

Caffeine and Caffeinated Beverages

Chinwe .U. Elochukwu

Department of Food Technology, Federal Polytechnic Oko, Anambra State, Nigeria.

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ABSTRACT: Caffeine is the most commonly used drug in the world and is found in coffee, tea, and soda, to over the counter (OTC) pain relievers, chocolate, and a whole host of food and beverage products branded with some form of the word "energy". It is a bitter white crystalline xanthine' alkaloid, that acts as a mild psychoactive stimulant drug which may be used medically for this purpose. It is a stimulant known to increase alertness, elevate mood and give temporary energy boost thereby easing fatigue. It also increases the effectiveness of certain drugs hence its use in some over-the -counter drugs. The health professionals have been slow to characterize problematic caffeine use and acknowledge that some cases may call for treatment. The negative effects of caffeine are often not recognized as such because it is a socially acceptable and widely consumed drug that is well integrated into our customs and routines. Many people can consume caffeine without harm while for some it produces negative effects, physical dependence, interferes with daily functioning, and can be difficult to give up, which are signs of problematic use. Doses within the range of 200-500 mg per day of caffeine or caffeinated products can be generally considered safe for people without medical conditions such as heart or liver disease. This paper highlights on the benefits as well as the risks associated with the consumption caffeine and caffeinated beverages.

Keywords: caffeine, coffee, beverages, stimulant, tea

I. INTRODUCTION

Caffeine is a bitter white crystalline xanthine' alkaloid, that acts as a mild psychoactive stimulant drug which may be used medically for this purpose. It is a stimulant known to increase alertness, elevate mood and give temporary energy boost thereby easing fatigue. It also increases the effectiveness of certain drugs hence its use in some over-the -counter drugs for the treatment of conditions such as migraine and cluster headaches. In the form of coffee, it is said to have some cardio

protective effect in individuals who are not hypertensive (Lovett, 2005). It possesses a weak diuretic action. It is found in varying quantities in the seeds, leaves, or fruits of many plants species (Andrews, 2009). The most common sources of caffeine are coffee, cocoa beans, cola nuts and tea leaves.

Beverages are drinks specially prepared for human consumption either at meal or leisure times. They are consumed for their thirst quenching properties or for their stimulating effects. Traditionally the beverages on a menu referred to coffee but it has now encompass tea, tisanes, milk drinks (hot or cold) and proprietary drinks such as Booril or Horlicks(Lillicarp and Cousins,2006). The essential component of any beverage is the water it contains; other components such as stimulants, colouring and flavouring ingredients which may perform some useful functions but they are not essential to the proper physiological functioning of the body. The stimulant commonly used in many beverages is caffeine. Food beverages are classified into two main categories namely alcoholic and non-alcoholic beverages. According to Andrews (2009), the non-alcoholic beverages are further classified into four categories namely water, refreshing drinks (colas, squashes, syrups, sodas, tonic water and ades), stimulants (tea and coffee) and nourishing drinks (malted drinks, milk shakes and fruit juices). Soft drinks and some fruit juices may contain caffeine arising from the raw materials used for its preparation or from deliberate addition.

Sources of Caffeine

Caffeine is found in pepper, mushroom, kola nut, tea, carbonated soft drinks, chocolate, cocoa and energy drinks, coffee, kola nut and guarana-berries and many other plants (Andrews, 2009). The major plant sources of caffeine are as follows:

- Coffee Plant: Coffea is a genus of flowering plants whose seeds, called coffee beans, are used to make coffee. It is a member of the

Rubiaceae family. They are shrubs or small trees native to tropical and southern Africa and tropical Asia. *Coffea* varieties include *coffea arabica* which accounts for 75-80 percent of the world's coffee production, while *Coffea canephora* accounts for about 20 percent. Several species of the caffeine in coffee "beans" is a natural plant defense against herbivory (American Horticultural Society, 2002). Coffee trees were cultivated about 1000 years ago in Yamen district of Arabia. Coffee has been found to be the biggest source of caffeine in adults Even decaffeinated coffee is not totally free of caffeine because decaffeination is a process which is not 100% efficient (Matissek, 1997). Caffeine-containing beverages are widely consumed worldwide. Coffee ranks as one of the world's most valuable and widely traded commodity crops and is an important export product of several countries (Lillicarp and Cousins, 2006).

