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Kathleen M. Laquale

Bridgewater State College, klaquale@bridgew.edu

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Red Bull®: The Other Energy Drink and its Effect on Performance

TRADITIONALLY, SPORTS DRINKS have been used by athletes to replenish electrolytes. They are known for their delivery of carbohydrate *energy* to fuel working muscles. Researchers at Gatorade® state, “there is no place for caffeine in Gatorade because caffeine is a drug, not a nutrient . . . other ingredients that are sometimes added to sports drinks to provide additional benefits such as vitamins, protein and caffeine aren’t needed because the body can’t use them during exercise.”¹ During exercise, the effect of caffeine on aldosterone, an antidiuretic hormone, results in greater water retention.² After exercise, caffeine has a diuretic effect that can limit rehydration by increasing urine production when the body is at rest. Thus, caffeine should not be consumed in the hours preceding exercise, when hydration is required, or after exercise, when the athlete needs to rehydrate. Enter Red Bull® Energy Drink into the athletic arena.

Developed in Austria, Red Bull’s marketing campaign promises the beverage “gives you wings.” According to Red Bull, all of the ingredients are synthetically produced by pharmaceutical companies, which “guarantees the highest quality” of ingredients. The company claims the combination of caffeine, taurine, and glucuronolactone will boost energy. So what is in Red Bull that can “give us wings?” Each 250 ml (8.3 oz) can of Red Bull contains the following: 1000 mg of taurine, 600mg of glucuronolactone, 80 mg of caffeine, 18 mg of niacin (niacinamide), 6 mg of pantothenic acid (calcium d-pantothenate), 2 mg of vitamin B₆ (pyridoxine HCl), vitamin B₂ (riboflavin), vitamin B₁₂ (cyanocobalamin), inositol, and nonmedicinal ingredients: carbonated water, sucrose, glucose (27 grams of sugar), citric acid, flavors, and caramel. Of the 15 ingredients, you could probably identify 9-10 as

being familiar. Let’s investigate three of the ingredients: taurine, glucuronolactone, and caffeine.

Taurine comes from the Latin word *taurus* or bull. It was isolated from ox bile in 1827 by German scientists Friedrich Tiedemann and Leopold Gmelin, who identified it as 2-aminoethanesulfonic acid. Taurine plays a role in digestion and is naturally found in bile, urine, and fluids of muscle, lungs, and nerve tissue of many animals. It is also in some plants and some bacterial species. Many companies that manufacture products containing taurine classify it as an amino acid; however, since it lacks a carboxyl group, it is not an amino acid and it is not incorporated into protein.² Taurine promotes the intestinal absorption of lipids or fats as cholesterol. It also works in electrically active tissues, such as the brain and heart, to stabilize cell membranes. Additionally, taurine has functions in the gallbladder, eyes, and blood vessels. Thus, it may be helpful in treating cardiovascular disease, high cholesterol, seizure disorders, macular degeneration, and hepatic conditions.³ The mechanism of its action, however, is specific to the pathology; therefore, if the condition isn’t present, intake of taurine will not help.⁴ The biosynthesis of taurine occurs in the liver via the cysteine sulfonic acid pathway. The mean intake in humans is estimated to be around 60 mg daily. Premature infants, who lack the enzyme to convert cysteine and synthesize taurine, may become deficient in taurine. Therefore, for the premature infant, taurine is a dietary essential nutrient often found as a supplement in baby formulas and baby foods.

Research on the effects of taurine or Red Bull on athletic performance is extremely limited. Alford et al. studied 36 volunteers assessing the effect of Red Bull on psychomotor performance, subjective alertness, and physical endurance.⁵ Red Bull was found to improve

aerobic endurance and anaerobic performance on cycle ergometers. The researchers concluded that the combination of the ingredients in Red Bull influenced the results. Baum and Weiss investigated the effect of taurine on cardiac parameters in thirteen endurance-trained subjects.⁶ They concluded the influence of caffeine and taurine affected cardiac contractility. In both studies, the number of subjects was small, they did not differentiate the influence of each ingredient independently, and at the writing of this column, there have not been additional studies since 2001 that have supported their results. Thus, the jury is still out in the influence of Red Bull on athletic performance.

Many supplement companies claim taurine is essential for humans, yet they base their statements on studies conducted on cats in the 1970s. It is indeed essential for the health of a cat, and is abundant in most forms of cat food, but it is not essential for healthy humans.⁷ In cats, it prevents dilated cardiomyopathy and feline central retinal degeneration (FCRD). Cats in the wild generally have rodents in their diet. Rodents have high levels of taurine in their brains. Housebound cats eating taurine-free foods developed the aforementioned conditions.⁷ As a preventive measure, commercial cat foods started to include taurine as an ingredient. Interestingly, just like human supplements that are not federally regulated, some cat foods have greater amounts of taurine and some have less.

Glucuronolactone or glucuronic acid received notoriety due to rumors that it was a Vietnam war-era drug manufactured by the American government to supply energy and feelings of well-being to soldiers in combat. The rumor states it was banned due to several brain tumor-related deaths; the rumors are not based on documented facts. The Red Bull company states glucuronolactone is included because it supplies energy, it increases feelings of well-being, and it is a precursor to taurine. A precursor (glucuronolactone) is a physiologically inactive substance that is converted into an active substance (taurine) through a chemical process that is facilitated by an enzyme.

