



Prevalance And Amounts Of B-Vitamins And Taurine In Popular Energy Drinks In Indian Market

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Abstract

Energy drinks are among the most popular packaged beverages consumed globally, falling under the category of functional beverages, which also includes sports drinks and nutraceutical beverages. They contain a variety of ingredients which, as claimed by the manufacturers, has a beneficial impact on its consumer's health. This study focused on examining the nutrition fact information on the product labels of the top-selling energy drinks in India to analyze B-vitamins and taurine profiles. The results were compared with the ingredient profiles listed on the product labels and the standards set by FSSAI for energy drinks. The top 10 commercially available energy drinks in the Indian market were identified through a multiple commercial retail websites. 10 samples each of 10 different energy drink brands popular in Indian market were included in this analysis, which makes a sample size of 100 samples. The ingredients selected for this study were as follows: vitamin B2, vitamin B3, vitamin B6, vitamin B9, and taurine. The findings of this study suggest a high prevalence of B-vitamins and taurine in all these energy drink brands, with many of the formulations containing well above the recommended values by FSSAI and below the concentrations mentioned on the product label, suggesting significant discrepancies and non-compliance with FSSAI standards as well as the product labels.

Key words: energy drinks, B-vitamins, taurine, FSSAI standards, product label, HPLC

Introduction

Energy drinks (EDs) are beverages designed to enhance energy, alertness, and concentration. They typically contain caffeine, sugar, vitamins, taurine, ginseng, and B vitamins, although specific amounts are often undisclosed.¹ These drinks are marketed for their purported benefits, including increased energy and alertness, reduced fatigue, enhanced physical performance, and boosted metabolic activity.² As functional beverages, they are grouped with sports drinks and nutraceutical beverages.³ Effective marketing has created a strong consumer base, with the global market for carbonated beverages projected to exceed 410 billion USD by 2023.⁴ The reason behind popularity of these beverages is marketing tactics used by these brands which claim to provide rapid energy boost through ingredients such as caffeine, vitamins, sugars and taurine.⁵ Although moderate consumption of caffeine and vitamins is advised, excessive intake can pose potential health risks.⁵

A study examined the effects of energy drinks (EDs) and concluded that they contain many poorly studied and unregulated ingredients with no therapeutic value. Reports of toxicity from these beverages indicate serious adverse health effects.^{4,6} Taurine, a non-essential amino acid concentrated in the brain, heart, and skeletal muscle,⁷ has inconsistent or limited evidence supporting its added benefits in EDs beyond caffeine's effects.¹ Caffeine and taurine, often found in EDs, can have synergistic effects⁸ and influence intracellular calcium levels in vascular smooth muscles, potentially leading to cardiac hypertrophy and heart failure.⁹ A study showed that consuming sugar-free EDs with high taurine (1g) and low caffeine levels (0.08g) increased mean arterial pressure and platelet aggregation, while reducing endothelial function.¹⁰ Additionally, high levels of Vitamin B6 in these drinks have raised concerns. Vitamins, essential micronutrients, play crucial metabolic and physiological roles. Water-soluble vitamins like vitamin C and B-group vitamins are vital for metabolism, and their deficiency can lead to disorders.¹¹ These vitamins are added in energy drinks for their biological functions and to unlock energy from sugars.¹² While B-group vitamins are claimed to improve alertness, concentration, and mood, a balanced diet usually provides sufficient amounts for active adults,^{13,14} negating the need for supplementation. No studies show that multivitamins in these drinks improve performance more than caffeine alone.¹ Neuropathic

conditions have been linked to daily consumption of 2-6 grams of Vitamin B6,¹⁵ dating as long as 1983, and later research shows that even small daily doses (as low as 50 milligrams) can be neurotoxic.^{4,16,17,18} Since the consumption rates and popularity of these beverages are on the rise, and therefore, it is important to continue examining the ingredients of these drinks for their safety evaluation. Therefore, the focus of this study was to measure B-Vitamins and taurine concentrations in energy drinks using HPLC and compare the obtained results with the nutrition fact panel on the product label and the standards set by FSSAI.