- Guaraná : Guaraná (*Paullinia cupana*), also known as Brazilian cocoa, grows as a shrub or woody vine in Brazil. Guarana is a natural source of caffeine derived from the seeds of the Guarana *Paullinia cupana* plant, which is native to South America. The native people in the Amazon region of South America have been using it for centuries as a way to boost energy, but this herb gained popularity in the west after it was added to soft drinks and energy drinks. Guaraná seeds have the highest caffeine content 3.6% -5.8% caffeine by weight of any known plant, which is an average of 47mg /g of caffeine. They are used as a soft drink flavoring in Brazil (Duke, 1985).
- Tea Plant: Tea is prepared from the leaf bud and top leaves of a tropical evergreen bush called *Camellia sinensis*. Tea was discovered by accident over 5000 years ago when leaves from a tea bush accidentally dropped into some boiling water and delicately flavoured the liquid. Tea was originally drunk for its medicinal benefits and it was not until the 1700s that it began to be consumed as the delicious beverage (Racheal et al., 2009).
- Kola Nut: Kola is a member of the tropical family *sterculiaceae*. It is a caffeine containing nut of evergreen trees of the genus *Cola*, primarily the species *Cola acuminata*, *Garcinia kola* (bitter kola) and *Cola nitida* (American Horticultural Society, 2002). There are over fifty species of kola. Of these, seven have edible nuts, but only two have been widely

exploited, these are *cola nitida* and *cola acuminata*. Cola nut, which is about the size of a chestnut, contains about 2% caffeine and is chewed by many people as a stimulant. It is used in the manufacture of cola group of beverages-coca cola, pepsi cola and kola. The caffeine content is likely responsible for the pharmacologic effects of cola nut (Komolafe , 1980).

- Cacao: Cacao (*Theobroma cacao*) is believed to have originated in the hot humid region near the source of the river Amazon in South America. The name cacao is used to describe the tree, while cocoa refers to the fruit or crop and the processed product (Komolafe , 1980). Compared with coffee, tea, and the plants above, cacao is a minor contributor to total caffeine consumption. Although cocoa is not considered to be toxic in typical confectionery doses, at least 1 report of animal toxicity has been published. A dog that consumed 1 kg of chocolate chips suffered hyperexcitability and convulsions, and subsequently collapsed and died, most likely because of acute circulatory failure secondary to theobromine/caffeine toxicity (Duke, 1985). Cocoa products are used extensively in the food and pharmaceutical industries. Cocoa powder and cocoa butter are often mixed with chocolate liquor (ground cacao seeds), sugar, milk, and other flavors.

CAFFEINATED BEVERAGES

Caffeinated beverage is a drink which contains caffeine, a stimulant which is legal and most popular in most developed countries. The most common caffeinated beverages are coffee and tea which in one form or another (usually served hot but sometimes iced) feature in most world cultures. Other drinks are artificially caffeinated as part of their production process. These include certain soft drinks (primarily cola drinks) and also energy drinks designed as a stimulant and to perpetuate activity at times when the user might ordinarily be asleep. The beverages containing caffeine such as coffee, tea, soft drink, sport drink and energy drink enjoy popularity.

