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Chemical Composition of Rejuvenator Energy Drink–A Local Herbal Fertility and Libido Booster

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ABSTRACT

Sexual dysfunction and infertility is a global issue and challenge that has led to the breakdown of many marriages especially in developing and underdeveloped countries. Many unorthodox medicine practitioners have formulated many concoctions with various claims of increasing sexual virility, libido and fertility, which Rejuvenator sold in many beverage stores in Nigeria is one of them. This study aims at determining the chemical composition of this concoction in order to ascertain potential side effects or benefits of such chemicals. Hence, the phytochemical, vitamin, mineral and proximate compositions of this commercial herbal concoction were investigated. The results obtained revealed that the concoction is rich in phytochemicals such as resveratrol (18147.5364 ppm), steroids (8539.7226 ppm), flavonones (6368.0202 ppm), flavan 3 ol (6505.2012 ppm), etc. It also showed high concentration of vitamins C (60.42963 mg/kg), A (22.156 mg/kg) and D (3.149254 mg/kg) with traces of other vitamins. The mineral and heavy metal composition was below the upper tolerable levels with potassium (8.893 ppm), calcium (4.893 ppm), sodium (4.782 ppm) and magnesium (2.894 ppm) having high amounts than the others and no traces of Aluminium and Cobalt. The proximate analysis revealed a high amount of moisture (93.283%), carbohydrate (3.130%), protein (2.45%) and traces of ash, fibre and fat. These results may be responsible for the alleged uses in ethnomedicine as a libido booster and the levels are below the upper tolerable levels. However, the claims need to be investigated in further studies in order for them to be validated.

Keywords: Rejuvenator, Phytochemicals, Vitamins, Minerals, Proximate, Aphrodisiac, Fertility

Abbreviations: NAFDAC: National Agency for Food, Drug Administration and Control; GC-FID: Gas Chromatography Flame Ionization Detector; ECF: Extracellular Fluid; RNA: Ribonucleic Acid; DNA: Deoxyribonucleic Acid.

INTRODUCTION

Plants have proven to be very crucial in healthcare as well as for manufacturing pharmaceutical drugs. Pharmacological and phytochemical characterization contributes both to the safe use of herbal medicines and the identification of leads for drug development [1]. Traditional medicine has been officially recognised as a source of primary health care [2]. This has led to an increase in healthcare delivery especially in Africa, Asia, Middle East, etc. [3]. A lot of research studies have shown that plants contain many bioactive compounds, necessary for good health [4-8].

Among these diverse bioactive compounds are carotenoids, flavonoids, vitamins, dietary fibres, minerals, amino acids, prebiotics, phytoestrogens, etc. [9,10]. It has been observed that plants derive their medicinal properties from these bioactive chemicals [11]. They are mainly extracted from roots, leaves, bark, seeds, fruits and even flower of plants and are used in the preparation of syrups, infusions and concoctions for the treatment of different ailments [12,13].

Erectile dysfunction and infertility have been a major cause of concern to many families. Main factors that frequently cause decrease in conception in female partners are congenital, immunological, iatrogenic, oligozoospermia, etc. [14] Although many synthetic drugs abound that are useful in treating these problems, their use has been limited due to their high cost and side effects [15]. Natural products and concoctions have been used over many years to treat erectile dysfunction although there is limited scientific evidence. The use of plants or plant-based products to stimulate sexual desire and to enhance performance and engagement is as old as man. A lot of plants have been reviewed in order to ascertain their efficacy as aphrodisiacs [16].

Rejuvenator energy drink is a herbal energy drink and aphrodisiac consumed extensively in most parts of Nigeria. Although it is branded and sold in most shops, it has not been registered by the National Agency for Food, Drug Administration and Control (NAFDAC), an agency of government charged with the regulation of production and consumption of drugs and food materials [9]. Despite this, people consume this herbal concoction mainly due to its alleged efficacy. The container label shows that it contains the following: *Tribulus terrestris*, *Capsasine*, *Cilantrosied*, *Myristica fragrans*, *Zingiber officinale*, *Rhodiola rosea*, *Ocinum bacilicum*, honey and cinnamon. *Tribulus terrestris* is a perennial herb that grows in eastern and western Asia, Southern Europe and Africa. Pre-clinical studies indicate that the plant possesses analgesic, antihypertensive, anti-inflammatory, anti-edematous, antioxidant, diuretic, hypoglycaemic, and antimicrobial properties etc. [17-20]. It has also been shown to increase sperm production especially as a combined supplement therapy although data from randomized trials for erectile dysfunction are mixed. In females, improvement in sexual dysfunction and improvements in hypoactive sexual desire disorder in pre and post-menopausal subjects have been reported. It also contains a high amount of saponins.

