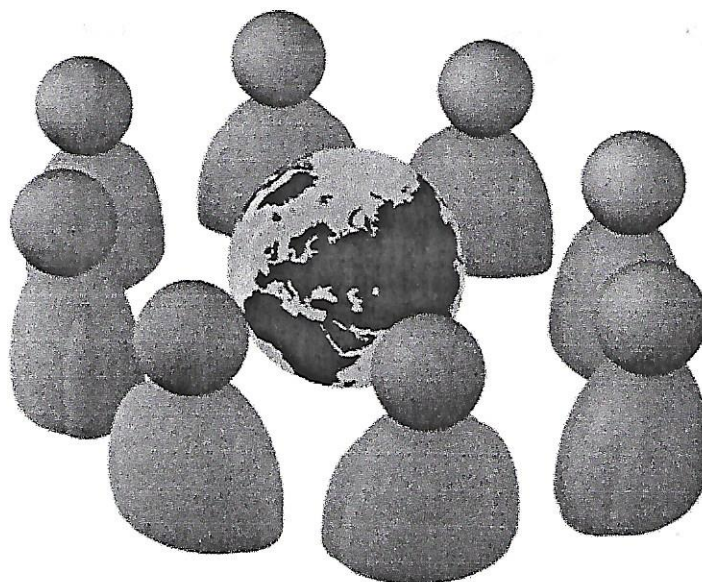




**Proceedings in
Advanced Research in Scientific Areas**

The 3rd year of International Conference on Advanced Research in Scientific Areas

ARSA 2014



1. - 5. December 2014

The biological effects of energy drinks components

A review of the literature

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Abstract This review examines the existing literature on biological aspects of energy drinks consumption, by assessing the pharmacological and physiologic effects of substances contained in these beverages and their mechanisms of action, known or suspected in the organism. Scientific articles written in English were consulted. In the present review, we discuss the relatively small number of studies that have assessed the mechanisms of action of substances contained in ED (caffeine, guarana, taurine, ginkgo biloba, L-carnitine, D-glucuronolactone, B vitamins, ginseng) and their pharmacological effects. Caffeine is the main active ingredient contained in ED and its negative effects are known. However, future research is sorely needed for understanding the health consequences of the other energy drinks ingredients.

Keywords - Energy Drinks, Caffeine, Glucose, Ginseng, Guarana, Taurine, Ginkgo Biloba, L-carnitine, Glucuronolactone, B Vitamins

I. INTRODUCTION

The Energy Drinks (ED) are available beverages commonly containing moderate-high concentrations of various ingredients to which mental and physical stimulant properties are attributed. The prevalence of ED consumption among adolescents and young adults has been steadily increasing [1]. Approximately 30% to 50% of them present a regular use [1]. They usually drink ED for different reasons, particularly for studying, partying, driving, for energy boost and wakefulness [2]. On the other hand, ED are sold to improve energy, resistance, athletic performance and concentration [3] and, for this reason, they drink these beverages for their positive effects (for example, the improvement of cognitive functions, alertness and mood) [4;5; 6; 7]. However, young people completely ignore the negative consequences of ED components and their mechanisms of action. Instead, in conjunction with its positive effects, the use of ED is not without health risks [8]. The main consumers are not aware of the possible side effects and possible interactions with drugs and/or biologically active substances on the market. The known and/or suspected pharmacology of ED components raises concern for potentially serious adverse effects. Many ingredients are understudied and not regulated. However, understanding the effects, above all, in at-risk and vulnerable populations (for example, children and adolescents) is needed. Toxicity surveillance, regulations of ED consumption need to be improved.

II. OBJECTIVE

The purpose of this document is to provide a description of the pharmacological and physiologic effects of ED components and their mechanisms of action, known or suspected on the organism. The current review was conducted on the PubMed database and on Scopus database, by selecting English-language articles that addressed ED consumption by children, adolescents and adults, evaluating ED ingredients, their biological aspects and their effect on health. We included studies from 1973 to 2014. The initial search was performed on February 2014 and updated on September 2014.

III. BIOLOGICAL ASPECTS OF THE SUBSTANCES CONTAINED IN ED

Caffeine is the main active ingredient contained in ED; other commonly used ingredients are guarana, taurine, L-carnitine, D-glucuronide lactone, ginseng, B-vitamins, Ginkgo Biloba, sugars and other different ingredients depending upon the specific brand [9;10]. The main components with mental and physical stimulant properties have been examined.

A. Caffeine

Since Red Bull was introduced in Austria in 1987 and in the U.S. in 1997, it has grown exponentially [11]; currently marketed are hundreds of different brands with a caffeine content ranging from 50 mg to 505 mg per can or bottle [12]. Caffeine is a substance that stimulates the central nervous system by promoting the activation of the sympatho-adrenal-medullary, and can raise blood pressure under conditions of psychological stress [13; 14; 15; 16], physiological, as well as during exercise [17;18; 19]. The increased blood pressure appears to be due to increased vascular resistance rather than the ejection volumes, given to the minimal changes in heart rate [20]. However, it was previously suggested that the increased blood pressure was due to stimulation of the sympathetic nervous system [21]. Although for caffeine there is no recommended daily amount, the American Dietetic Association says that women of reproductive age and children should not take more than 300 mg in a day (the equivalent of 2-3 cups of coffee) [22]. Caffeine consumption and its withdrawal were correlated with various health effects, including irritability, anxiety, mental confusion, trembling of the hands and limbs, osteoporosis, digestive problems, nausea, insomnia and drowsiness, urinary frequency, headache, palpitations, arrhythmias and increase in blood pressure [23]. Indeed, caffeine is a substance able to cause addiction: studies on adults [24; 25], adolescents [26; 27], have shown that