- Coffee : Coffee normally takes its name from the country where it is grown; Brazils come from Brazil; Mocha from mocha (Al Mukha) in Yemen and Java from Java. However some coffee houses and manufacturers may have their own blends of coffee under various brand names. Milds are coffees outside Brazil (Andrew, 2009). The amount of caffeine a cup of coffee contains varies a great deal,

depending on the strength of the particular brand of coffee, and the method of brewing -- which determines how concentrated the caffeine is. The size of the coffee cup will also determine how much caffeine it contains. The amount of caffeine actually consumed depends on the strength of the coffee and the size of the cup. For example, a shot of espresso, the strongest type of coffee, contains about 50mg of caffeine per fl oz, but as a shot is only 2 fl oz, it would give you 100mg of caffeine, the same amount as an 8 fl oz cup of brewed coffee. Instant coffee is weaker at about 50mg per 8 fl oz cup (Racheal et al., 2009). On coffee consumption pattern in Nigeria, studies show that coffee significance and degree of acceptance have persistently be on the increase at a rapid rate, due to amplified demand for the drink amongst corporate Nigerians in the private and public sectors who are daily confronted with the rigor of their busy schedule and have the need to stay alert and fit in challenging working environments. Presently, a number of working class groups depend on coffee to stay-off lethargy and maintain alertness throughout the working period of the day. It has also been discovered that many people rely on a cup or two of coffee ahead of the envisaged huge traffics common in major cities as they set out for home after the day's work. Coffee is served in most offices during breaks, at conferences and other formal business gatherings. It is also popular among students during exam periods.

- **Tea:** Tea produces what is regarded as a healthy beverage containing approximately only half the caffeine content of coffee and at the same time it aids muscle relaxation and stimulates the central nervous system. All teas are fermented (oxidized) during the process of manufacture which gives them their black colour. The only exception is the green tea (Andrews et al., 2007). Tea is classified into three typed namely black tea, green tea and oolong tea. The many different types of tea vary from containing high levels of caffeine, to herbal teas which contain no caffeine at all. Regular tea, usually an Orange Pekoe or Black tea blend, contain about the same amount of caffeine as instant coffee -- 50 mg per 8 fl oz cup. The length of time tea is being steeped affects the strength of the beverage so the amount of caffeine in a cup of tea varies from about 20mg to 80mg per 8 fl oz cup (Andrews, 2009). Caffeine in Tea varies quite a bit, there

is some variation among different types of tea, with Chai ranging from about 60-120mg of caffeine per 8 fl oz cup, Assam black tea about 80mg per 8 fl oz cup, Earl Grey and Darjeeling teas containing average amounts of caffeine at around 50mg, Oolong having only 40mg, Green tea 25mg and White tea 15mg (Lillicarp and Cousins, 2006). Most tea manufacturers do not list caffeine amounts on labels.

- **Soft Drink:** Soft drinks, typically marketed to kids, often contain rather a lot of caffeine. Cola is the most well-known source of caffeine, containing from about 30-60mg caffeine per 330ml can, depending on the brand. Caffeine content in soft drinks varies by brand from 10 to 50 mg of caffeine per serving (Violeta et al., 2010); however the US Food and Drug Administration limits the maximum amount in carbonated beverages to 6 mg/oz. Therefore caffeine content allowed in soft drinks may be in the range between 30 and 72 mg/355 mL (12 oz) or 8.45-20.28 mg/100 mL (NSDA, 1999).
- **Sports Drinks :** Sports drinks are beverages whose stated purpose is to help athletes replace water, electrolytes, and energy after training or competition, though their efficacy for that purpose has been questioned, particularly after exercise which is only moderate (Cohen2013). Sports drinks can be split into three major types namely Isotonic sport drinks (which contain similar concentrations of salt and sugar as in the human body); Hypertonic sport drinks (which contain a higher concentration of salt and sugar than the human body) and Hypotonic sport drinks (which contain a lower concentration of salt and sugar than the human body) (Andrews,2009). Sports drinks and energy drinks are usually marketed in a way that emphasizes their caffeine content, although the actual amount of caffeine they contain varies greatly. Some contain about the same amount as tea or coffee, from 50-100mg caffeine per serving, while others contain much, much more.
- **Energy Drink:** Energy drink may be used to describe carbonated beverages that contains large doses of caffeine and sugar in combination with other ingredients such as guarana, taurine , gingseng, green tea, amino acids and minerals (Olakintan,2012).Most people consume energy drinks with the believe that they give extra energy and significantly improve alertness, physical and mental performance, driving

