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Quantitative Estimations of Caffeine and Taurine Concentration in Selected Brand of Energy Drink Sold in Supermarkets Gusau, Zamfara, Nigeria

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Abstract

The proliferation of different energy drink in the Zamfara state and Nigeria in general has called for strictly monitor by food the regulatory, because of the high content of caffeine and its health effects. The study was carried out to determine the pH, Caffeine and Taurine Concentration in selected energy drink sold in Gusau supermarkets, using UV- visible Spectrophotometer at wavelength of 270 nm and 570nm for the concentration of caffeine and taurine respectively. It was found that the caffeine level in the ten selected energy drinks was high compared to the level of taurine with ED8 and ED6 has highest caffeine concentration of 665.0 mg/100ml and 576.5 mg/100ml respectively. Taurine content are very low compare to what the body can accommodate with the highest concentration of 93.8 mg/100ml and 90.5 mg/100ml for ED10 and ED2 respectively. All the energy Drinks were acidic and higher than the threshold of pH 5.5. There is need for strict monitoring of all the imported and local production of energy drink in Nigeria because of their health effect of excessive intake of caffeine, and proper labeling of the contents concentrations in the energy drink to unable consumer make their choice.

Keynote: Caffeine; Taurine; Energy Drink; Spectrophotometer.

1. Introduction

An energy drink is a type of drink that contained stimulant compounds, such as caffeine and taurine to provide a mental and physical stimulation. Energy drink has become common drinks in Nigeria today with different brands. According national food and drugs administration control (NFDAC), the proliferation of energy drink in Nigeria is very alarm, because of the high content of caffeine and its adverse health effect on adolescent [7,8].

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World Health Organization also published a meta-analysis of energy drink studies that noted the health risks associated with energy drink consumption are primarily related to their caffeine content [1]. It was found that the content of caffeine in energy drink varies from brands to brands and other ingredients such as taurine, glucuroncolactone, and vitamins [11,9] Old and young adults consumed these products majorly without mindful the health risk [3]. Some of the caffeine related health risks are cardiovascular functioning and bad for developing children which have a smaller body size to developed tolerance to stimulant drugs [3,4]. As result of this health risk, some countries banned the sale of energy drink to the children [12]. The U.S food and drug administration regulate the use of caffeine in carbonated beverage to 71mg per serving because many people believes caffeine are save without been regulated in the energy drink [7]. In Nigeria different brand of energy drinks entering market day by day without proper labeling of the active ingredients such as caffeine [9]. Caffeine has been identified as the common ingredient of energy drinks; it was deliberately added as flavoring agent and additive [8,16]. Caffeine stimulates the central nervous system that reduce physical fatigue and mental alertness to eliminate unusual weakness or drowsiness that may occur [2,8,23]. Taurine (amino acid) are one of the active ingredient of most popular demand energy drink with concentration ranging from 750 and 1000 mg per serving. Taurine is non essential amino acid, clinically recommend at 3000 mg per day, which moderate calcium release and also has potential impact on the brain, heart, and skeletal muscle [14,15,17]. Since its conditionally essential amino acid, a healthy individual can produce the minimal amount required for the essential daily functions. Some countries banned the use of taurine in energy drink because the health effect are not fully known, but it has been shown that it play a role in four different forms of kidney disease such as glomerulonephrities, nephropathy, chronic renal failure and acute kidney injury [20,6].

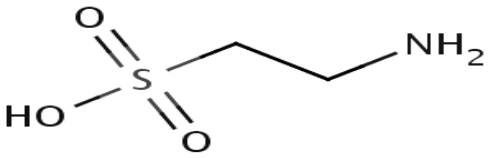

Figure 1: structure of Taurine

Combination of caffeine and taurine ingested together can result to cardiac effect which is also a concern given that caffeine alone can increase blood pressure and heart rate. Several warning has been issue by [18]. High consumption of energy drink and caffeine among teenager and young adult raise serious concern because of advance effects on health especially brain when it combine with alcohol consumption [18].

