PJN
ISSN 1680-5194

PAKISTAN JOURNAL OF NUTRITION

ANSInet
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan
Mob: +92 300 3008585, Fax: +92 41 8815544
E-mail: editorpjn@gmail.com

Pakistan Journal of Nutrition 11 (9): 845-848, 2012
ISSN 1680-5194

Determination of Caffeine and Trace Minerals Contents in Soft and Energy Drinks Available in Basrah Markets

Sarmad G. Mohammed, Alaa G. Al-Hashimi and Khadeeja S. Al-Hussainy
Department of Food Science and Biotechnology, Agriculture College, Basrah University, Basrah, Iraq

Abstract: Ten brands of beverages (soft and energy drinks) consumed in Basrah governorate/Iraq, were analyzed for its pH, trace minerals and caffeine contents. The beverages included (O_2, Boom Boom, Wild Tiger, Power horse, Kalaschnikow, Pit bull, Pepsi, Mountain dew, Riviere and Barbican). Results showed that the pH of the beverages ranged from 2.75-3.66. Iron and Calcium were found in all beverages, Cadmium was found in (Boom Boom, Pit bull, Kalaschnikow and Barbican). Lead was found only in O_2, Power horse, Kalaschnikow and Riviere. Manganese was found in Boom Boom, Wild Tiger, Power horse, Pit bull and Riviere. Caffeine was found in all beverages except Riviere and Barbican, the highest level of caffeine was in Kalaschnikow (103.13 mg/100 ml) when compared with the other beverages.

Key words: Soft drinks, energy drinks, pH, caffeine, trace minerals

INTRODUCTION

Soft drinks are commonly consumed by our youths not for their nutritional benefits, but to quench thirst during the hot summer, or maybe they think that these soft drinks will help them in digestion, while athletes use energy drinks to keep up their energy during intense physical activity and competitions. The market for these beverages has increased in the past years and although they might be harmless, overdoses or combination of these with other drinks could be harmful to the health of some consumers in certain circumstances (Santa-Maria *et al*., 2002).

All kinds of soft drinks are acidic, especially cola. Cola drinks make our bodies poor in oxygen (Lin *et al*., 2003a). Energy drinks often contain ingredients such as caffeine, guarana, glucuronolactone, methylxanthines and taurine. Beverage components include sugar, artificial sweeteners, physiological stimulants, preservatives, artificial flavors or colors, food acids and other food additives (Jacobson, 2005). The quantity of these ingredients should be known by consumers, although these products do not carry any nutritional labels and hence the public do not know the health benefits or hazards associated with the consumption of these beverages.

Caffeine is a stimulant commonly found in many foods, drinks and has a mild addictive effects on the body. Caffeine is known chemically as trimethylxanthine and the chemical formula is $C_8H_{10}N_4O_2$ (Burge and Raches, 2003). Caffeine's effect on our body, our nervous system, our mind, our psychology is no longer illusion (Lin *et al*., 2003b). Caffeine stimulates the central nervous system/ in the amounts presently being consumed, it can cause insomnia, nervousness, irritability, anxiety and disturbances in the heart rate and rhythm (Laasonen *et al*., 2003).

In moderate doses, caffeine can increase alertness, reduce fine motor coordination of the human system, alter sleep patterns (Kamimori and others, 2000) and cause headaches, nervousness and dizziness. In massive doses, caffeine is lethal. A fatal dose of caffeine has been calculated to be more than 10 grams (about 170 mg/kg body weight); this is the same as drinking 80 to 100 cups of coffee in rapid succession-not an easy thing to do. Effects of caffeine include an increase in heart rate, constriction of blood vessels (Lovallo *et al*., 2000). This study aimed to compare the caffeine and trace minerals of soft and energy drinks available in Basrah markets.

MATERIALS AND METHODS

Beverages samples: Ten brand of beverages were purchased from Basrah markets.

pH Determination: beverages pH were determined by using sartorius pH meter.

Trace element determination: A flame atomic absorption spectrophotometer model (shimadzu AA-630-12) with an air-acetylene burner (slot dimensions 100_L0.62 mm) was used for determination of Fe, Cd, Pb, Mn and Ca.

Caffeine determination: Caffeine was determined by using shimadzu gas chromatography. Caffeine is separated on a micro C18 column, using a mobile phase of 25% acetic acid, 70% water and 5% isopropyl alcohol at pH 3.0 and UV detection at 254 nm.

Corresponding Author: Sarmad G. Mohammed, Department of Food Science and Biotechnology, Agriculture College, Basrah University, Basrah, Iraq

Beverages are filtered through 0.45 micron filters and injected directly into the chromatograph. Caffeine is eluted in approximately 7 min.

Statistical analysis: All results were analyzed statistically using two-way analysis of variance with unbalanced repeated measurements. Statistical between individual time points was made by using Revised Least Significant Difference (RLSD) test. The probability level for significance was 5% or less.

RESULTS AND DISCUSSION

pH values in Table 1 show that all beverages were low in its pH, Pepsi was the lowest pH (2.75), while Kalaschnikow was the highest pH (3.66).

