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Caffeine alternatives: Searching a herbal solution

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Abstract

This review assesses the potential use of various herbal plants which are beneficial for health and can help to stimulate the body energy. It is recognized in the available literature and findings on effect of caffeine on health and nutrition that Caffeine is a stimulant found in famous energy drinks, but it can negatively affect on our health and the consumption of caffeine should be limited. However sensitive population like children, lactating women, should not consume more amount of caffeine. Thus, the purpose of this review paper is to state that herbal extracts or plants can be used as energy boosters in replacement of caffeine and some chemical stimulants. Large number of plants have medicinal properties and from the ages some plants are traditionally used as natural energy boosters.

Methods: A search through different data base was performed to find various studies on effects of caffeine and alternatives of caffeine.

Keywords: Caffeine, caffeine replacement, stimulant herbs, energy booster

Introduction

The demand of energy drinks is increased in market and widely consumed by adults which helps to maintain the mental as well as physical health. There are several types of energy drinks, sports drinks are available in the market which contain various nutrients and are consumed by people as nutraceuticals (Melton 2007; Sanders *et al.*, 2007) ^[63]. Energy drinks are the beverages which are developed by adding various energy boosters such as caffeine, guarana, taurine, green tea extract, sugar, etc. which helps in increase the basal metabolic rate. Energy drink are developed by considering recommended dietary allowances and nutritional content. It is important to maintain protein, vitamins requirements (Peacock *et al.*, 2013) ^[53]. Generally, in energy drink caffeine is commonly used. Caffeine is natural chemical stimulant and belongs to class of compound methylxanthines and contain antioxidants. The chemical formula of caffeine is C₈-H₁₀-N₄-O₂ and it is one of the most studied chemicals in food technology. Even with all the knowledge of caffeine and years of its consumption in beverages and food supply there is persistence of many question and gaps in understandings its health effects (IFIC, 2003) (Wolde WU-JU & Wolde, 2014) ^[81]. Though it contains high nutritive value, but more consumption of caffeine can be harmful for human health and it is slightly addictive. The daily intake of caffeine should ideally be less than 400mg per day. The more intake of caffeine can be harmful, though significant person to person variability exists. Like, overconsumption of caffeine can increase sleep complications and negatively affect daytime performance (Attipoe *et al.*, 2016) ^[6].

In (Giles *et al.*, 2012) ^[24] states that the energy drinks containing taurine, guarana, caffeine and glucose may improve performance and mood but there are no proven studies which assessed the effects of these ingredients on neither individual nor interactive basis. Evaluations were done on effects of caffeine, Taurine and glucose alone and in combination of different sorts on people who are habitual to the above and they have performed these evaluations when the subjects have abstained for 24 hours from the ingredients. Energy Drinks and their consumption are associated in the past with cases of cardiac arrest, spontaneous coronary dissection, and coronary vasospasm (Shah *et al.*, 2019) ^[64].

Since the past 2 decades, Energy drinks, considered to be a new category of beverage in the market which were introduced at first in 1997 in the United States of America, are rapidly growing to be a part of day to day life prominently among the adolescents (Kaur *et al.*, 2019) ^[38]. In first half of twentieth century, the number of scientific reports is considerable evidence that caffeine may enhance exercise capacity and recovery from fatigue. To its central stimulating actions these effects are applicable (Borzaga *et al.*, 2014) ^[13]. Whatever available evidence from controlled experiments, they confirm that caffeine is very much effective ergogenic aid for all over the

range of athletic activities (Shiby *et al.*, 2013) ^[68].

Across the globe energy drinks contains caffeine which affects both health and quality of life. Consumption of caffeine can lead to some diseases in sensitive population which includes, lactating and pregnant women, children, aged people (Wolde, 2014) ^[81] which leads to the need for an energy booster in energy drink which is not harmful to any age group and provides required nutrients.