Myristica fragrans (nutmeg), a tropical evergreen plant native to Indonesia is rich in antioxidants. It also possesses anti-inflammatory properties. It equally boosts libido especially by stimulating the nervous system.

Rhodiola rosea is a herb that grows in the cold mountainous regions of Europe and Asia. it contains over 140 active ingredients. It helps to alleviate fatigue. It also helps in diabetes management.

Ocinum basilicum is a leafy green herb that originated in Asia and Africa. It has a lot of medical benefits.

Cinnamon is a spice made from the inner bark of a tree known as *Cinnamomon*. It has anti-obesity property, antioxidant property, and reduces risk of cardiovascular disease.

According to the manufacturers, a single dose of half tumbler daily taken consecutively for one week will correct any form of erectile dysfunction in men and increase libido and fertility in both men and women, a claim that is scientifically unverified.

Owing to the high consumption rate, the present study investigated the chemical profile of this herbal concoction by quantifying the phytochemicals, heavy metals, vitamins, minerals, and proximate composition [16].

MATERIALS AND METHODS

Methods

A bottle of Rejuvenator energy drink was bought from a retail store in Aba, Abia State, Nigeria. The sample was sent to Docchy Analytical Laboratories and Environment Services Limited in Nnewi, Anambra State, Nigeria for analyses.

Phytochemical analysis

The phytochemicals present in Rejuvenator were analysed using GC-FID according to the method described by Association of Official Analytical Chemists.

Heavy metal and mineral analysis

The heavy metal analysis was conducted using Agilent ES240AA Atomic Absorption Spectrophotometer according to the method described by American Public Health Association.

Vitamin analysis

The vitamin analysis was carried out according to the method described by Okwu and Paul.

Proximate analysis

The proximate composition of the Rejuvenator was analysed according to the method of Duru.

RESULTS

Plants and plants products have been over the years used to increase sexual satisfaction, virility and fertility. This stems mainly from their phytochemical compositions (Figure 1).

The result of the phytochemical composition of Rejuvenator is presented in Table 1.

Table 1: Phytochemical components of Rejuvenator energy drink.

Component	Retention	Area	Height	External	Units
Proanthocyanin	0.190	5184.3944	427.802	7.2917	ppm
Lunamarin	1.583	4709.7496	369.572	8.6196	ug/ml
cardiac glycoside	2.633	12170.5138	945.575	11.3284	ug/ml
Anthocyanin	3.550	3903.4112	306.580	5.0215	ug/ml
Ribalinidine	4.400	10229.5051	797.090	13.1597	ug/ml
Flavan 3 ol	12.620	6505.2012	510.587	7.5576	ppm
Rutin	12.990	7261.1404	564.292	9.0117	ug/ml
Naringenin	13.273	5414.6802	430.677	2.2881	ug/ml
Cyanogenic glycoside	13.973	3725.9862	292.760	5.0080	ppm
Spartein	15.620	5351.2845	419.380	9.5901	ug/ml
Flavonones	18.950	6268.0202	498.244	10.9228	ppm

Steriods	22.456	8539.7226	666.846	14.6479	ppm
kaempferol	25.563	4875.0349	383.357	3.3761	ug/ml
Epicatechin	27.910	13725.1531	1063.342	20.5907	ug/g
Phytate	28.276	9186.5206	716.488	12.3475	ug/ml
Resveratol	33.810	18147.5364	1384.596	20.6849	ppm
Oxalate	35.650	17427.5578	1329.989	27.5258	ug/ml
Catechin	36.526	5159.9954	404.908	1.1328	ug/ml
Sapogenin	42.706	13247.6644	1026.936	21.7710	ug/ml
		161133.0720		211.8759	

