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EXPLORING THE COMPOSITION, BENEFITS, AND RISKS OF ENERGY SUPPLEMENTS: A REVIEW

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ABSTRACT

Energy supplements, which include powders, beverages, and bars, have grown in popularity among both athletes and non-athletes. The many kinds of energy supplements, their components, and their possible advantages and disadvantages are all examined in this review. Caffeine, guarana, ginseng, ashwagandha, and protein sources are typical components. However, these supplements could improve cognitive function, stamina, and energy levels. Chemicals High concentrations of heavy metals, hazardous chemicals, sweets, and possible drug combinations can also be harmful to one's health. The review emphasizes the significance of cautious formulation, taking into account each person's tolerance, and being aware of any potential negative consequences. It also covers the importance of shelf life, allergen content, and nutritional balance in the creation of energy supplements. This thorough analysis seeks to educate producers, customers, and medical experts on the intricate terrain of energy supplements.

KEYWORDS: Energy supplements, Caffeine, Guarana, Ginseng, Ashwagandha, Protein bars, Energy drinks, Nutritional balance.

INTRODUCTION

Energy drinks are a type of beverage that can include additional nutritional supplements or caffeine in addition to other liquid items.[1] They were originally introduced in Europe in 1987. Following Red Bull's introduction in 1997, the market grew globally and became extremely well-known. Since then, a number of brands have been introduced globally, and

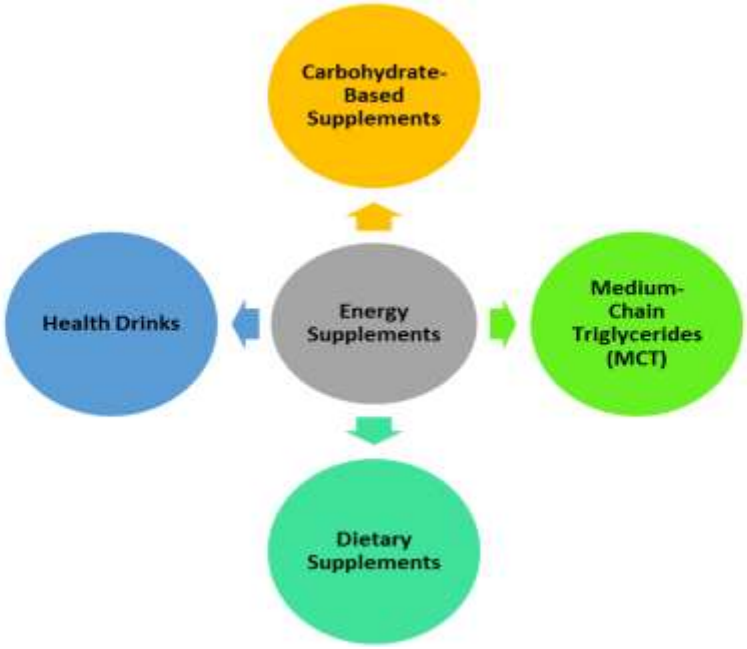
the market for energy drinks has expanded significantly. Over 5.8 billion liters of energy drinks were consumed annually in about 160 countries in 2013.[2]

Manufacturers now target young people instead of athletes as their target market. Energy drinks are heavily advertised in areas that are well-liked by teenagers and young adults. Boys make up two thirds of the market for energy drinks, with customers aged 13 to 35 making up around two thirds of the market.[3] Energy drinks are made with a mix of stimulants and energy boosters to offer the consumer a "energy boost." Caffeine is the main ingredient in the majority of energy drinks. Typically, eight ounces of them contain 80–150 mg of caffeine, which is the same as five ounces of coffee or two 12-ounce cans of caffeinated soda.[4] While some companies offer versions that have been artificially sweetened, the majority of products on the market include significant quantities of glucose. Taurine, methylxanthines, vitamin B, ginseng, guarana, yerba mate, acai, maltodextrin, inositol, carnitine, creatine, glucuronolactone, and ginkgo biloba are other components that are frequently utilized.