Herbal supplements are widely used all over the world, billions of dollars spends in recent years and many herbs have been studied but still there is gaps in knowledge.(LaSala *et al.*, 2015) ^[42] plant-based stimulants simple sugars(fructose, glucose), glucuronolactone (a naturally occurring glucose metabolite), amino acids (taurine, carnitine, creatine), herbs (ginkgo biloba, ginseng, kudzu, stevia), importance and their effect are not understood properly (Hurlock & Lee, n.d.) ^[32]. Compounds named as Adaptogens are plant-based derivatives when helps in normalizing endocrine functions and helps in better in adaptation towards environmental stress. These herbs play a key role in stress response modulation, energy stimulation, and improvement in sleep quality Ginkgo biloba, holy basil, Pueraria tuberosa, rhodiola, Arnica Montana have been used for stress relief from the ancient times. Adaptogen have been used as energy boosters in combination or as a single agent these herbs also shows a calming effect on the central nervous system(Stansbury *et al.*, 2013) ^[70]

Ingredients used in energy drink

Caffeine

There are many commonly consumed alkaloids, but caffeine is one of the most consumed, we consume caffeine in many forms such as coffee, tea, or soft drinks and overdose may cause abnormal stimulation of the nervous system and also adverse effect in the cardiovascular, gastrointestinal systems, and hematologic. As energy drinks are doing very strong in market, as we see short- and long-term effect of this energy drinks must be evaluated more closely to involve the psychological impact of these products. For serving size, the type of product, and preparation method is depends on the amount of caffeine in food. For affect in caffeine content, teas and coffees, the plant also responsible. If we see caffeine content in tea or coffee, for example an eight-ounce cup of drip-brewed coffee typically has 65-120 mg caffeine; an eight-ounce serving of brewed tea has 20-90 mg; and a 12-ounce canned soft drink has 30-60 mg (Knight *et al.*, 2004) ^[41] and if we see in energy drinks contain 50 -160 or more than that and plus caffeine from guarana and which we added other sources not declared as caffeine; if we want to see 6 mg caffeine then we need just one ounce of solid milk chocolate. Different source of caffeine which include over-the-counter pain relievers, it also helps in to increase the rate at which the medication is absorbed into the body. It also included in cold medications and stimulant tablets. (Wolde, 2014) ^[81]

Guarana

If we see different effective stimulant, dietary supplement or herb guarana is one of them. It has nearly twice the concentration of caffeine found in coffee seeds (guarana seeds contain about 2-4.5% caffeine, compared to 1-2% for coffee seeds). Other plants which produce caffeine, with high amount of caffeine, cause defensive toxin that repels herbivores from the berry and its seeds. There are different colours of fruits like from brown to red and colour of their seeds is black, and its covered by white arils. Basic myth

among the Sateré-Mawé people is colour contrast when the fruit is split open has been compared with the appearance of eyeballs (Higgins *et al.*, 2014) ^[30].

Taurine

The acid which is found in brain, heart, and skeletal muscle is taurine and it is non-essential amino acid. For processing cholic acid and conjugating bile acids with chenodeoxycholic acid taurine play very important role. There has been no contra effect of dosing of taurine with level up to 1,000 mg per 250ml (Peacock *et al.*, 2013) ^[53] according to toxicology studies. For improving physical performance, there are mixed result regarding benefits of use before and during exercise; and if we increased the plasma taurine levels will affect neurotransmitters in young adults and alter brain level. In young smokers noted protective effects on ECF when exposed to proinflammatory insults, (study of taurine and C vitamin supplementation). According to study, by modifying monocyte endothelial interactions and thus attenuating impairment of FMD, taurine and vitamin C may restore ECF in young smokers. There is effect of FMD, but that effect was not as great as taurine, because of vitamin C supplementation. The effect taurine dose is equivalent to 100g of fresh fish and from this we can reduce risk of coronary artery disease and there is no contra effect of taurine supplementation (McLellan *et al.*, 2012) ^[59]

Glucose

Glucose has been found to extend endurance exercise as long as it is consumed at regular intervals in fluids at levels of 6-8% of content rather than the 11-12% that is commonly found in Energy Drinks that can slow gastric emptying. The combination of glucose and caffeine may enhance cognitive performance in sleep deprived individuals for 30 to 60 minutes post ingestion, though with inconsistent evidence causing improvements in physical or cognitive improvement on its own. (Haller *et al.*, 2007)