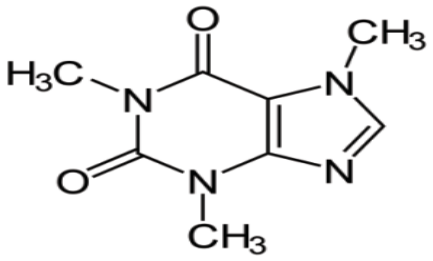

Figure 2: structure of caffeine

1.1 Materials and Methods

All reagents used are of analytical grade and obtained from sigma and Co

1.2 Instrumentation

UV-visible Spectrometer (Perkin Elmer lambda 35 model), pH meter (Bechman model, 72)

1.3 Sample Collections

All the ten energy drink brand samples were within average volume of 50-80 ml and they were obtained from different supermarkets in Gusau metropolis, Zamfara, Nigeria.

1.4 Determination of pH

The pH of energy drink samples were determined using pH meter, as described in the work of [17]. 50 ml of energy drink were measured into a cleaned beaker and the calibrated pH meter electrode was dipped direct to the portion of the energy drink sample. The electrode was cleaned in distilled water after every each sample before taking the reading of another sample.

1.5 Preparation of Standard solution of Caffeine

25 mg of caffeine standard was weighed and dissolved in 250 ml of CCl_4 in a cleaned 500 ml capacity of volumetric flask and stirred, A serial dilution were made from standard solution for calibration curve. With different concentration of 2.0, 4.0, 6.0, 8.0, 10 mg/100ml Absorbance of each standard solution was measured at 270 nm using 1 cm quartz curvet. A graph of absorbance was plotted against concentration of caffeine standard solution to obtained calibration curve [1].

1.6 Preparation of standard solution of Taurine

35 mg of Taurine standard was weigh and dissolved is 70% ethanol by volume to obtained standard solution of taurine. Serial dilutions were prepared with addition of 5 drops of Ninhydrine and heat in water bath at temperature of 60^{OC} to form colored compound called taurine Nihydrine complex. Absorbance of each concentration was taken at wavelength of 570 nm this was use to prepared a calibration curve [15,17].

1.7 Extraction of caffeine from energy drinks samples

Extraction of caffeine from the energy was carried out by the method describe by [5]. 5 ml of each energy drink was measured into a cleaned separation funnel and 10 ml of distilled water, 20% aqueous Na_2CO_3 and 20 ml of CCL_4 .were added. The separating funnel was inverted several times to obtained non aqueous CCL_4 layer; it was removed to a cleaned volumetric flask and repeated to all the energy drink samples. The absorbance to each extract was measured at 270 nm in 1cm quartz curvet

1.8 Extraction of Taurine from energy Drink Samples

Extraction of taurine was carryout using the method developed by [5]. 50 ml of each energy drink was measured and evaporated to dryness to obtained residues. The residues were dissolved in 10 ml 70% of ethanol and heat with 5.0 ml of 0.2% solution of ninlydrine in the water bath for 20 minutes at 60^{oc}. A color complex of taurine - ninhydrine was developed. The colored extracts were analyzed using UV/visible spectrometer at wavelength of 570nm. The principles was base that Ninhydrin react with primary and secondary amines in the taurine which produces blue or purple color and this reaction is negative to caffeine

1.9 Quality Assurance

All glass wares used were washed and sterilized with concentrated nitric acid solution before used and the instruments were calibrated before used.

