

## Microbiological Quality and Safety of Energy Drink Available in the Local Markets in Saudi Arabia

Research Article

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### Abstract

Energy drinks have become a popular beverage worldwide. The global market for energy drink has gained momentum in the past decade, and demand is increasing every year. The objective of this study was to evaluate the microbiological quality and safety of commercial energy drinks available in the local stores in Saudi Arabia. Total bacterial count, coliform, *Escherichia coli*, *Salmonella*, and *Staphylococcus aureus* were included in this analysis. Out of a total of 20 tested energy drinks, microbial contamination was present in only two products. Microbial levels of the total bacterial count for most of the samples were very low ( $< 1.0 \log \text{CFU/ml}$ ). The initial biochemical analysis from these two samples indicated the presence of *Bacillus* which is common spoilage bacteria in soft drinks showed bacterial contamination. In addition, we also tested the impact of energy drinks on beneficial microorganisms (*Bifidobacterium* and *Lactobacillus* spp). We found that in all tested energy drinks bacterial population decreased by at least  $4.0 \log \text{CFU/ml}$  indicating the negative effects of drinks on the survival of beneficial microorganisms. Our findings suggested that safety improvements are needed in these energy drinks. Moreover, consumers also need to be educated regarding the impact of various ingredients, their safety, and recommendation regarding the use of these drinks. This will help to ensure safe products available for today's savvy, health-conscious consumer. Thus, the proposed methodology could be useful for quality and safety control purposes in the energy drinks industry.

**Key words:** Energy drink; Microbiological quality; energy drink safety; Bacterial contamination.

### Introduction

The global market for energy drink has gained momentum in the past decade, and demand is increasing every year. Likewise, there is an increased awareness of the importance of energy drink safety. Each year new energy drinks come on the market in Saudi Arabia [1,2]. However, the Saudi Council of Ministers has decided to ban energy drink advertising altogether. This ban also applies to the distribution of free energy drinks to consumers of all age groups and prohibits the sale of energy drinks in restaurants and canteens in government facilities, education and health facilities, halls of government and private sports clubs. A committed council resolution of factory owners and importers of energy drinks has warned of the harmful effects of energy drinks [3,4]. As the global market for energy drinks approaches nearly \$15 trillion, the general consumption of energy drinks has increased accordingly, particularly among college students. The consumption rates among this demographic are increasing because of the concentra-

tion enhancement and fatigue-relieving effects of energy drinks [5], yet there is relatively little information regarding the safety and quality of these products. In addition, information on the use of energy drinks among students is vague and misleading. In the quest to be the strongest and fastest, many students consume unproven, potentially harmful, or even banned energy drinks. Popular energy drinks such as Red Bull, Power Horse, Bison, Bugzy, Code Red, Boom Boom, Shark, Double Horse, Blu Day, Black, and AMP were used in this study [6,7,8]. Caffeine is no longer banned by the World Anti-Doping Agency. Nevertheless, one should only use caffeine with the advice of a sports scientist or sports dietitian and individual responses to caffeine should be considered. Red Bull energy drink is a popular carbonated taurine drink with caffeine that claims to vitalize the body and mind. Red Bull is designed especially for moments of increased physical and mental stress and improves endurance, alertness, concentration, and reaction speed. The effectiveness of Red Bull energy drink is supported by quite a bit of scientific research and endorsed

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by recognized sports professionals [9,10]. The ergogenic effect of caffeine in endurance exercise performance is well established. Two important key factors are: microbiological quality and safety of commercial energy drinks available in the local stores.

## Saudi Arabia

Cities of Saudi Arabia including Riyadh are very hot and arid reaching an average temperature as high as 36°C. Temperature, oxygen, and moisture content of the storage area are the most important factors that influence the type of microbial growth and spoilage. There are not well established and regulated criteria for the storage of food products including energy drinks in Saudi Arabian markets. As a result of this, even imported products such as energy drinks have been shown to be a potential risk factor for the development of microbial hazards. In addition, there is very limited published information regarding the quality and safety of these products in Saudi Arabian markets [11]. Therefore, in this study we tested the microbiological quality of these drinks to ensure that the products are safe.