Green tea

If we see beverages which is from ancient times and which considered a medicine and healthful then green tea is best option. For headaches, pains and body aches this plant is always recommended according to Chinese medicine. Depression, detoxification, digestion, as an energizer and to prolong life. The three main component which is in leaves of green tea is act upon human health: essential oils, xanthic bases (caffeine and theophylline) and especially, polyphenolic compounds. Caffeine acts mainly upon stimulating wakefulness, decreasing the sensation of fatigue, central nervous system and facilitating ideas association. Because of theophylline tea content is the reason for some effect caused by caffeine. Some are there which has much higher diuretic effect than caffeine is Theophylline induces psychoactive activity, it also has a slightly inotrope and vasodilator effect. If we see most interesting effects are seen at respiratory level and bronchopulmonary. For non-specific relaxation on respiratory stimulation and the bronchial smooth muscle, Theophylline is responsible. In beverages some essential oil which is great extent is present which is evaporate after some time, thus it is not very convenient to overextend the brewing time. Among all only the one-off facilitating digestion is must be highlighted. If we see tea which as higher percentage of essential oils is green tea. Polyphenols is the reason for great deal of attention for green tea. Polyphenols is strong present

important biological properties and strong antioxidants. The aqueous extract of GTP possesses antidiabetic, antibacterial, hypocholesterolaemia properties, antimutagenic and anti-inflammatory is demonstrated by numerous studies. It also benefits in oral diseases like periodontal disease, as protection

against dental caries and tooth loss (which may significantly affect a person's overall health). The main players in the beneficial effects on human health next detailed, among all GTP is Gallic acid and catechins. (Cabrera *et al.*, 2006) ^[16]

Table 1: Common energy boosters in energy drinks

Name	Daily dosage	Response	reference
Caffeine	100 mg per day	stimulates, or excites, the brain and nervous system	(Curran, 2017; Wolde WU-JU & Wolde, 2014)
Taurine	500 mg per day	Improved mental focus, concentration, serve as antioxidant, glucose homeostasis	(Wilson <i>et al.</i> , 2013)
Guarana	300 mg per day	Stimulant	((Patrick <i>et al.</i> , 2019)
Yerba Mate	300 mg per day	stimulant, anticonvulsant	(Riachi & De Maria, 2017)
Carnitine	500 mg per day	Stimulant	(Liepinsh <i>et al.</i> , 2011)

Additional concern

A. Effects of caffeine

Caffeine is used in energy drinks in large amounts to provide the consumer with desirable effects such as alertness, elevated mood, and better memory. Energy drinking use high Caffeine content generally much more than a can of cola drinks which ranges from 50 mgs to 500 mg or even in some cases more than that (Reissig *et al.*, 2009) Increase in sales of energy drinks (Heckman *et al.*, 2010) has raised concerns among professionals in public health sector due to the adverse effects of both caffeine intoxication and high content of calories from sugars used in the making of these drinks (Clauson *et al.*, 2008; Rath, 2012) ^[19]

Most research done on the possible links between caffeine and cancer are only made on tea and coffee and the relationship between caffeine, cardiovascular health and coffee were explored by the makers with a huge emphasis on conditions of heart rate, Arrhythmia, Blood pressure and serum cholesterol levels. Since the research is only done on coffee and tea, it is very difficult to isolate the effects of caffeine unless the focus of the research is purely on effects of caffeine as a consequence of this there is very little research on caffeine and its effects on cancer and if there is any such research the knowledge is also very sparse. However, there are positive references from coffee and tea research that relate to caffeine (Nawrot *et al.*, 2003) in his review has concluded that caffeine to be very unlikely to be carcinogenic when consumed at levels less than 500 mg per day (or below five cups of coffee per day). Adding to that, the overall evidence indicates that caffeine present in coffee is not involved in the cause of breast or bowel cancer although case control studies performed earlier appeared to link pancreatic cancer, Bladder and ovaries cancer to intake of caffeine but more recent and better performed studies have not supported the above conclusions. (Tavani and La Vecchia, 2004; Zeegers *et al.*, 2004) ^[19] In other hand several case controls studies have demonstrated that potential risk of colorectal cancer is reduced by consumption of coffee. (Tavani & Vecchia 2004) ^[73] In a review of study conducted by (Tavani & Vecchia, 2004) 73 showed that consumption of caffeinated beverages not only have reduced the risk of colon or colorectal cancer but there may even be a protective effect. A study also had confirmed that there is no relation between rectal cancer and caffeine consumption (Wolde, 2014) ^[81] Anxiety, Stress, Depression, and partial focus was placed on these areas.