1.10 results and discusion

1.11 Discussion

pH value indicate acidity and alkalinity content of the energy drink brands selected from the study area. The pH of ten energy selected are shown in table 1, all the pH of the energy drink are acidic and the energy drink 9 and 1, are more acidic with pH 3.11 and 3.35, respectively. Energy drink 7, and 10 with pH 3.90 and 3.86 are lower in acidic content. Generally the pH of the ten energy drinks is range from 3.11 to 3.92. This results pH value in the energy drinks was similar to the work of [1,9] which also show that all the result of energy drink are acidic The acidic nature of the energy drinks may attribute to the present of carbon dioxide and other acidic materials added as additives or preservative such as malic acid, ascorbic acid, citric acid, by the manufacturers as reported by [9]. Acidic value of energy drinks are above the recommended threshold of 5.5 pH value can cause tooth decay [7]. The concentration of caffeine in the present study as shows in table 1, the concentration was determine in three replicate to fine the standard error at 99% confidence level. Energy drink branded 8, has the highest caffeine content of (6.58±0.128) with dilution factor of 665.0 mg/100ml follow by energy drink (ED6) with concentration of caffeine (5.765±0.1) with dilution factor of 576.5 mg/100ml, while energy drink (ED7) with caffeine concentration of (4.801 ± 0.2) with dilution factor 480.1mg/100ml. this trend is also similar to the finding of [1,9,2]. Energy drink (ED3 and ED2) has lowest caffeine concentration of 1.369 ± 0.367 and 1.825 ± 0.108, respectively. This value is within the recommended value [22]. The higher level caffeine concentration than recommended value of (300 mg-400 mg) for children, pregnant woman, and people with underline illness

such as diabetic type 2, high blood pressures and arrhythmias as shows in ED8, ED6, and ED7 pose health risk [19]. Excessive consumption of caffeine by the person with underline illness may alter the cardiovascular function and elevated mental performance which in turn result to high blood pressures [7,10] and [10]. ED3 and ED2 with lowest caffeine level of can be safe for those who engage in exercise, and those without underline illnesses according to European food safety Authority [7]. The concentration of taurine was determine in three triplicate and find the standard error at 99% confidence internal as shown in Table 2.. ED10 with taurine concentration of 0.938 ± 0.1 with dilution factor of 93.80 mg/100ml, ED 6 with taurine concentration of 0.905 ± 0.055 with dilution factor of 90.50 mg/100ml and ED7 with taurine concentration of 0.747 ± 0.007 with dilute factor of 75.70 mg/100ml are higher than other energy drinks. Generally the taurine in the all the energy drinks are below the recommended value. There is no report of health risk on the consumption of this taurine (amino acid) [5,6]. Taurine is a conditional amino acid which can be produced by the body and the body can accommodate as high as 400mg/100ml to 600mg/100ml. But it was reported that taurine is capable of mitigate the effect of caffeine in the body [13]. Taurine has important functions in the heart and brain. It helps support nerves growth. It also reduces the rate of heart failure by lowing the blood pressure and nervous system [5,6]. Despite that, there is no available information on the effect of higher taurine the body, all the energy drink samples from the present study, shows very low concentration of taurine, but higher in caffeine content. Figure 3 shows the concentration of caffeine, taurine and pH in the energy drink, low content of taurine. ED6 has highest concentration of caffeine and taurine and 3.35 pH and ED3 has low content of caffeine but high content of taurine and 3.61 pH while ED9 has the lowest pH of 2.11 the result of taurine is very low compare to the recommended value an average body can accommodate [5]. It was reported that the combination of the caffeine with taurine in the energy drink, can mitigate the effect of caffeine sine there is no proven of negative effect of taurine in the body [13] and more also the body can produce taurine since is non but it was reported that essential or conditional amino acid Generally, there is known correlation between the content of caffeine, taurine and Ph in all the energy drinks sold in zamfara, the manufacturers of this energy drink may be interested in addition of caffeine despite the health effects of high consumption caffeine in body. The amount of taurine are generally low in all the energy drink samples, despite that, there is no report of effect of high content of taurine in body.

Table 1: Concentration of Caffeine in (mg/100)

Energy drink	Conc. caffeine	Dilution factor	pH
ED1	**2.822 ± 0.0931**	**282.2**	**3.35**
ED2	**1.825 ± 0.108**	**182.5**	**3.48**
ED3	**1.369 ± 0.367**	**136.9**	**3.61**
ED4	**3.505 ± 0.128**	**350.5**	**3.85**
ED5	**2.809 ± 0.101**	**280.9**	**3.76**
ED6	**5.765 ± 0.1**	**576.5**	**3.76**
ED7	**4.801 ± 0.2**	**480.1**	**3.92**
ED8	**6.580 ± 0.128**	**665.0**	**.32**
ED9	**3.777 ± 0.105**	**377.7**	**3.11**
ED10	**2.858 ± 0.178**	**285.8**	**3.86**