Methodology

For sample collection, e-commerce websites and apps were used for filtering out the top 10 brands and making purchases. A total of 100 non-alcoholic energy drink samples, comprising 10 samples each from 10 different brands, were procured from various online and offline stores in Prayagraj, Uttar Pradesh at different time period and stored at 4°C in sterile conditions. The samples were tested at Instrumental Laboratory, Rohilkhand Laboratory and Research Center, Bareilly, Uttar Pradesh in 2022. At the time of testing, the samples were firstly degassed using ultrasonicator, followed by sample preparation. All reagents and reference materials used in this study were of HPLC analytical grade and all the lab wares and instruments used were sterile. Different mobile phases were used for extraction of different analytes¹⁹⁻²³ which have been enlisted in the table 1 below:

Table 1: Mobile phases for extraction of different analytes through HPLC¹⁹⁻²³

Sr. No.	Analyte	Mobile Phase A	Mobile Phase B	Ratio of mobile phase A:B
1.	B-vitamins (B2, B3, B6, B9)	Sodium Sulphonic Acid and 25% Methanol	Pentane Acetic Acid and 25% Methanol	62.5:37.5
2.	Taurine	Phosphate solution	Buffer	80:20

Later, the samples were subjected to HPLC for analysis. The HPLC instrument used was Agilent HPLC-1260 Infinity II with an autosampler, Agilent Zorbax Eclipse Plus C18 column (5 µm, 4.6 x 250 mm).

Table 2: HPLC instrument condition for analysis of different analytes

Sr. No.	Analyte	Flow rate (ml/min)	Run time (in min.)	Injection vol. (in µL)	Detector	Column Oven Temp.	λ_{max} (in nm)	Retention time of standard (in min.)	Average Retention time of sample (in min.)
1.	B-vit. (B2, B3, B6, B9)	1.0	B2- 32 B3,B6- 10 B9- 13	20	DAD	Ambient	B2, B3- 262 B6- 290 B9- 282	B2- 16.36 B3- 3.93 B6- 9.55 B9- 5.72	B2- 19.42 B3- 3.89 B6- 9.04 B9- 6.08
2.	Taurine	1.0	15	10	UV	Ambient	360	2.78	2.81

The UV maximum absorbance value of the sample had to match that of the standard. The results were calculated using Agilent OpenLAB software to control the system and process the data. After analysis, the average concentration of the analytes of these 10 samples per brands was taken into consideration and the obtained processed data was then tabulated (table 3,4,5) for comparison with FSSAI standards and product label claims.

Results and discussion

The data obtained from HPLC analysis of B-vitamins and taurine are presented as an average value below in tabulated form for comparison of actual concentration of analytes in the samples of brand B-1 to B-10 with that of concentrations as per FSSAI standards and those mentioned on the product label.

Table 3: Concentration of vitamin B2 and B3 in different brands (B1-B10) of energy drinks

Brand	Vitamin B2 conc. in sample			Vitamin B3 conc. in sample		
	As per FSSAI	As per product label	Analysis result	As per FSSAI	As per product label	Analysis result
	Conc. (ppm)	Conc. (ppm)	Average Conc. (ppm)	Conc. (ppm)	Conc. (ppm)	Average Conc. (ppm)
B-1	12	8.29	390.30	160	25.14	46.44
B-2	12	2	49.98	160	24	0.00

B-3	12	NA	1130.58	160	7.6	50.29
B-4	12	NA	24.34	160	19	55.95
B-5	12	NA	1505.43	160	30	48.30
B-6	12	NA	979.33	160	7.6	47.35
B-7	12	NA	36.87	160	19	0.00
B-8	12	NA	60.41	160	131.2	0.00
B-9	12	NA	2374.18	160	30	83.89
B-10	12	2	0.00	160	24	44.38