Several studies investigating acute effects of energy drinks on mood but only one such observation was made in relation to chronic use of caffeine, but still null findings were relatively common, most of the studies of chronic use of caffeinated

beverages provided evidence to suggest that mental health problems were associated with it. But all the studies are identified as cross sectional and some of them didn't control few key factors, to be specific such as Sex, additional caffeine intake, Socioeconomic status etc. and the nature of the relationships between them in not fully understood and therefore longitudinal and intervention studies are required to improve the understandings of such phenomena (Richards & Smith, 2016) ^[62]

B. Consumption of caffeine

Caffeine is one of the most consumed psychostimulants all around the world. Its widely and naturally present in variable amounts in leaves, Fruits, beans of more than 60 plants. Primary sources of dietary caffeine are roasted coffee beans and tea leaves (Barone and Roberts, 1996). It can also be found in cocoa beans, Kola nuts, yerba mate, and guarana berries. Most frequent ingestion of caffeine is commonly done through drinks like coffee (71%), soft drinks (16%), and tea (12%) (Heckman *et al.*, 2010). Over past two decades or so, Functional beverages such as energy drinks, caffeinated sports drinks, Juices have been introduced in addition to it caffeine can me commonly found in cocoa, Chocolate, and in medical field as formulations of antipain medication and dietary supplements. Rates of caffeine consumption is growing in adolescents as they want to improve their concentration and try to compensate for less periods of sleep and fatigue. There is also a major consumption among them while studying, mixing with alcoholic beverages for taste preference in order to hide flavour and ability to drink more yet avoiding hangovers in order to increase social bonding as a result of peer pressure and reduced shyness. Due to the evidence indicating adverse effects of Energy drinks consumption are rising, it has raised concerns in scientific community and general community about the impact of this product on health (Peacock *et al.*, 2013) ^[53].

Adverse short-term cardiovascular effect such as blood pressure, palpitation are resulted due to high intake of caffeinated energy drink as shown in many studies (van Dam *et al.*, 2020) ^[75] stated that people who consume energy drink should be advised to limit their caffeine intake to less than 200 mg of caffeine and consumption along with alcohol.

One of the main reasons for concern regarding consumption of more caffeine through caffeinated energy drink is due to the cause of extreme adverse health effects like gastrointestinal effects, insomnia, anxiety and various cardiac diseases (Bigard, 2010; Harris & Munsell, 2015; Reissig *et al.*, 2009; Seifert *et al.*, 2011) (Reid *et al.*, 2017) ^[60]. In this review (Champlin *et al.*, 2016) ^[15] stated that much work is

needed to understand the negative effects of energy drink consumption among adults and college student population who generally use caffeinated energy drink on various occasion.

Potentially harmful outcomes on pregnancy are feared to be factual due to heavy coffee consumption and its stated in some of the inherent studies (Cornelis, 2019) [18] and it can be explain on multiple biases. During the phases of brain development in areas of planning, Emotional control and performance specially in children and adolescence, Frequent consumption of Energy drinks by these age groups can impact their progress. Adding to that these drinks also contain guarana, taurine and other vitamins which adds onto the effects of caffeine and its impact. Accessibility of these energy drinks in general shopping areas, stores, supermarkets and rigorous marketing of these drinks have made them available and got them accepted by many age groups and specially children. More than 140 countries are reported to be markets for energy drinks and more than half of the buyers have been either children or adolescents and young adults. Studies in countries of USA, Europe and Saudi Arabia are conducted to explore the consumption attitude towards these drinks (Bhojaraja *et al.*, 2016) [12].

