

## Proceedings of the 2010 Energy Drinks Symposium

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**Abstract:** The 2010 Energy Drinks Symposium was organised and sponsored by the Austrian Food Testing Institute (Lebensmittelversuchsanstalt, LVA) and the Austrian Food Industries Association (FIAA) in Vienna, on 12 October, 2010.

**Keywords:** Energy drinks, alcohol, dietary caffeine sources, diuretic potential, driving.

### INTRODUCTION

Energy drinks are non-alcoholic, water-based functional beverages developed to enhance performance and are available in over 160 countries with approximately 3.9 billion litres consumed across the world every year [1]. They typically contain carbohydrates, amino acids, caffeine and vitamins. Energy drinks should be distinguished from other drinks such as soft drinks and sport drinks due to their different composition and function. Energy drinks have been developed for times of increased physical and mental exertion. They are not designed to quench one's thirst, or to hydrate the body.

The European Food Safety Authority (EFSA) recently concluded that taurine and D-glucurono- $\gamma$ -lactone present in energy drinks are not of safety concern [2]. For example, the EFSA Panel on Food Additives and Nutrient Sources Added to Food (ANS) concluded that it is unlikely that D-glucurono- $\gamma$ -lactone would have any interaction with caffeine, taurine, alcohol or the effects of exercise, and that additive interactions between taurine and caffeine on diuretic effects are unlikely.

Published research has demonstrated the positive benefits of energy drink consumption on both physical and mental performance [3, 4]. However, some reports have emerged that suggest potential negative consequences of energy drink consumption. Recent concerns have been raised regarding (a) the possible masking effects of energy drinks with regard to the subjective feelings of alcohol intoxication, (b) the need for actual intake data on energy drink consumption, and (c) the diuretic potential of energy drinks. It was therefore the aim of this symposium to provide interested stakeholders with detailed information on these topics. A summary of the corresponding presentations is given below.

### EFFECTS OF ENERGY DRINKS IN COMBINATION WITH ALCOHOL?

C. Alford, University of the West of England, UK

#### Background

One experimental study [5] had suggested that energy drinks combined with alcohol might reduce the subjective feelings of alcohol intoxication, resulting in a so-called masking effect. The aim of the present study was to evaluate objective and subjective effects of alcohol versus placebo at two alcohol doses (0.046 and 0.087% blood alcohol concentration, assessed with breathalyser), both alone and in combination with an energy drink in a balanced order, placebo-controlled, double-blind design.

#### Methods

Two groups of 10 young adult male and female volunteers, mean age 24, range 19-33 years, participated in the study. The study comprised two test sessions. On each session, Group 1 consumed Red Bull<sup>®</sup> Energy Drink and Group 2 consumed a placebo drink. In addition, they consumed two doses of alcohol or no alcohol (see Table 1).

On each test day, participants were tested three times (at baseline, then approximately 40 minutes after consuming the first drink and similarly after the second drink, with an hour between drinks). Tests included objective measures of performance (reaction time, word memory, Stroop test) and subjective mood scales sensitive to alcohol consumption and perception of impairment (i.e. clearheaded, clumsy, drowsy, energetic, mentally slow) [6].

#### Results

Participants showed significantly impaired objective performance (slower reaction time, poorer memory) after alcohol compared to the no alcohol condition. In addition, there was a significant difference between the different doses of alcohol with participants having poorer memory after the higher alcohol dose. Stroop completion time was faster (improved performance) with the energy drink plus alcohol combination compared to the placebo drink plus alcohol

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**Table 1. Study Design**

	Test Session 1	Test Session 2
Group 1 (N=10)	Red Bull® Energy Drink + Alcohol (two doses)	Red Bull® Energy Drink+ no-Alcohol
Group 2 (N=10)	Placebo Energy Drink + Alcohol (two doses)	Placebo Energy Drink + no-Alcohol

Note: Test session 1 and 2 were undertaken in a balanced order.

combination. Participants felt significantly impaired (less clearheaded, clumsier, drowsier and more mentally slow) after alcohol compared to no alcohol. In addition, there was a significant difference between the different doses of alcohol with participants feeling less clearheaded, more clumsy and mentally slow after the higher alcohol dose. None of the subjective measures showed a significant difference between the energy drink and the placebo treatments.

