mouth and ends up at the anus (liver, gallbladder and pancreas play the role of accessory organs) only the stomach can resist an acidic environment up to pH 2.0. But before the acidity of soft drink reaches the stomach it passes through all the other organs involved in the digestive system thus causing an abnormal acidic environment. Hence the linings of the mouth, pharynx and esophagus are highly sensitive to acids. Also there is a very common practice of taking soft drinks when a person suffers from acidity or after having a heavy meal. The phosphoric acid present in soft drink competes with the hydrochloric acid of the stomach and affects its functions. When the stomach becomes ineffective, food remains undigested causing indigestion, gassiness or bloating (swelling of stomach). Thus people who are suffering from acidity should not be drinking soft drinks because actually it increases acidity further.

### c. Effect on Kidneys

Kidneys are less able to excrete phosphoric acid when it is in excess. Thus, there is extra work for kidney. Soft drinks remove Calcium from the body, causing an excess amount of Calcium that tend to be deposited in kidney, resulting in nephrolithiasis (kidney stones).

### d. Effect on Skin

Acidic blood affects the action of glutathione, which is an antioxidant enzyme. In addition, these drinks lack vitamins and minerals. By taking these drinks, people cut their intake of fresh juices, milk and even water and deprive themselves from essential vitamins and minerals that are mandatory for skin. Thus, the skin becomes more prone to wrinkles and aging.

### e. Effect on Bones

Phosphoric acid, present in carbonated drinks is violently poisonous, it de-oxidizes blood. In

detergent manufacturing industries, phosphoric acid is used to produce water softener. Water softener removes Ca<sup>2+</sup> and Mg<sup>2+</sup> ion from hard water. In human body, the function remains the same by removing Ca<sup>2+</sup> from bones causing osteoporosis (porous bones).

### f. Obesity and weight-related diseases

Many of these experiments examined the influence of sugar-sweetened soft drinks on weight gain in children and adolescents. In one experiment, adolescents replaced sugar-sweetened soft drinks in their diet with artificially sweetened soft drinks that were sent to their homes over 25 weeks. Compared with children in a control group, children who received the artificially sweetened drinks saw a smaller increase in their BMI (by  $-.14 \text{ kg/m}^2$ ), but this effect was only statistically significant among the heaviest children (who saw a benefit of  $-.75 \text{ kg/m}^2$ ) (Malik et al., 2006).

### g. Bone loss

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In a meta-analysis of 88 studies, drinking soda correlates with a decrease in milk consumption along with the vitamin D, vitamin B6, vitamin B12, calcium, protein and other micronutrients. Phosphorus, a micronutrient, can be found in cola-type beverages, but there may be a risk in consuming too much. Phosphorus and calcium are used in the body to create calcium-phosphate, which is the main component of bone. However, the combination of too much phosphorus with too little calcium in the body can lead to a degeneration of bone mass.

### h. Hypokalemia

There have been a handful of published reports describing individuals with severe hypokalemia (low potassium levels) related to chronic extreme consumption (4-10 L/day) of colas (Tsimihodimos et al., 2009).

### i. Soft drinks and bone density

Research suggests a statistically significant inverse relationship between consumption of carbonated beverages and bone mineral density in young girls, which places them at increased risk of suffering fractures in the future. The phosphoric acid contained in some soft drinks (colas) displaces calcium from the bones, lowering bone density of the skeleton and leading to weakened bones, or osteoporosis. Heaney concluded that carbonated

soft drinks, which do not contain the nutrients needed for bone health, may displace other foods which do, and that the real issue is that people who drink a lot of soft drinks also tend to have an overall diet that is low in calcium (J Bone Miner., 2003).

#### **j. Fizzy drinks may cause premature aging**

The high phosphate levels (usually found in soft drinks and some prepared foods) may cause premature aging in mice. The investigators found that phosphate toxicity could not only reduce body weight and growth, but also could induce severe muscle, skin, and organ atrophy of the mice. More important, phosphate toxicity suppressed reproductive abilities and reduced the overall survival of the mice. "If mouse studies were to imply human responses, this particular study would recommend 'avoid phosphate toxicity and enjoy a healthy life.

#### **k. Tooth Decay**

All soft drinks are acidic which corrodes the teeth by eroding its enamel. The high amount of sugar consumed through soft drinks lead to the development of bacteria that attack the teeth thus aggravating dental problems. Therefore, soft drinks contain acid and sugar that corrode and destroy the teeth in one shot. Most soft drinks contain high concentration of simple carbohydrates : glucose, fructose, sucrose and other simple sugars. Oral bacteria ferment carbohydrates and produce acid, which dissolves tooth enamel during the dental decay process; thus, sweetened drinks are likely to increase risk of dental caries. The risk is greater if the frequency of consumption is high (Marshall et al., 2003). A large number of soft drinks are acidic, and some may have a pH of 3.0 or even lower. Drinking acidic drinks over a long period of time and continuous sipping can therefore erode the tooth enamel. However, under normal conditions, scientific evidence indicates Coca-Cola's acidity causes no immediate harm (Mikkelsen et al., 2004).

#### **Harmful effects of sports drinks**

- a) There are many health benefits to consuming orange juice, fruit juices and sports drinks such as Gatorade. These drinks may contain beneficial ingredients such as vitamin C and antioxidants; they can also replenish nutrients lost during a sporting event and lower the chance of heart disease, cancer and even Alzheimer's.
- b) These drinks can sometimes do more harm than good, if not consumed carefully. Orange, fruit and sport drink consumption should always be followed by tooth brushing, or if you are not able to brush,

drink plenty of water to remove sugar that lingers on the teeth and gums.

- c) Sugar is consumed by bacteria and converts to and acid, which wears away at teeth and causes cavities.
- d) Tooth enamel can be worn, by consuming these drinks, leading to cavities, sensitive teeth and eventually tooth loss. Studies have indicated that toothpaste with fluoride may help to lessen the effects of these drinks. (Dr. Bernard., 2012).

#### **CONCLUSION**

The additives of soft drinks and sports drinks were found to have adverse effects. Both drinks are most favorable in summer season but regular usage may degrade the health. Soft drinks are more harmful in comparison to sports drinks. The carbonated soft drinks were found to show more toxic effects on health status. The pH level of soft drinks was less and they were more acidic in nature than sports drinks. The study also showed that regular consumption of these drinks degrades the status of teeth and can cause various toxicities mainly soft drinks which after long run may create further complications.

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