C. Herbs containing caffeine.

Caffeine is a natural mild chemical stimulant found in fruits, seed and leaves of more than 60 plant species all over the world. Caffeine containing herbs are commonly used as beverages such as yerba mate, guarana, and coffee. Daily intake and response of these herbs are shown in Table no 1. Beverages with guarana and yerba mate appears in market. Guarana and yerba mate are used as additives in some of beverages and also labelled in way that makes them seem exotic (Gyllenhaal *et al.*, 2000) [28]. (Ashihara, 2006) [5] in his review mention that coffee herbs contain two various types of alkaloid from nucleotides first type is (1-N-methylnicotinic acid) trigonelline which is pyridine alkaloid and another one is (3,7-N-dimethylxanthine) theobromine and (1,3,7-N-trimethylxanthine) which is caffeine.

Native Americans used plants like *Ilex guayusa Loesener*, *Ilex paraguariensis.*, and *Ilex vomitoria Aiton* as esteems stimulant teas which are high in caffeine and methylxanthines. *Ilex paraguariensis* (yerba mate, chimarrao, or terere) is a type of plant which is ever green in nature and can be found grown by both cultivation and in wilderness in sub-tropical brazil, Argentina and other places with similar conditions (Negrin *et al.*, 2019) [50].

Herbal Substitute of caffeine

In today's lifestyle everyone deals with stress regularly and our body put efforts to manage that stress in different ways and keep balance. There are some herbs called as Adaptogen that helps human body to adapt stress and support normal process and restore energy and balance in the body. That herbs increases the body resistance to physical, biological, emotional, and environmental stress and promote normal physiological function (*Adaptogens: Herbs for Strength, Stamina, and Stress Relief - David Winston - Google Books*, n.d.) (Stansbury *et al.*, 2013) [70]

According studies a composition which comprises of kudzu and ginkgo biloba extract can be used as a potential replacement of caffeine. This extract contains flavoglycosides and terpene lactones which are extracted from ginkgo biloba and in ratios of one to other, along with standardized puerarin

extracted from kudzu roots. Many other components can be added to the above compositions in order to gain additional benefits and flavour (Zhou 2012) [83] (Incorvia, 2015) [33].

Ginkgo biloba

Ginkgo biloba is one of most widely used herb in the world. It belongs to *Ginkgoaceae* family (Achete De Souza *et al.*, 2020) [1] it is widely consume as medicine in china and all Asian countries at starting its been used for digestive system related problem (LaSala *et al.*, 2015) [42]. It's been sold since sixties in USA and it is now phytotherapeutic product (Achete De Souza *et al.*, 2020) [1] *ginkgo biloba* extract used in energy drinks as a source of stimulant (Vanbever *et al.*, 2009) [76] the anti-oxidant properties of this plant regulates the expression of antioxidant enzymes in a positive manner and reduce reactive nitrogen and oxygen species resulting in reduction of lipid peroxidation (Achete De Souza *et al.*, 2020) [1] as therapeutic for many diseases *ginkgo biloba* leaf extract are resulted promising. The leaf extract of this plant is top in the list of bestselling herbal products (Mahadevan & Park, 2008) [47].

Pueraria tuberosa

In Indian traditional system of medicine, also known as Ayurveda *Indian Kudzu or Pueraria tuberosa Linn.* is considered to be among the most important medicinal plant. It is mentioned under the name of Vidari in the Ayurvedic Pharmacopoeia. It belongs to *fabaceae* family. powder of the tubers of this plant also known in Hindi as vidarikand. it's recommended for adults in the dose of 2-6 gm/ person. The tubers of this herbs are rich in isoflavonoids the important phytochemical of this herbs are puetuberosanol, daidzein, genistein (Rastogi *et al.*, 2013) [58]. *Pueraria* is known to provide enhanced and improved alertness and has a friendly and subtle taste, but the state of this improved alertness fades away in one to one and half hour depending on the amount of consumption (Pu *et al.*, 2020) [56]. Vidari is very commonly confused or compared to alfalfa buvidari leaves have higher nutrition value than that of alfalfa (Gulizia & Downs, 2019) [26].

Stevia Rebaudiana

stevia is generally known as candy leaf, honey leaf and sweet leaf, it tastes sweet due to presence of steviol glycosides it has 100 -300 times sweetness of sucrose. It is good source of essential ammino acids, vitamins bioactive compounds like phenolic compound, phytosterols and hydrocarbons (Khiraoui *et al.*, 2017) [39] *S.rebaudiana* are found in south and central America. People of japan using it as a sweetener as a natural control for diabetes. *Stevia* also has been used to help control weight in obese persons (Kim *et al.*, 2011) [40].