ability, decrease mental fatigue during long periods of concentration and helps to burn fat stored in the body when ingested during physical activities. Nigerians’ love for energy drinks is evident in the myriad of brands that have saturated the markets in the past few years. There are so many brands; Power Horse, London Best, Red Bull, Spark, Monstar, Hippo and many more. The popular appeal of the non-alcoholic drink is that it enhances mental and physical performance because of the ingredients, chief of which is caffeine. There are natural energy drinks such as coconut water which can be used as a form of energy drink, particularly for sports men and women. Coconut water has been called ‘Mother Nature’s sports drink’. Coconut water is a natural alternative that does not just boost energy levels in joggers and athletes, but lowers blood sugar levels and diabetes risk. It has even been used intravenously, directly into

the human blood stream, to stabilize electrolytes or treat people who were severely dehydrated. (Kathleen,2014) .

- **Cocoa Drink:** The amount of caffeine in chocolate drinks varies, according to the brand and the type of chocolate. On average, milk chocolate contains about 18mg of caffeine per 100g. Dark chocolate contains much more caffeine, with dark chocolate containing upwards of 70mg of caffeine per 100g bar -- almost as much as you get in a cup of coffee. Some manufacturers add extra caffeine to chocolate to produce a stronger caffeine containing bar that is around 100mg caffeine per piece (Dillinger, 2000). White chocolate doesn't usually contain caffeine. The table below represents the report by Ogah and Obebe, 2012 on the caffeine content of certain cocoa beverages found in the Nigeria market.

Sample Name	Sample Code	Concentration (µg/ml)	Amount of Caffeine(mg/ml)
Blue Boat Choco	BC	2.503	3.125
Bounvita	BV	1.442	1.803
Cowbell Chocolate	CC	2.404	3.005
Jago Chocolate	JC	2.212	2.765
Milo	ML	1.981	2.476
Nescafe Classic	NC	6.712	8.390
Nescafe Gold Blend (Decaffeinated)	ND	1.846	2.308
Ovaltine	OV	2.154	2.693
Peak Choco	PC	2.365	2.956
Richoco	RC	2.096	2.620

Table 1: Concentration and Amounts of Caffeine in the various Beverage samples

Source: Ogah, C.O. & Obebe, O.T. (2012)

BENEFITS OF CAFFEINE AND CAFFEINATED BEVERAGES

Research shows that caffeine consumed in moderation can have some positive benefits to most people. However many others experience negative effects, including withdrawal symptoms when reducing caffeine intake. Caffeine amounts have been increasing over the last decade. There is the need for manufacturers to label caffeine amounts accurately. According to researches done in various research centers, it has been found that

- Caffeine potently blocks an inhibitory neurotransmitter in the brain, leading to a net stimulant effect .The controlled trials show that caffeine improves both mood and brain function (Nehling et al., 1992).

- Caffeine raises the metabolic rate and helps to mobilize fatty acids from the fat tissues partly due to its stimulant effect on the central nervous system and this can enhance physical performance(Doherty and Smith,2005) .This also implies that caffeine helps in weight loss.
- Coffee lowers your blood glucose level and may even increase the metabolic activity and numbers of Bifidobacteria in the gastrointestinal tract, which are beneficial .In observational studies, coffee has been repeatedly associated with a lower risk of diabetes (Rachel et al.,2009).
- Coffee contains a decent amount of several vitamins and minerals. It is also the biggest source of antioxidants in the modern diet. It is

loaded with antioxidants and beneficial nutrients that can improve our health. The studies show that coffee drinkers have a much lower risk of several serious diseases. Fresh coffee from organic, whole beans that are pesticide-free can help keep the brain and muscle tissue remain young. Adding commercial milk or creamer, and worse yet sugar, will tend to diminish the value received from coffee (Arne, 2004).