The reason behind the low pH values of these beverages may attributed to CO_2 gas used in manufacturing these beverages or the presence of other acids such as citric acid, phosphoric acid, ascorbic acid, malic acid, tartaric acid (Bassiouny and Yang, 2005; Ashurst, 2005). This acids inhibit the growth of microorganisms such as bacteria, mould and fungi which may contaminate beverages. Drinking acidic beverages over a long period can erode tooth enamel and predispose the consumer to dental disease (Marshall *et al*., 2003; Bassiouny and Yang, 2005).

Caffeine was found in all beverages except Riviere and Barbican as shown in Table 2, the higher level of caffeine was in Kalaschnikow 103.13 mg/100 ml when compared with other beverages followed by Boom Boom, Power horse, O_2, Pit bull, Pepsi, Wild Tiger and Mountain dew respectively.

Table 3 shows minerals concentrations in beverages, Iron and calcium were found in all beverages, iron was the highest in Riviere (0.103 mg/100 ml) and the lowest in O_2 (0.012 mg/100 ml). Calcium was the highest in Power horse (6.6 mg/100 ml) and the lowest in Wild Tiger (1.9 mg/100 ml). Cadmium was the highest in Boom Boom (0.034 mg/100 ml) and found just in (Boom Boom, Pit bull, Kalaschnikow and Barbican), while was the lowest in Kalaschnikow. Lead was found only in O_2, Power horse, Kalaschnikow and Riviere and was the highest in Power horse (0.014 mg/100 ml) and the lowest in O_2 (0.010 mg/100 ml). Manganese was found in Boom Boom, Wild Tiger, Power horse, Pit bull and Riviere and was the highest in Wild Tiger (0.021 mg/100 ml) and the lowest in Pit bull (0.010 mg/100 ml).

Mineral elements are important building blocks needed for renewal of tissues such as blood and bone. Minerals are inorganic substances, usually required in small amounts from less than 1 to 2500 mg per day, depending on the mineral. As with vitamins and other essential food nutrients, present in all body tissues and fluids and their presence is necessary for the maintenance of certain physicochemical processes which are essential to life. Although they yield no energy, they have important roles to play in many activities in the body (Malhotra, 1998; Eruvbetine, 2003). In this study all minerals were below the harmful limits.

Table 1: Beverages pH

No.	Beverages	pH
1	O_2	2.96±0.02
2	Boom Boom	3.49±0.07
3	Wild Tiger	3.18±0.12
4	Power horse	3.42±0.09
5	Kalaschnikow	3.66±0.01
6	Pit bull	3.38±0.03
7	Pepsi	2.75±0.04
8	Mountain dew	3.20±0.01
9	Riviere	2.92±0.01
10	Barbican	2.92±0.00

Results are expressed as Mean±SD

Table 2: Caffeine concentrations of beverages

No.	Beverages	Mg/100 ml
1	Kalaschnikow	103.13±1.14
2	Boom Boom	102.56±1.11
3	Power horse	94.53±0.10
4	O_2	90.89±1.02
5	Pit bull	79.99±1.00
6	Pepsi	80.00±1.34
7	Wild tiger	79.94±0.22
8	Mountain dew	44.08±0.34
9	Riviere	BDL
10	Barbican	BDL

Results are expressed as Mean±SD. BDL = Below Detection Limit

According to (Health Canada, 2010), the maximum recommended daily intake of caffeine is 45-85 mg per day for children (2-4 years), 125 mg per day for teenager (13 years) and 400 mg per day for adult and comparing with our results Table 4 shows the limit of daily intake of studied beverages according to (Health Canada).

Perhaps the most important reason for the consumption of caffeine by so many individuals relates to the long-standing belief that caffeine enhances mental effectiveness. Death due to excessive caffeine ingestion is not common and only a few cases have been reported in the literature. The acute lethal dose in adult humans has been estimated to be 10 g/person. Death has been reported after ingestion of 6.5 g caffeine, but survival of a patient who allegedly ingested 24 g caffeine was also reported (Stavric, 1988; James, 1991).

Athletes must be made aware that energy drinks are not appropriate substitutes for optimal fuel and fluid and may have no bearing at all on how energized they feel. In addition, athletes should be educated about these products.

Caffeine is a central nervous system stimulant and although the effect is temporary, it may make an athlete feel more "energized." In laboratory studies, caffeine at a dose of about 6 mg/kg body weight has often proved effective at enhancing exercise performance lasting from

Table 3: Minerals concentrations of beverages

		Trace minerals (mg/100 ml)				
No.	Beverages	Fe	Cd	Pb	Mn	Ca
1	O_2	0.012±0.01	BDL	0.010±0.01	BDL	2.5±0.01
2	Boom Boom	0.044±0.00	0.034±0.01	BDL	0.017±0.01	4.1±0.01
3	Wild tiger	0.023±0.03	BDL	BDL	0.021±0.00	1.9±0.00
4	Power horse	0.075±0.02	BDL	0.014±0.00	0.011±0.02	6.6±0.03
5	Kalaschnikow	0.095±0.01	0.014±0.02	0.011±0.01	BDL	5.2±0.01
6	Pit bull	0.101±0.00	0.025±0.00	BDL	0.010±0.00	5.5±0.02
7	Pepsi	0.040±0.01	BDL	BDL	BDL	3.4±0.01
8	Mountain dew	0.082±0.02	BDL	BDL	BDL	2.7±0.00
9	Riviere	0.103±0.00	BDL	0.012±0.01	0.014±0.02	2.9±0.01
10	Barbican	0.023±0.01	0.016±0.01	BDL	BDL	3.2±0.00