Withania somnifera

In various indigenous medical systems, *Withania Somnifera* commonly called ad Indian ginseng or ashwagandha has been a very crucial and important herb for more than 3000 years. The roots of this plant are bifurcated into different categories called as rasayanas which are known to create a sense of wellbeing and various other health benefits (Gupta & Rana, 2007) [27] It is considered to be a natural energy booster. The plant also has huge pharmaceutical applications too. It has properties like analgesic, anti-inflammatory, antipyretic, anti-asthmatic, and wound healing capabilities. Also, it possesses anti-diabetic, anti-cancerous and hepatoprotective properties

too (Ganguly, 2013) [23]

Lepidium meyenii

Maca (*Lepidium meyenii*) is native to Peru and this plant belongs to the cruciferous (Brassicaceae), Nutritional value of maca root only partially lies in its major dietary constituents, which include starch, dietary fiber, and protein (Wang & Zhu, 2019) [79] Quinoa contains all the nine essential amino acids, almost twice as much fiber as most other grains and perfect for people with gluten intolerance it helps to prevent certain chronic diseases; low in calories only has about 53 calories per 100 grams and modulates immune function. Lucuma contains beneficial nutrients that sugar lacks (Islam *et al.*, 2019) [34] Number of papers describes important effects of maca. One of them says that maca has been traditionally used for medicinal purposes and as a source of energy, stamina also been used as tonic for problems (Balick & Lee, 2002) [7].

Phyllanthus niruri

More than 600 species of Phyllanthus genus are spread across subtropical and tropical regions of the world. *Phyllanthus niruri* is a tropical shrub from the family Euphorbiaceae it is also known as stone breaker (Lee *et al.*, 2016) [43] it is used as traditional medicine and also as an energy booster. The plants contain phytochemicals such as flavonoids, saponin, alkaloids and tannins (Moniharapon *et al.*, 2020) [49]

Aegle marmelos

Aegle marmelos L. belongs to rutaceae family and have many health benefits, such as anticancer, antimicrobial properties, this tree is grown all over the world and it is high in nutrition (Venthodika *et al.*, 2020) [77], it has vast traditional scope. Pulp of this fruit contains various alkaloids such as marmeline, Angeline, O-methylhalfordinine, aegelenine, is open tenyl half ordinol, fragrine (C13H11O3N). fruit juice of Bael gives an instant boost of energy to the body and it has normalizing effect (Bhardwaj & Nandal, 2015) [10] and it is also stated in the review (Bamola *et al.*, 2018) [8] that fruits of this plant contain high energy and nutritional value

Rhodiola Rosea

Rhodiola rosea L is also known as "golden root" or "roseroot", is an adaptogen herb with variety of effects namely cardioprotective, anticarcinogenic and its belongs to family Crassulaceae (Pu *et al.*, 2020) [56] And properties such as anti-stress based on data of evidence supporting the effectiveness of this plant for depression is limited, Hence a review of available animal and humans suggesting an antidepressant action is possible. (Amsterdam & Panossian, 2016) [3].

A review identified a significant amount of data about the effects of this plant and its extracts on stress and its related disorders and other mechanistic studies show the ability of this plant's extract to boost levels of energy and normalise stress levels. (Angheliescu *et al.*, 2018) [4].

Cordyceps Sinensis

Cordyceps sinensis is also known as Yarsagumba is among very rare fungus species. It is generally found as a parasite on caterpillar of moth also can be found under alpine grass at high altitude. this fungus is generally referred as summer plant and winter insect. This fungus is specially used as one of the food products in Asian countries and its widely used for medicinal purpose (S. P. Li *et al.*, 2006) it is also widely used

as a traditional energy booster and for its ability to enhance stamina in human body. it has very positive effect of fat metabolism which is important to boost health and energy (Chandra Joshi *et al.*, 2017) [16].