ED-Energy drinks. Concentration of Caffeine at 99% Confidence level

Table 2: concentration of taurine in the energy drinks

Samples	Conc. of Taurine in mg/100ml	Dilution Factors
ED1	**0.327 ± 0.027**	**32.70**
ED2	**0.255 ± 0.007**	**25.50**
ED3	**0.225 ± 0.017**	**22.50**
ED4	**0.368 ± 0.006**	**36.80**
ED5	**0.286 ± 0.009**	**28.60**
ED6	**0.905 ± 0.055**	**90.50**
ED7	**0.757 ± 0.002**	**75.70**
ED8	**0.416 ± 0.108**	**41.60**
ED9	**0.283 ± 0.012**	**28.30**
ED10	**0.938 ± 0.1**	**93.80**

Concentration of Caffeine at 99% Confidence level

Comparison of Concentration of Caffeine, Taurine and pH of the Ten Energy Drink Samples

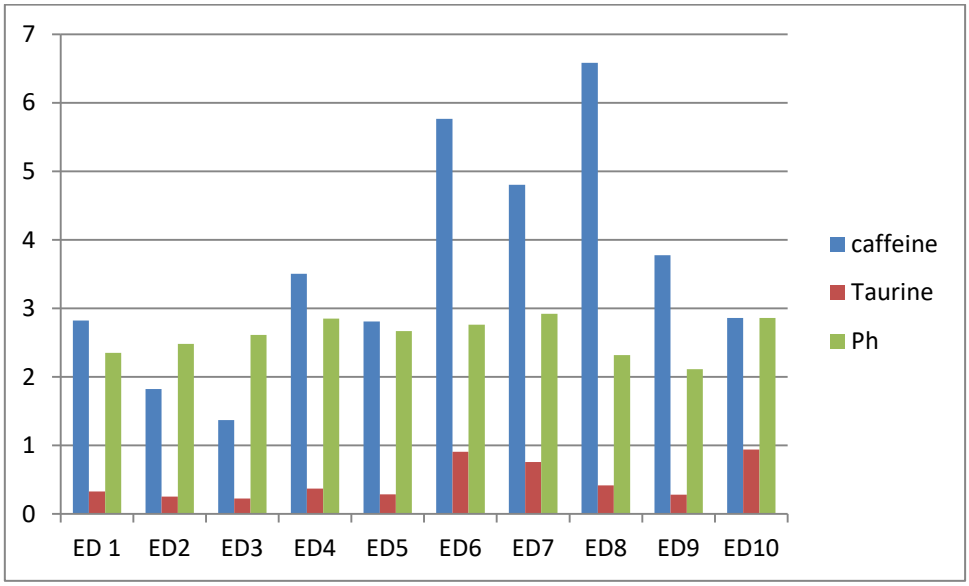

Figure 3: Shows the concentration of caffeine, Taurine and pH

Key; ED is energy drink

1.12 conclusion

The caffeine, taurine and pH of the selected energy drink from Zanfara State Nigeria, shows that caffeine in all the energy drink are high, but ED8 and ED 6 with concentration of 665.0mg/100ml and 576.5 mg/100ml respectively are the highest. The taurine content in all the energy drink are generally low compare to what the

body can accommodate, because there is no negative effects on high consumptions of taurine reported in the literature. Therefore, the high content of caffeine need to be regulated because of people with underline health illness and abuse of the energy drink by some adult for sexual purpose. A strict mention need to taken in order compel the manufacturers on the important of food labeling of contents. These will help the consumers to make the choices based on the display content with their respectively concentration. Manufacturers need to be encouraged to increase the concentration of taurine in the energy drink, because of its health benefit.

1.13 Recommendation

The following are recommended from the current studies of quantities estimation of quantitative estimations of caffeine and taurine concentration in selected brand of energy drink sold in supermarkets gusau, zamfara. Nigeria

- Continues monitoring and strict regulation by agencies such as NAFDAC,on the contents of all energy drinks sold in Nigeria
- There is for continues awareness and orientation of the effects of caffeine on adult and children
- Improvement on food labeling of contents to enable consumers to make their choose

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