Table 4: Concentration of vitamin B6 and B9 in different brands (B1-B10) of energy drinks

Brand	Vitamin B6 conc. in sample			Vitamin B9 conc. in sample		
	As per FSSAI	As per product label	Analysis result	As per FSSAI	As per product label	Analysis result
	Conc. (ppm)	Conc. (ppm)	Conc. (ppm)	Conc. (ppm)	Conc. (ppm)	Conc. (ppm)
B-1	20	3.43	0.00	0.01	NA	646.50
B-2	20	4	115.43	0.01	NA	0.00
B-3	20	0.8	0.00	0.01	NA	777.28
B-4	20	2	0.00	0.01	NA	734.96
B-5	20	4	6.86	0.01	NA	693.34
B-6	20	0.8	0.00	0.01	NA	665.36
B-7	20	2	0.00	0.01	NA	669.73
B-8	20	24.48	114.63	0.01	NA	0.00
B-9	20	4	11.48	0.01	NA	565.29
B-10	20	4	22.53	0.01	NA	728.86

Table 5: Concentration of taurine in different brands (B1-B10) of energy drinks

Brand	Taurine conc. in sample		
	As per FSSAI	As per product label	Analysis result
	Conc. (ppm)	Conc. (ppm)	Conc. (ppm)
B-1	500	4000	1631.93
B-2	500	4000	1104.19
B-3	500	NA	1097.50
B-4	500	NA	1494.39
B-5	500	NA	1054.30
B-6	500	NA	1139.46
B-7	500	NA	953.92
B-8	500	4000	1124.42
B-9	500	2380	777.84
B-10	500	4000	1113.89

The analysis of vitamin B2, B3, B6, and B9 concentrations in ten different brands (B1-B10) of energy drinks reveals significant discrepancies between FSSAI standards, product labels, and actual results. For vitamin B2, the product label concentrations ranged from 2 ppm to 8.29 ppm, with B-1 having the highest and B-2 and B-10 the lowest concentration. Actual concentrations ranged from 0 ppm in B-10 to 2374.18 ppm in B-9, exceeding labeled values by up to 1187.09 times and FSSAI standards by up to 1,97.85 times. For vitamin B3, labeled concentrations ranged from 7.6 ppm to 131.2 ppm, with actual values ranging from 0 ppm in B-2, B-7, and B-8 to 83.89 ppm in B-9, exceeding labels by up to 11.04 times. Vitamin B6 labeled concentrations ranged from 0.8 ppm to 24.48 ppm, with actual values from 0 ppm in several brands to 115.43 ppm in B-2, exceeding labels and FSSAI standards by up to 5.8 times. For vitamin B9, no label values were provided, with actual concentrations ranging from 0 ppm in several brands to 777.3 ppm in B-3, exceeding FSSAI standards by up to 77728 times. These findings highlight significant non-compliance and potential consumer fraud.

The analysis of taurine concentration in ten different brands (B1-B10) of energy drinks reveals discrepancies between FSSAI standards, product labels, and actual results. The FSSAI standard for taurine is 500 ppm. Product label concentrations range from 2,380 ppm to 4,000 ppm, with B-9 having the lowest and B-1, B-2, B-8, and B-10 having the highest. Actual taurine concentrations range from 777.84 ppm in B-9 to 1,631.93 ppm in B-1, exceeding labeled values by up to 4.76 times and FSSAI standards by up to 3.26 times. These findings highlight discrepancies and potential non-compliance with regulatory standards.

Conclusion

This study focused on the analysis of vitamin B2, B3, B6, B9, and taurine concentrations in various brands of energy drinks and the results reveal significant discrepancies between actual measurements, product labels, and FSSAI standards. As per the results, actual concentrations of vitamins and taurine frequently exceed the amounts listed on product labels and regulatory standards, sometimes by substantial margins. These discrepancies indicate potential non-compliance with regulatory standards and consumer fraud, due to the inaccurate labeling of the product.

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