### Conclusions

Alcohol impaired objective performance (slower reaction time, poorer memory). Subjective measures showed significant and consistent effects reflecting awareness of alcohol intoxication as well as sensitivity to increasing alcohol dose. There were no overall significant group differences for subjective measures between the energy drink and placebo groups in the presence of alcohol. Participants felt significantly impaired after alcohol, and generally more impaired after the higher alcohol dose, regardless of whether they had consumed energy drink or the placebo drink with alcohol. Therefore, the alcohol and energy drink combination did not alter or reduce the perception of alcohol intoxication when compared to alcohol alone (alcohol + placebo) at either dose. There was no evidence that the energy drink masked the subjective effects of alcohol at either dose.

### VALIDATION OF A CAFFEINE ASSESSMENT TOOL AND SUBSEQUENT ASSESSMENT OF CAFFEINE INTAKE IN A GENERAL POPULATION SAMPLE

J. König, University of Vienna, Austria

#### Background

There are virtually no data available on caffeine intake for the general population, in particular data on dietary caffeine sources are missing.

#### Methods

The Caffeine Assessment Tool (CAT) was developed on the basis of a CAT for the assessment of caffeine intake in pregnant women [7]. The CAT was translated into German and adjusted for regional and national characteristics. Consistent with the method of validation of the original CAT, our version was also validated using a 3 day weighing record as reference in a total of 51 individuals (26 female, 25 male, mean age was 32.8, range 24-65 years). Analyses of caffeine and paraxanthine concentrations in saliva were used as biomarkers for caffeine exposure. Since only limited information is available on actual caffeine concentration in typical beverages and foods, 111 samples of major contributors to caffeine exposure were analyzed by a standardized HPLC

method for the quantification of caffeine. Saliva samples were analyzed for caffeine and paraxanthine concentrations with the same method.

### Results

Statistically significant Pearson correlation coefficients for the CAT were 0.817 and 0.427 respectively compared to 3 days records and to saliva caffeine concentrations. Foods analyzed for caffeine content included chocolate, coffee, tea, ice tea, energy drinks, soft drinks and other coffee based foods and beverages. Analysis showed a wide range of caffeine contents between food categories but also between different products within the same category.

### Conclusions and Outlook

The validated CAT has been shown to be a suitable tool for the assessment of caffeine intake in a general population sample. Therefore the CAT has been converted into an in-house, computer-based interview and caffeine intake has been assessed in a nationally representative sample of the adult population in Austria. Although final results are not yet available from the total sample, it is likely that (1) the major contributor to total caffeine intake is coffee, (2) the daily average exposure to caffeine from all caffeine sources is between 200 and 300 mg, and (3) there is a large variation of individual caffeine exposure with some extremes at high and low percentiles.

### DIURETIC POTENTIAL OF ENERGY DRINKS

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#### Background

Literature suggests that both caffeine and taurine can induce diuresis; although they act via different cellular mechanisms (natriuresis and urinary concentration), their diuretic actions might be additive. This is of interest, as several commercially available energy drinks contain both substances.

#### Methods

Sixteen healthy male volunteers (median age 25, range 18 to 28 years) were invited to participate. The participants underwent a physical examination, and had to pass a urinary concentration test with a urine osmolality of higher than 800 mosm/l after a 12 hour thirst period. Participants were informed that they would be consuming a variety of unspecified "energy drinks", and that they would be excluded from the study if they failed the urinary concentration test before the ingestion of the test drink. Four participants failed the urinary concentration test and therefore were excluded from

the study [8]. The effects of caffeine and taurine were examined in a cross-over-design in which each volunteer received four different test drinks (750ml of energy drink containing 240mg caffeine and 3g taurine, and three other test drinks that lacked caffeine, taurine or both) after avoiding fluid intake for 12 hours. Urine was collected for 6 h after each drink and analysed for osmolarity and sodium.

### Results

Mixed model analyses of the data for all treatments demonstrated that urinary output and natriuresis were significantly increased by caffeine (mean differences 250ml and 30mmol; both  $p < 0.05$ ) and that there were no such significant effects of taurine (mean differences 60ml and -4mmol). The urinary osmolarity at baseline was significantly negatively correlated with the urinary output ( $r = 0.37$ ;  $p < 0.001$ ). The higher urinary osmolarity was at baseline, the lower the following urinary output. Urine osmolarity values at baseline and in the six hour urine collection did not differ significantly between treatments.