Glucuronolactone is a naturally occurring metabolite in the body that is produced by the metabolism of glucose in the liver. Physiologically, the liver detoxifies hormones and carcinogenic compounds by binding them to glucuronic acid and excreting them in bile (produced in the liver). Some studies claim glucuronolactone has been shown to improve memory and concentration, and it acts as an antidepressant and stimulant by reducing sleepiness and sleep-related inci-

dents.⁸ Hence, it's inclusion in Red Bull. Little research has been done on the effects of glucuronolactone on athletic performance, and the only relevant studies have been conducted on animals.⁹ The body manufactures glucuronolactone naturally and a deficiency is rare.

Caffeine is an alkaloid found naturally in foods such as coffee beans, tea, and guarana. The effects of caffeine are widely understood and will not be discussed. However, it is important to mention the consumption of Red Bull in conjunction with other energy drinks (Table 1) that contain caffeine. Marcus Stroud, Jacksonville Jaguars defensive tackle, mixes Red Bull with Mountain Dew Code Red to give him his "jolt" just before kickoff. Stroud claims he can only have one can of Red Bull and that's why he mixes it with Mountain Dew: "I don't want to fall out from the Red Bull—anything over one can of Red Bull and I get the jitters."¹⁰ Since there are 80 mg of caffeine in Red Bull and 55 mg of caffeine in Mountain Dew, Marcus is ingesting 135 mg of caffeine before the game. Caffeine is coupled with close to 40 mg of sugar: Is Marcus setting himself up for dehydration? Research has shown that a 6% carbohydrate solution (i.e., 6 grams of carbohydrate per 100 ml of beverage, or 14 grams per 8 ounces) strikes the optimal balance in taste, rapid fluid absorption, and delivery of carbohydrate energy to fuel working muscles.¹ Thus, sports drinks containing over 14 grams of sugar per 8 oz can inhibit the release of water to the muscles, and mixing caffeine and sugar will cause the body to get rid of water (diuretic). Red Bull does not rehydrate the body after physical exertion.

Could it be the large amount of caffeine that is providing the energy boost? According to Roland Griffiths, PhD, a John Hopkins professor of behavioral biology, energy drink consumers are being misled by advertising for the products. "The ads give people the idea that they are getting a cocktail of various ingredients fine-tuned to synergistically enhance energy. This is wrong. The effects of these drinks are largely due to

TABLE 1 LIST OF ENERGY DRINKS

Sobe Superman Super Power Energy Drink
SoBe No Fear
Power Horse Energy Drink
Liquid Ice Energy Drink
Gorilla Juice Energy Drink
Moxie Energy Drink

the presence of added caffeine and the magnitude of the effect is completely caffeine-dose dependent.”¹¹ Table 2 provides a list of assorted items containing caffeine (mg).

Conclusion

There are three main ingredients in Red Bull. Taurine is not essential for humans, but only for housebound cats. Taurine should only be recommended as a remedy if a specific condition actually exists, and only under the supervision of a physician. Since glucuronolactone is a precursor to taurine, and taurine is not necessary unless a specific condition exists, and the body manufactures glucuronolactone naturally, do we need glucuronolactone? There is total agreement that one ingredient in Red Bull does what it claims: caffeine will stimulate the central nervous system and act as a diuretic so it should be in an energy drink. Finally, research investigating the effects of combining caffeine, taurine, and glucuronolactone is extremely limited.

Each of these three ingredients has side effects that vary in severity. According to French nutritionist Isabelle Vanrullen, they can interact with each other. France, Norway, and Denmark have banned the sale of Red Bull. If an athlete is slightly dehydrated, Red Bull may compound the problem by increasing the athlete's heart rate. In 2000, Ross Cooney, a healthy, 18-year-old basketball player from Limerick, Ireland,

collapsed on the court and died after drinking four cans of Red Bull before a basketball game. He died as a result of Sudden Arrhythmia Death Syndrome (sudden death due to cardiac arrest brought on by an arrhythmic episode).⁹ Outside the athletic realm, several deaths in Europe have been linked to alcoholic drinks containing Red Bull. Patrons will request drinks containing Red Bull mixed with various liquors. The caffeine in Red Bull will keep them awake and alert while drinking, which counteracts the depressive effect of alcohol. This increases the risk of alcohol poisoning from excessive consumption.

The decision to consume Red Bull energy drink is a choice. Given the noted ingredients, the claims, the scientific evidence, and the side effects, the potential consequences of the decision should be carefully considered. For more information on hydration and fluid replacement, review the National Athletic Trainers' Association Position Statement at (www.nata.org/statements/position/fluidreplacement.pdf).¹²

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TABLE 2. ASSORTED ITEMS CONTAINING CAFFEINE

ITEM	CAFFEINE (MG)
Coffee 8 oz	100 - 150 mg
Starbucks Grande 16 oz	550 mg
Starbucks Short 8 oz	250 mg
Decaffeinated 5 oz	2-5 mg
Black tea 8 oz	47 mg
Coca Cola 12 oz	64 mg
Mountain Dew 12 oz	55 mg
Pepsi 12 oz	43 mg
Dr. Pepper 12 oz	61 mg
Chocolate Bar	12-15 mg
Excedrin 1 tablet	65 mg
Anacin	32 mg
Dexatrim 1 tablet	200 mg
NoDoz 1 tablet	100 mg
Red Bull 8.3 oz	80 mg

Kathleen Laquale is an associate professor in the Department of Movement Arts, Health Promotion and Leisure Studies and the director of the undergraduate and graduate athletic training education programs at Bridgewater State College in Massachusetts.