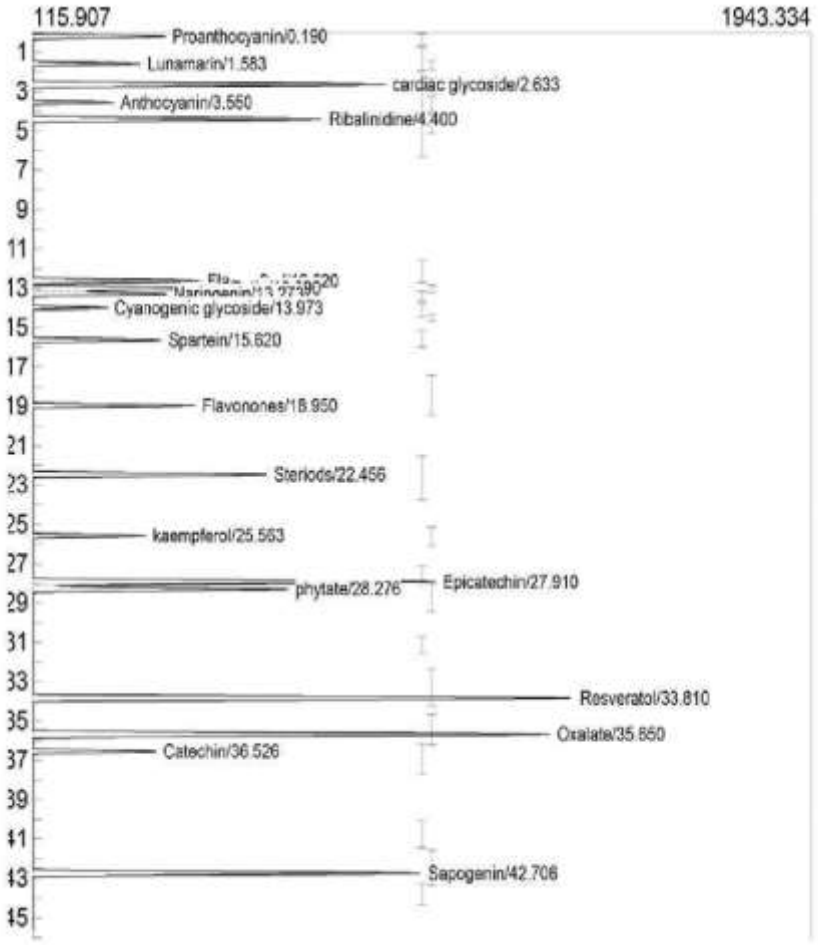

Figure 1: The chromatographic spectrum of Rejuvenator.

The result shows the highest area of 18147.5364 ppm for resveratrol. Other phytochemicals with high area values are steroids (8539.7226 ppm), flavonoids (6368.0202 ppm), cyanogenic glycosides (3725.9862 ppm) and flavan 3 ol (6505.2012 ppm) [20].

The results of the proximate analysis of Rejuvenator energy drink is shown in Table 2.

Table 2: Result of proximate analysis of Rejuvenator energy drink.

Parameter	Weight of dish (g)	Weight of sample (g)	Weight of dish+weight of sample before drying (g)	Weight of dish+weight of sample after drying (g)	% of parameter
Moisture content	37.129	2.01	39.139	37.264	93.283
Ash content	37.129	2.012	-	37.136	0.35
Fibre content	79.774	2.04	-	79.778	0.196
Fat content	78.593	2.03	-	78.605	0.591
Protein	-	-	Titre value	%Nitrogen	%Protein
	-	-	0.7	0.392	2.45
Carbohydrate	-	-	-	-	%Carbohydrate
					3.13

The result of vitamin analysis of Rejuvenator energy drink is shown in Table 3.

Table 3: Result of vitamin content of Rejuvenator energy drink.

Parameter	Absorbance	Concentration
Vitamin A (Retinol)	0.65	22.156 mg/kg
Vitamin E (Tocopherol)	0.062	1.588 mg/kg
Vitamin C (Ascorbic acid)	0.822	60.42963 mg/kg
Vitamin D (Calciferol)	0.047	3.149254 mg/kg
Vitamin B_1 (Thiamine)	0.16	0.0192 mg/100 g
Vitamin B_2 (Riboflavin)	0.15	0.018 mg/100 g
Vitamin B_{12} (Cobalamin)	0.195	3.471698 mg/kg
	Titre value	Concentration mg/100 g
Vitamin B_3 (Niacin)	5	0.61 mg/100 g
Vitamin B_6 (Pyridoxine)	11.9	0.244664 mg/100 g

The results of mineral and heavy metal composition are shown in Table 4.