### Conclusion

Taken together, this study demonstrates that the diuretic and natriuretic effects of the tested energy drink were largely mediated by the caffeine component. Taurine played no significant role in the fluid balance in moderately dehydrated healthy young consumers. Consequently, the diuretic potential of energy drinks does not differ significantly from other caffeine containing beverages.

## POSITIVE EFFECTS OF ENERGY DRINK ON DRIVING PERFORMANCE DURING PROLONGED DRIVING

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### Background

Driver sleepiness is one of the most common causes of traffic accidents on public highways. Having regular breaks during a long distance drive is therefore recommended. Various additional countermeasures are used to reduce driver sleepiness. The purpose of this study [9] was to examine whether Red Bull® Energy Drink could counteract sleepiness and driving impairment during prolonged driving.

### Methods

24 healthy volunteers, mean (SD) age 22.8 (1.4) years old, participated in this double-blind, placebo-controlled crossover study. After 2 hours of highway driving in the STISIM driving simulator subjects had a 15-minute break and consumed Red Bull® Energy Drink (250 ml) or placebo (Red Bull® Energy Drink without the functional ingredients: caffeine, taurine, glucuronolactone, B vitamins (niacin, pantothenic acid, B6, B12) and inositol) before driving for 2 additional hours. A third condition comprised 4 hours of uninterrupted driving. The primary outcome parameter was the standard deviation of lateral position (SDLP), i.e. the weaving of the car. Secondary parameters included SD speed, subjective driving quality, sleepiness, and mental effort to perform the test.

### Results

No significant differences were observed during the first two hours of driving, i.e. prior to the drink. Red Bull® En-

ergy Drink significantly improved subsequent driving relative to placebo: SDLP was significantly reduced during the 3rd ( $p = 0.046$ ) and 4th hour of driving ( $p = 0.011$ ). Red Bull® Energy Drink significantly reduced the standard deviation of speed ( $p = 0.004$ ), improved subjective driving quality ( $p = 0.0001$ ) and reduced mental effort to perform the test ( $p = 0.024$ ) during the 3rd hour of driving.

Subjective sleepiness was significantly decreased during both the 3rd and 4<sup>th</sup> hour of driving after Red Bull® Energy Drink ( $p = 0.001$  and  $p = 0.009$ , respectively). Relative to uninterrupted driving, Red Bull® Energy Drink significantly improved each parameter.

### Conclusion

Red Bull® Energy Drink significantly improves driving performance and reduces driver sleepiness during prolonged highway driving.

## SUMMARY

This symposium informed interested stakeholders regarding topics discussed recently in relation to energy drinks. The data presented show that the combination of alcohol and energy drinks does not alter or reduce the perception of alcohol induced intoxication and impairment when compared to alcohol alone. In other words, there was no evidence that energy drinks masked the subjective effects of alcohol intoxication. Excessive consumption of alcohol can have adverse effects on human health and behaviour. These findings lend support to the conclusion that the negative consequences of alcoholic drink consumption are due to the alcohol, and not a result of the mixture, be it with cola, orange juice, tonic or whatever else is mixed with alcohol.

Preliminary results for the assessment of caffeine intake in a general population sample suggest that the major contributor to caffeine consumption is coffee and that the daily average exposure to caffeine from all caffeine sources is between 200 and 300 mg, although noting that the sample included individuals with high or low consumption. Further findings from this assessment will also contribute data on energy drink consumption.

It was also demonstrated that the diuretic potential of energy drinks does not differ significantly from other caffeine containing beverages [8]. Specifically, the combination of caffeine and taurine in energy drinks does not result in increased diuresis and consequent water loss compared to caffeine alone, which could be of concern under conditions of physical exertion.

Finally, a study showed that Red Bull® Energy Drink significantly improves driving performance and reduces driver sleepiness during prolonged driving [9]. This provided further objective data demonstrating the positive effects of energy drinks in combating driver fatigue.

These presentations showed that claims regarding the negative health implications of energy drink consumption with regard to increased dehydration or masking subjective awareness of alcohol induced intoxication and impairment were not supported. These findings add to the literature showing that energy drinks have positive effects under a range of conditions, including reducing fatigue.

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