While there is a large variety of high-protein bars available, most of them have the following ingredients: sugars, other low-weight polyhydroxy compounds (Like glycerol), alcohols (Like sorbitol), lipids (Like palm oil), vitamins, and minerals; very little water, and other minor ingredients. No matter how they are made, formulations remain difficult to create because of the interactions that occur when ingredients are mixed, which can lead to a product with a short shelf life and a rapidly shifting sensory profile.[5,6]

One may use nutritional supplements (NS) for cosmetic purposes or to enhance sports performance. Athletes have been using NS at an enormously higher rate in recent years, both professional and amateur.[7,8] Supplements containing protein powder are sold for a variety of purposes, such as weight loss, muscular growth, and/or meal replacement. Ready-to-drink beverages and powders that need to be mixed with milk or water before consumption are common supplements.[9] There have been reports of hazardous materials like heavy metals, pesticides, and hepatotoxic herbal extract detected in several protein powders, especially those marketed in India.[10]

Types of energy supplements



1. **Carbohydrate-Based Supplements:** Athletes frequently use supplements that are based on carbohydrates because they are quick-acting energy sources. They usually have a high carbohydrate to medium-chain triglyceride (MCT) ratio; 50:0.1 to 1:5 is a typical ratio.[11]

2. **Medium-Chain Triglycerides (MCT):** MCTs are a popular option for short-term energy increases because they are lipids that are quickly absorbed and transformed into energy.[11]

3. **Dietary supplements:** This wide group of nutrients consists of vitamins, minerals, proteins, and herbs that can promote energy metabolism by helping to fill in dietary deficiencies.[12]

4. **Health drinks:** These are promoted for boosting energy and frequently mix different nutrients, especially in areas like India where they are commonly consumed.[13]

Herbs used in energy supplements

1. **Guarana**

Synonym- Guarana Gum, Guarana Seed, Zoom Cocoa and Brazilian Cocoa**.**[14]

Biological source- Guarana is derived from the *Paullina cupana* and *Paullinia sorbilis* plants native to northern Brazil.[14]

Family- Sapindaceae

Geographical source- Amazon basin and in other parts of Brazil.

Chemical constituent- Caffeine, Theophylline, Theobromine, Tannins and Saponins.[14]

Part used- Seeds

Fig. 1: Guarana.

Effect

- Guarana has more caffeine than coffee, it can improve mental clarity and perhaps help with weight loss.
- Although it has been linked to a number of health advantages, adverse effects including anxiety and sleeplessness are frequently caused by caffeine.[15]
- Memorial Sloan-Kettering: This South American jungle shrub's seeds are frequently used to treat paralysis, diarrhea, migraines, and irritation of the urinary tract.[16]
- Discovered that a variety of supplements and medications, including those containing caffeine, acetaminophen, clozapine, adenosine, lithium, and monoamine oxidase inhibitors, are suspected to interact with guarana. After all, Boozer et al.[17]
- Person Certain individuals may have severe adverse effects from guarana. The amount of caffeine has an impact on appetite suppression. Generally speaking, guarana's caffeine content is the cause of adverse effects such as anxiety, sleeplessness, fast heartbeat, and upset stomach.[15]

2. Ginseng

Synonym- Asian ginseng, Korean ginseng, Chinese ginseng (Panax ginseng), American ginseng, Canadian ginseng (Panax quinquefolius) and Siberian ginseng (Eleutherococcus senticosus).[18]

Biological source- Belonging to the root of Panax species.

Family- Araliaceae

Geographical source- Korean Peninsula, Northeast China, Russian Far East, Canada and the United States.

Chemical constituent-vitamins (A, B, C and E), minerals (iron, magnesium, potassium and phosphorus), fibers, proteins, saponins and Ginsenosides.[19]

Part used – Root

Fig. 2: Ginseng.

Effect

- Ginseng Shows such as antioxidants, anti-inflammatory agents, cognitive function boosters, anabolic and immunostimulants, and enhancers of endurance performance.[19]
- It has been demonstrated that this lowers blood pressure, boosts immunity, and lessens mental stress.[19]
- In addition, long-term ginseng usage enhanced cardiovascular and respiratory health and decreased blood lactate levels while also enhancing athletic performance.[20]
- In individuals with modest training, ginseng demonstrated anti-fatigue qualities and positive benefits on the central nervous system (CNS), adrenal glands, and sexual function. According to other research, ginseng enhances alertness and reduces weariness. resistance by activation of cortisol.[21]
- This herb's root extract helps treat sexual diseases including erectile dysfunction in males and increases their desire. This plant species belongs to the family Simaroubaceae, which is distributed in Indonesia and Malaysia Vietnam, Thailand, and Laos. Jack Eurycomalongifolia includes Canthine-6-, Tirucallane-Type Triterpenes, Biphenylneolignans, and Quassinoids, among other Squalene derivatives. Alkaloids One and Beta-Carboline, which have anti-inflammatory, anti-malarial, anti-ulcer, and anti-cancer properties.[22] and anti-plasmodial properties.[23]