Results are expressed as Mean±SD. BDL = Below Detection Limit

Table 4: Limit of daily intake of studied beverages according to (Health Canada)

				Children	Teenager	Adult
No.	Beverages	Mg/can	Volume	Can per day		
1	Power horse	311.94	330 ml	0	0	1
2	Kalaschnikow	257.82	250 ml	0	0	1
3	Boom Boom	256.40	250 ml	0	0	1
4	O_2	227.22	250 ml	0	0	1
6	Pepsi	200.00	250 ml	0	0	2
7	Wild tiger	199.85	250 ml	0	0	2
5	Pit bull	198.37	248 ml	0	0	2
8	Mountain dew	110.20	250 ml	0	1	3-4
9	Riviere	BDL	340 ml	NA	NA	NA
10	Barbican	BDL	330 ml	NA	NA	NA

NA = Not Available

1-120 min (Graham, 2001). The dose of caffeine contained in energy drinks is not always apparent on the label but may be high enough to put the athlete at risk for failing a doping test for caffeine.

REFERENCES

Ashurst, P.R., 2005. Chemistry and Technology of Soft drinks and Fruit Juices. 2nd Edn., Vol. III (4) Blackwell Scientific Publication, London, pp: 433.

Bassiouny, M.A. and J. Yang, 2005. Influence of drinking patterns of Carbonated beverages on dental erosion. General Dentistry, 53: 207-210.

Burge, L.J. and D.W. Raches, 2003. Determination of caffeine by HPLC with UV detector. J. Liquid Chromatogr. Related Technol., 26: 1977-1990.

Eruvbetine, D., 2003. Canine Nutrition and Health. A paper presented at the seminar organized by Kensington Pharmaceuticals Nig. Ltd., Lagos on August 21, 2003.

Graham, T.E., 2001. Caffeine and exercise: Metabolism, endurance and performance. Sports Med., 31: 785-807.

Health Canada, 2010. It's Your Health. Caffeine. February 2006, updated March 2010. Online: http://www.hc-sc.gc.ca/hl-vs/iyh-vsv/food-aliment/caffeine-eng.php (accessed September 20, 2010).

Jacobson, M.F., 2005. Liquid Candy-How Soft Drinks are harming America's Health. 2nd Edn., Blackwell Scientific Publication Washington DC, pp: 464.

James, J.E., 1991. Toxicity. Caffeine and Health, edited by J.E. James (London: Academic Press), pp: 63-95.

Kamimori, G.H., D.M. Penetar, D.B. Headley, D.R. Thorne, R. Otterstetter and G. Belenky, 2000. Effect of 3 caffeine doses on plasma catecholamines and alertness during prolongedwakefulness. Eur. J. Clin. Pharmacol., 56: 537-544.

Laasonen, M., P.T. Harmia, C. Simard, M. Raesaenen and H. Vuorela, 2003. Spectrophotometeric determination of caffeine in coffee and tea leaves. Anal. Chem., 75: 754-760.

Lin, C.I., A.K. Joseph, C.K. Chang, Y.C. Wang and Y.D. Lee, 2003a. Estimation of caffeine in tea samples by spectrophotometrically. Analytica Chimica Acta, 481: 175-180.

Lin, Y., Y.J. Tsai, J.S. Tsay and J.K. Lin, 2003b. Estimation of caffeine by HPLC in different OTC drugs. J. Agric. Food Chem., 51: 1864-1873.

Lovallo, W.R., M. Al'Absi, G.A. Pincomb, R.B. Passey, B.H. Sung and M.F. Wilson, 2000. Caffeine, extended stress and blood pressure in borderline hypertensive men. Int. J. Behavioral. Med., 7: 183-188.

Malhotra, V.K., 1998. Biochemistry for Students. Tenth Edition. Jaypee Brothers Medical Publishers (P) Ltd, New Delhi, India.

Marshall, T.A., S.M. Levy, B. Broffit, J.J. Warren, J.M. Eichenberger-Gilmore, T.L. Burns and P.J. Stambo, 2003. Dental carries and beverage consumption in young children. Pediatrics, 112: e184-189.

Santa-Maria, A., M.M. Diaz, A. Lopez, M.T. de Miguel, M.J. Fernandez and A.I. Ortiz, 2002. *In vitro* toxicity of stimulant soft drinks. Ecotoxicol. Environ. Saf., 53: 70-72.

Stavric, B., 1988. Methylxanthines: Toxicity to humans. 2. Caffeine. Food Chem. Toxicol., 26: 645-662.