## Materials and Methods

### Samplings

Twenty different commercial energy drinks were collected from local stores in Riyadh, Saudi Arabia. The samples were collected based on the protocol described earlier by Aljaloud et al. [11]. The numbers of samples were based on the availability of drinks in a particular district of Riyadh. These products were randomly labeled with different number (three digit for day of month and time (example 110 means first day of the month 10 am)). All products were picked in duplicates from each store and then shipped to Food Microbiology Laboratory at North Carolina Agricultural & Technical State University, Greensboro, NC, for microbial quality and product safety analysis.

### Microbiological and Safety Quality Test

From each commercial sample, 25 ml of drinks were added in 100 ml sterilized Brain Heart Infusion (BHI) broth and mixed thoroughly. Samples were then incubated at 37 °C for 4 h to allow for microbial cell recovery if present. One milliliter from each sample was then withdrawn and diluted with 0.1% peptone water. The appropriate dilutions were plated onto duplicate selective agar medium. To obtain the total bacterial count, samples were plated on BHI agar. To test for coliform and *E. coli*, samples were plated on Violet Red Glucose Bile agar (VRGBA) and MacConky agar, respectively. Similarly, samples were plated on Xylose lysine deoxycholate (XLD) agar for *Salmonella*, and Baird-Parker agar (BPAB) for *Staphylococcus aureus* count.

### Impact on the survival of *Lactobacillus* and *Bifidobacterium*

Batches of sterilized 5 ml DeMan- Rogosa- Sharpe (MRS) both samples were prepared then 5 ml of each commercial sample was added separately into each MRS broth. Samples were then inoculated with active *Lactobacillus reuteri* (*L. reuteri* ATCC SD2112) and *Bifidobacterium* (*B. bifidum* ATCC 15696) to achieve final inoculum level of 6.0 Log CFU/ml. We selected these strains as both *Lactobacillus* and *bifidobacteria* make up an integral part of

the healthy human intestinal flora. Samples were then incubated at 37°C for 4 h to determine the impact of energy drinks on the survival of *Lactobacillus* and *Bifidobacterium*. One milliliter from each sample was then withdrawn and diluted with 0.1% peptone water. The appropriate dilutions were plated onto duplicate selective agar medium. Samples were plated on MRS agar for the enumeration of *Lactobacillus* and on *Bifidobacterium* iodoacetate medium 25 (BIM-25) for the enumeration of *Bifidobacterium*.

## Results and Discussion

### Microbiological and Safety Quality Test

Table 1 shows the list of energy drinks tested. Our results showed that none of the commercial samples contain harmful bacteria. The results indicated the absence of *E. coli*, *Salmonella* and *Staphylococcus aureus*. The total bacterial count for most of the samples are very low (< 1 log CFU/ml). Only two tested samples that have bacterial population of approximately 2.0 Log CFU/ml. These samples have low caffeine concentrations and higher pH values compared to other samples which could be the reason of survival of bacterial population. The initial biochemical analysis from these two samples indicated the presence of *Bacillus* which is common spoilage bacteria in soft drinks.

### Impact on the survival of *Lactobacillus* and *Bifidobacterium* spp.

All test energy drink showed lethal effect on both *Lactobacillus* and *bifidobacterial* strains tested as the bacterial count decreased to below 2.0 log CFU/ml. With only three products (17-19), the populations of *Lactobacillus* and *Bifidobacterium* spp. were approximately 2.5 log CFU/ml.