- Coffee may reduce the risk of Parkinson's disease. In one study, men who drank no coffee were two or three times more likely to develop Parkinson than those who drank more than four cups a day (Carter, 2003)
- Kola nuts contain large amounts of caffeine and theobromine and are therefore used as a stimulant. They produce a strong state of euphoria and well being, enhance alertness and physical energy, elevate mood, increase tactile sensitivity, suppress appetite and hunger and are used as an aphrodisiac (Odebunmi, 2009). The caffeine in the nuts also acts as a bronchodilator, expanding the bronchial air passages, hence kola nuts are often used to treat whooping cough and asthma (Duke, 1985).

RISKS OF CAFFEINE AND CAFFEINATED BEVERAGES

- Caffeine is an addictive substance, so regular consumption of products that contain even moderate amounts of caffeine may lead to addition to the products with withdrawal reactions like mood changes and flu-like symptoms. These include headaches, fatigue, irritability, difficulty in concentrating, depression, nausea/ vomiting and muscle ache or stiffness (Juliano and Griffiths, 2004). Coffee is popular because our society chronically suffers low energy and fatigue. The stimulating effects of coffee are used to get through the day and they create dependency. The caffeine does not create or sustain long-term energy it just hypes the system by over stimulating the adrenal glands, which ultimately carries a long term price.
- Caffeine increases the amount of sugar in the blood and provides an energy lift, but it also throws body chemistry out of balance (Raymond, 2002).
- The proliferation of energy drinks in this 21st century poses a lot of challenges in Nigeria. They are called energy drinks and what that

means is that they can energize the users with the help of the substances they contain. The caffeine in it can lead to increase in blood pressure, stimulates the heart to the extent that it worsens heart disease condition; energy drink should not be used like drinking water. The manufacturers warned consumers not to take more than one can of its energy drink in a day.

- Caffeine consumption in children is often blamed for sleep problems and bedwetting. According to the write up of Agbaje in the business day of July 11, 2014, he stated that caffeine can have negative effects on pregnant women or on women who would like to become pregnant including an increased risk for difficult conception and miscarriage. Caffeine is transmitted through the placenta and through breast milk to the baby.
- People who are involved in high energy activity such as athletes, dancers, weightlifters or construction workers can take a minimal amount of energy drink without any health hazards. When people take too much energy drinks, it can lead to high blood pressure and even death. Diabetics are cautioned to avoid caffeine because it leads to an increase in blood sugar.

Generally caution is advised when consuming high doses of caffeine, as it is possible to cause blood pressure and even to develop mental health problems. According to Weinberg and Bealer, (2001), consumption of greater than 250-300 mg of caffeine per day can cause adverse effects such as sleep disturbances and tachycardia, doses less than 500 mg per day are generally considered safe for people without medical conditions such as heart or liver disease.

II. CONCLUSION AND RECOMMENDATION

Nigerians often abuse the use caffeine and caffeinated products by consuming them in excess, sometimes mixing them with alcoholic drinks. This may lead to caffeine intoxication and increases the fatality of the drinks. There is the need for moderation which is the only way one can maintain good health. Energy drinks when taken in a regulated and responsible manner may be beneficial to health while unregulated intake of energy drinks may be disastrous. We need to be careful with energy drinks which market themselves as "healthy". The caffeine content may or may not appear on the label of energy drinks. A

lack of proper labeling details contributes to the ignorance of the people. Proper labeling is of great importance.

Finally, a nation where the citizens are beset with one health problem or the other as a result of consumption of harmful drinks or caffeinated products cannot be said to be raising a healthy generation. These products in the long run would be doing an incalculable damage to the nation

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