- Like most supplements, ginseng can have adverse effects; depending on the dosage and individual metabolism, some of these effects may be significant. It has been demonstrated that ginseng usage causes diarrhea, sleeplessness, headaches, tachycardia, and blood pressure swings, which may result in gastrointestinal issues. Women may also encounter extra negative consequences, such breast soreness and vaginal hemorrhage. The majority of these Patients with breast cancer should cease using ginseng due to significant adverse effects. Digoxin, insulin, and other medicines can all interact negatively with ginseng. inhibitors of monoamine oxidase and anticoagulants. Additionally, it may not be appropriate for those with high blood pressure.[16]

3. Caffeine

Synonym- Caffedrine, cafeina, Caffeine Methyltheophylline, Caffeine, Anhydrous

Biological source- Caffeine is extracted from Coffea arabica (Coffee bean), Cola acuminate (kola nut), and Camellia sinensis (Tea leaves) plants.[24,25]

Family- Xanthine alkaloids

Geographical source- Latin America, eastern Africa, Asia, and Arabia

Fig. 3: Caffeine.

Effect

- While the data is conflicting, some studies suggest that modest intakes of caffeine may have health benefits, such as lowering the risk of type 2 diabetes, Parkinson's disease, liver disease, colorectal cancer, and enhancing immunological function.2.[24,26,27]
- While severe side effects are uncommon, people react differently to coffee; some are regarded as nonresponders, while others encounter notable adverse effects at comparable dosages. Caffeine is FDA-considered generally safe, with no significant acute or long-term negative effects at less than 3 mg/kg of body weight.[24,27,28,29]

- Regretfully, 3 mg/kg body weight may be readily reached, particularly in thin or average-sized teens. For instance, a 200-lb person would only consume 1.8 mg/kg of caffeine from an ordinary 16-oz energy drink, whereas a 100-lb person would consume 3.6 mg/kg. Smokers, people with cardiovascular disease, and people who consume other foods or drinks containing caffeine are more likely to experience serious adverse reactions. Caffeine toxicity is dose dependent, and fatalities have been reported at very high dosages (150–200 mg/kg).[24,26,27]

4. Ashwagandha

Synonym- Indian Ginseng, Indian Winter cherry.[30]

Biological source- It is extracted from Withania somnifera Dunal's dried roots and stem bases.[30]

Family- Solanaceae.[30]

Geographical source- Rajasthan, Punjab, Haryana, Uttar Pradesh, Gujarat, Maharashtra and Madhya Pradesh

Chemical constituent- isopelletierine, anaferine, cuseohygrine, anahygrine, and steroidal lactones (withanolides, withaferins), and saponins.[31]

Part used - root or leaves.

Fig. 4: Ashwagandha.

Effect

- Ashwagandha improves VO_{2max}, or maximum oxygen consumption, which helps athletes have more endurance. An individual's aerobic capacity is determined by their VO_{2max}, a physiological measure. This measure of cardiorespiratory fitness characterizes both physical well-being and athletic achievement.[32]

- The possible advantages of ashwagandha root extract consumption on strength and muscular growth in young, healthy men engaged in resistance exercise. The study was carried out using a placebo-control grouping strategy.
- The ashwagandha group showed significantly greater improvements than the placebo group in:

- Bench press strength (+46.0 kg vs +26.4 kg, p=0.001)
- Leg extension strength (+14.5 kg vs +9.8 kg, p=0.04)
- Arm muscle size (+8.6 cm^2 vs +5.3 cm^2, p=0.01)
- Chest muscle size (+3.3 cm vs +1.4 cm, p<0.001)"

- The taking supplements containing ashwagandha is associated with significant increases in muscle mass and strength, suggesting that ashwagandha consumption in conjunction with resistance training may be advantageous.[33]

Formulations 0f energy supplements

1. Protein bar

Protein bars are made by carefully choosing components to maximize their nutritional content, visual appeal, and practical advantages. Many strategies for developing high-energy protein bars customized for diverse customer needs—especially athletes—are highlighted in recent Studies.

Fig. 5: Protein bar.

Choice of ingredients

- **Protein sources:** To increase the protein intake, commonly utilized proteins include soy protein isolate, whey protein isolate, and plant-based choices including kidney bean flour and lupine seeds.[34,35]

- **Functional ingredients**: Adding nuts and dried fruits (Dates, apricots) not only improves flavor but also increases the amount of fiber and antioxidants.[34,36]

Profile of nutrition

- **Energy content:** To meet the energy demands of physically active people, most bars have an energy content of 200–300 kcal and a balanced protein, fat, and carbohydrate ratio.[37,38]
- **Health benefits:** Bars with a high content of dietary fiber and antioxidant activity can enhance both general health and sports performance.[36]

Sensory assessment

- **Consumer acceptance:** The importance of flavor and texture in product creation is highlighted by sensory testing showing that formulations including a combination of natural components frequently obtain higher acceptance rankings.[39,37]

Even while improving nutritional benefits is the main goal, it's important to take into account any potential negatives as well, such high energy density and allergen content, which may influence customer decisions and health effects.