Tribulus Terrestris

Tribulus terrestris belongs to family of Zygophyllaceae and its commonly referred as Tribulus, goat head in china. It is grown in subtropical regions such as India, South America, Spain, Pakistan, China (Zhu *et al.*, 2017) [83] This plant has shown positive amount of boosting energy level in humans and animals (Swaroop *et al.*, 2017) [72] the correct amount of these standardized botanical extracts should be used. The right dose differentiates between a poison and a remedy, so more is not always good.

Arnica montana

Arnica montana L. (arnica) is native to region of Europe. The genus belongs from Asteraceae family and commonly known as leopard's bane it is a flowering plant (Craciunescu *et al.*, 2012) [16] Several medicinal properties are attributed to this plant. Dried Arnica flower is available as a spice in the USA and commonly used as a diaphoretic, diuretic and stimulant herb (Sharma *et al.*, 2016a) [19] A study shows that *in vitro* anti-inflammatory activity of *A. montana* extract on lipopolysaccharide-stimulated J774.

Camellia sinensis

Camellia sinensis is used as a natural medicine the extract of this tea used in old days in china it is mostly consumed beverage in the world next to water. A cup of hot steaming tea in the morning is known to boost energy and refresh our sensory organs (Ramakrishnan & Rangiah, 2016) [18] Green tea leaves ingredients analysis has shown that it contains polyphenols (36% of dry weight), methylxanthines (3.5%), amino acids (4%), organic acids (1.5%), carotenoids (Bedrood *et al.*, 2018) [15].

Centella asiatic

Centella asiatica (L.) is from a plant family Apiaceae which is previously known as Umbelliferae and is considered to be of a subfamily called Mackinlayoideae (USDA 2016) And it was reassigned from the subfamily of hydrocotyloideae because of the studies of molecular phylogenetic research (Gray *et al.*, 2018) [25] (Heong *et al.*, 2011) [29] in a review has stated that the extract from this plant assists in promoting health to prevent diseases and helps in boosting energy levels. This plant is also known as gotu kola and generally called as Indian pennywort this plant found in some Asian countries such as, India, China, Sri Lanka, Africa (Prakash *et al.*, 2017) [54].

Chlorophytum borivilianum (L.)

Chlorophytum borivilianum is also called as safed musli belongs to the kingdom Plantae and family Liliaceae. The important phytochemicals present in this plant are saponin, tannins, glycosides and alkaloids (Vishan & Srivastava, 2016) [78], and also the roots of this plant are used for boosting the levels of energy of human body. This plant was initially located in the region of Maharashtra, a state in the Indian subcontinent and its distribution is found among the states of Andhra Pradesh, Gujarat, Madhya Pradesh, and Rajasthan. Borivilianosides a term used for identifying steroidal saponins having cytotoxicity, were isolated from extracts of *C.*

borivilianum(Chowdhary & Kaushik, 2019) ^[17] the bioactive compound consists of proteins, steroids, carbohydrates, minerals, alkaloids and these are the primary source of medicinal properties (Singh Roshan *et al.*, 2013; Journal & Vol, 2013) ^[36].

Ocimum sanctum

Ocimum sanctum is also referred as Tulsi, and it is considered to be holy/sacred plant in Hindu religion and its worshiped all over the Indian subcontinent. it belongs to the family of labiatae and is a multiple branched and stout aromatic herb

which grows to about 75cm in height) it contains more than 60 phytochemicals and bioactive compounds such as flavonoids, terpenoids, essential oil, phenolic compounds and steroids (Singh & Chaudhuri, 2018) ^[69] *Ocimum sanctum* has shown very crucial and important properties such as being radio protective and cardioprotective along with anti-stress effect that helps in countering conditions like adrenal hypertrophy, hyperglycaemia, corticosterones and chronic stress and also helps to boost energy (Stansbury *et al.*, 2013) ^[70].