In this study we evaluated the microbiological quality and safety of 20 most common energy drinks available in the local stores in Saudi Arabia. The samples were selected based on the size of the samples and affordability to purchase the products. Our results confirmed the safety and quality of all tested products as they showed low level of total bacterial population and absence of common spoilage and pathogenic bacteria. However, our findings showed that energy drinks could have negative impact on human health as these drinks demolish the presence of natural flora such as *Lactobacillus* and *Bifidobacterium* spp. in human gastrointestinal tract. These bacteria are important to the health and contribute to different aspect of human health. Regular consumption of energy drink could have a long term negative impact on health and consumers should be educated about such effect to maintain healthy life style.

### Limitations

During this study we faced several challenges that limit the scope of the work, we were only be able to collect 20 different brand of energy drinks from local stores in Riyadh. This is due to the restriction in sales regulations. Availability of energy drinks varied from region to region limits the sample size needed to represent the large population. We understand that this is a small representation of the energy drink products. However, this study could open the opportunity for possible collaboration with other countries and exam wide range of commercial products.

**Table 1. List of energy drinks, quantity of caffeine, total bacterial count and pH values.**

Product Number	Caffeine (mg/L)	Total Bacterial Count (Log CFU/ml)	pH value
1	3500	1.6	3.85
2	300	< 1.0	4.1
3	280	< 1.0	3.86
4	530	1.2	3.9
5	300	< 1.0	4.1
6	900	< 1.0	3.54
7	320	1.7	4.15
8	210	< 1.0	4.23
9	450	< 1.0	3.9
10	500	< 1.0	3.79
11	120	2.1	4.15
12	310	1.3	4.2
13	500	< 1.0	3.75
14	310	1.75	3.8
15	400	< 1.0	4.05
16	500	< 1.0	3.76
17	160	2.3	3.95
18	50	2.5	4.2
19	10	2.1	4.1
20	290	< 1.0	3.87

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## References

- [1]. Aljaloud SO (2014) Availability of dietary supplements in Saudi Arabia. *Journal of Theories and Applications the International Edition*, Alexandria, Egypt 82(2): 86-100.
- [2]. Temple JL, Ziegler AM, Epstein LH (2016) Influence of price and labeling on energy drink purchasing in an experimental convenience store. *J Nutr Educ Behav* 48(1): 54-59. e51.
- [3]. Aljaloud SO (2015) Effectiveness of an educational program on the cognitive status and habits on the use of dietary supplements facts information to consumers in Saudi Arabia. *Journal of theories and applications the International Edition*. 86(3).
- [4]. Aljaloud SO (2015) Dietary supplements for professional athletes: A great potential for Saudi Arabia. *J Nutr Health Food Eng* 3(1): 00097.
- [5]. Kim YJ, Jeon EM, Shim SB, Seo HJ (2015) Effects of awareness and knowledge of energy drinks on consumption patterns among college students. *Korean J Health Promot* 15(1): 31-38.
- [6]. Aljaloud SO (2013) Understanding the behavior and attitude of professional athletes in Saudi Arabia toward dietary supplements (Doctoral dissertation, North Carolina Agricultural and Technical State University).
- [7]. Aljaloud SO, Ibrahim SA (2013) Use of dietary supplements among professional athletes in Saudi Arabia. *J Nutr Metab* 2013: 1-7.
- [8]. Kim JG, Yousef AE, Dave S (1999) Application of ozone for enhancing the microbiological safety and quality of foods: a review. *J Food Prot* 62(9): 1071-1087.
- [9]. Alford C, Cox H, Wescott R (2001) The effects of red bull energy drink on human performance and mood. *Amino Acids* 21(2): 139-150.
- [10]. Alhyas L, El Kashef A, AlGhaferi H (2015) Energy drinks in the gulf cooperation council states: A review. *JRSM Open* 7(1).
- [11]. Aljaloud SO, Ibrahim SA, Fraser AM, Song T, Shahbazi A (2013) Microbiological quality and safety of dietary supplements sold in Saudi Arabia. *Emir J Food Agric* 25(8): 593-596.