2. Energy drink

Energy drink formulations are created by carefully choosing components that ensure both safety and efficacy while delivering rapid energy boosts. Current studies emphasize different ingredients and production processes for successful energy drink creation.

Fig. 6: Energy drink.

Essential components in energy drink formulation

- **Caffeine and Herbal additives:** The main stimulant in coffee is frequently mixed with herbal supplements that boost energy, such as guarana and goji.[40,41]
- **Amino Acids and Nutrients:** To promote energy metabolism and general health, ingredients including taurine, amino acids, and bioactive nutrients are incorporated.[40,42]
- **Minerals and Vitamins:** B vitamins, vitamin C, and minerals like chromium are necessary for the body to produce energy and carry out metabolic functions.[42]

Novel methods of formulation

- **Methods of encapsulation:** Strategies such as liposome encapsulation enhance the bioavailability and stability of active substances, guaranteeing their continued effectiveness in the beverage.[41]
- **Quick preparation:** Quick preparation and consumption are made possible by formulations such as solid energy cubes, which improve consumer convenience.[43]

  Energy drinks are widely known for their rapid energy increases, but due to high quantities of sugar and caffeine, they must be carefully formulated to prevent negative health effects. The development of energy drinks continues to face a significant challenge: balancing safety and efficacy.

3. Energy supplement powder

A meticulous selection of components is made during the production of energy supplement powders in order to maximize their nutritional content, taste, and shelf life. Numerous research show various strategies and compositions designed for certain purposes, such animal feeding or military uses.

Fig. 7: Energy suppliment powder.

Choice of ingredients

- **Active ingredients:** Gluconeogenic substrates, such as sodium propionate and 1,2-propanediol, which raise energy levels, are frequently used, along with vitamins and caffeine.[44,45]
- **Base ingredients:** To boost protein content and total energy value, powders can be made using milk powder and native flours (Such as wheat, Soybean and chickpea).[46]

Production techniques

- **Methods:** In order to produce a uniform mixture, methods like mixing, roasting, and stirring at room temperature are used.[45,46]
- **Evaluation of Shelf-Life:** Research indicates that formulations can sustain acceptable microbiological and organoleptic qualities for an extended period of time, even in difficult environments.[47]

Nutritional benefits

- **Energy density:** A number of formulations have a high caloric content; some may provide 77.50 megacalories per liter, which is more than standard fat sources.[45]
- **Health benefits:** Adding nutraceutical powders to your diet can benefit your health in a number of ways, including stress resistance and increased reproduction in animals.[48]

  Even though energy provision is frequently the main emphasis, it is important to take into account the nutritional balance and the possibility of negative consequences if formulations are not carefully prepared.

Marketed formulations of energy supplements

1. **Protein energy bar**

	**Brand name-** Yoga Bar Multigrain Energy Bar **Manufactured from-** Sproutlife Foods PVT. Limited **Net weight-** 38 gm

	**Brand name-** Patanjali Herbal Protein Bar **Manufactured from-** SS Vitran healthcare private limited **Net Weight-** 35 gm
	**Brand name-** MuscleBlaze 10g Protein Bar **Manufactured from-** Numix Industries Private Limited **Net weight-** 50 gm

2. Energy drink

	**Brand name-** Red Bull Energy Drink **Manufactured from-** Red Bull **Net quantity-** 250 ml
	**Brand name-** Sting Energy Drink **Manufactured from-** Rockstar Inc. (PepsiCo) **Net quantity-** 250 ml

	**Brand name-** Ocean Energy Drink **Manufactured from-** Ocean Beverages **Net quantity-** 250 ml

3. Energy supplement powder

	**Brand name-** Nutrition Planet NXT Level Pre-Workout **Manufactured from-** Nutrition Planet **Net quantity-** 300 gm
	**Brand name-** Glucon-D Enstant Energy **Manufactured from-** Zydus Wellness Products Ltd**.** **Net quantity-** 1000 gm
	**Brand name-** Wellcore - Micronised Creatine Monohydrate **Manufactured from-** Wellversed Health Private Limited **Net quantity**-100 gm

CONCLUSION

The market for energy supplements has expanded quickly due to rising consumer demand for goods that improve endurance, energy, and cognitive function. This evaluation emphasizes the intricacy of energy supplements, including their many components, possible advantages,

and hazards. Even though athletes and others with hectic schedules may benefit from energy supplements, it's important to take into account each person's tolerance, possible drug interactions, and nutritional balance.

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