Table 2: Traditional herbs as stimulants

Herbs	Common name	Bioactive compounds	Medicinal properties	Useful part	References
Ginkgo bibola	maidenhair tree	Terpene, lactones, flavonoids, fatty acids, proanthocyanins	Antitumor Activity, Improve memory and mental concentration	Leaves	(Fang <i>et al.</i> , 2020) ^[21] .
Pueraria tuberosa	Indian kudzu	Tannins, catechins, flavonoids, quinones	High nutritive content and energy stimulant	Roots, leaves	(Gulizia & Downs, 2019) ^[26]
Stevia Rebaudiana	Candy leaf, sugar leaf	Carotenoids, vitamins, anthocyanins, flavonoids	the prevention of cancer and cardiovascular disease	Leaves	(Kim <i>et al.</i> , 2011) ^[40]
Withania somnifera (L.)	Indian ginseng, Ashwagandha	Nicotine, alkaloids, somnine	Antiulcer, anticancer, anti diabetic, use for Alzheimer, energy booster	Fruit, roots, leaves, seeds	(Bharti <i>et al.</i> , 2016; Pratibha <i>et al.</i> , 2013) ^[11, 55] .
Lepidium meyenii	Maca	phenols, sterols, alkaloids glucosinolates,	Antifatigue, increases immunity function	Root	(Gan <i>et al.</i> , 2017) ^[22]
Ocimum sanctum	Holy basil, Tulsi	Proteins, sterols, tannins, flavonoids, saponins	Fever, bronchitis, anxiety, antibacterial, antidiabetic	Leaf, stem, seeds, roots	(Joshi <i>et al.</i> , 2017) ^[35]
Phyllanthus niruri	stonebreaker, gale of wind	Coumarins, flavonoids, terpenoids, lignans	Antiviral, use against ulcer	Leaf	(Tjandrawinata <i>et al.</i> , 2017) ^[74]
Aegle marmelos	Indian Bael	Psoralen, marmenol, rutaretin, limonene, lupeol, cineol, citral	Heart problem, asthma, urinary problems	Fruit, leaves, bark	(Shashank & Poonia, 2020) ^[67]
Pterocarpus marsupium	Vijaysar	Tannins, alkaloids	Skin disease, heart problem	Flowers, leaf	(Kathal & Rawat, 2016) ^[37]
Rhodiola Rosea	Arctic root	Flavonoids, phenylpropanoids, glycosides	Enhance physical performance	Roots	(Li <i>et al.</i> , 2017; Ming <i>et al.</i> , 2005) ^[45, 48]
Codyceps Sinensis	caterpillar Fungus	steroids, terpenes, phenolic compounds,	Anti-cancer, anti-inflammatory, immunomodulatory	Mushroom	(Oh <i>et al.</i> , 2019) ^[51]
Tribulus Terrestris	Gokshura	Tannins, saponins, flavonoids	Use against cardiovascular disease, antiseptic	Fruits,	(Ștefănescu <i>et al.</i> , 2020) ^[71]
Arnica montana	mountain arnica	flavonoids	Stimulant herb	Leaf, stem, flower	(Sharma <i>et al.</i> , 2016) ^[65]
Camellia sinensis	Green tea	Catechins, gallic acid	Antibacterial	Plant	(Cabrera <i>et al.</i> , 2006) ^[14]
ginseng	Asian ginseng, panax ginseng	alkaloids, tannins, saponins, steroidal lactones, flavonoids, ginsenosides	Energy booster	Stem, leaf's, root	(Zhang <i>et al.</i> , 2018) ^[82]
Centella asiatica	Gotu kola, Brahmi	Catechin, rutin., flavonoids, luteolin	Boost energy level	Leaf, bark, seeds, flowers, berries	(chew shio heong 2011)
Chlorophytum borivilianum (L.)	Safed Musli, Swetha Musli	phenols, saponins, flavonoids, alkaloids, tannins, steroids, triterpenoids, and vitamins	Energy booster, Aphrodisiac agen	herbs	(Mrinalini Prasad <i>et al.</i> , 2019) (Huang <i>et al.</i> , 2019) ^[31]

Conclusion and future scope

This review on after very careful and rigorous study suggests that there is a high probability of caffeine which plays a key role as energy stimulant in the current industry of energy drinks and other related beverages could be effecting health of many consumers, and that organic and traditionally used herbs can be used to replace caffeine as energy boosters. As a result, we could create a better energy stimulant which not only add value to the beverages in terms of preventing health effects but also can serve as immunity building components which provides better results. All the natural herbs which are reviewed in the above study may have the potential to replace caffeine with a high probability of being a better and

improved replacement in terms of flavour and health benefits.

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