Table 4: Mineral and heavy metal composition of Rejuvenator energy drink.

Sample	Composition (ppm)
Nickel	0.019
Potassium ppm	8.893
Chromium ppm	0.094
Molybdenum ppm	0.228
Tin ppm	0.045
Cobalt ppm	0.00
Arsenic	0.072
Cadmium	0.032
Manganese	0.024
Calcium	4.893
Aluminium	0.00
Zinc	0.289
Sodium	4.782
Selenium ppm	0.022

DISCUSSION

Resveratrol (3,5,4'-trihydroxy-trans-stilbene) belongs to the polyphenols stilbenoids group. Studies have shown that this compound possesses antioxidant, anticarcinogenic, antitumour, estrogenic/antiestrogenic activity. High amounts of this compound can be found in grapes and wines. Resveratol has been shown to increase ovarian follicular reserve and prolong ovarian lifespan, thereby acting as an anti-aging agent. Also, it can be used as a protective and/or therapeutic agent, particularly in male infertility caused by testicular toxicity. Low resveratrol doses (0.1-1.0 mg/ml) has been documented to enhance cell proliferation whereas higher doses (10.0-100.0 mg/ml) induces apoptosis and decreases mitotic activity on human tumours and endothelial cells. Resveratrol does not appear to have side effects at short term doses (1.0 g). However, at doses of 2.5 g per day, side effects may occur like nausea, vomiting, diarrhoea, liver dysfunction in patients with non-alcoholic fatty liver but no major side effects were stated in long term clinical trials. A dose of 5 g per day has been shown to be safe and well tolerated. Resveratrol, as an anti-inflammatory agent gets the blood pumping especially in the genitals with an aroma that stimulates the brain thereby increasing libido. Resveratol modulates both male and female reproduction. In females, it is regarded as a phytoestrogen while in males, it enhances production of testosterone, triggers penile erection and improves spermatogenesis. Therefore, the high level of resveratrol in Rejuvenator may be one of the factors responsible for increase in libido and fertility as claimed by the users.

The result also shows a high level of steroids (8539.7226 ppm) in Rejuvenator. Steroid hormones are produced in the adrenal glands, ovaries, testes and they regulate a wide range of physiologic functions. All steroid hormones are derived from cholesterol and in most cases are transported through the blood bound to a specific protein carrier to target organs. Both androgens (male sex hormones) and estrogens (female sex hormones) are responsible for development of primary and secondary sex characters. Compounded bioidentical hormone therapy preparations produce highly variable responses that are dependent on a number of factors including genetic background, prior exposure to steroid hormones and environmental and lifestyle factors. The high level of steroids in Rejuvenator may be a contributing factor responsible for the high libido experienced (as alleged) by the use of this energy drink.

The result also shows a high level of flavonones of 6368.0202 ppm. Flavonones are a type of flavonoids and are various aromatic and colourless ketones derived from flavones that often occur in plants as glycosides. Flavones differ from other flavonoids due to the presence of a double bond between C2 and C3 in the flavonoid skeleton and there is no substitution at the C3 position and they are oxidized at C4 position. Also, the high value of another flavonoid known as flavan 3 ol (6505.2012 ppm) is another indication that this herbal concoction is rich in flavonoids. Flavonoids have been associated with the inflammation of tissues in the body and represent the most studied plant polyphenols. Among many natural products, flavonoids have been extensively investigated for the treatment of male reproductive system dysfunction, spermatogenesis disturbance and sperm quality decline. This herbal concoction is very rich in other types of flavonoids, such as kaempferol, naringenin, anthocyanins and glycosides.

These huge phytochemicals present in the Rejuvenator energy drink may be responsible for the reproductive qualities reported by the users and may also play other key protective and therapeutic functions in the body.

The result shows a moisture content of 93.283%. The high moisture content is as a result of the herbal concoction being water based and this may affect the shelf life. Water is extensively used in the body for various metabolic functions such as transport, solvent for substrates, body temperature regulation, etc.

The result shows a low fibre content of 0.196%. Fibre is known to prevent constipation by stimulating bowel movement. The low fibre content is an indication that it may not serve as an anti-constipation agent. The result also shows a low ash content of 0.350%, fat content of 0.591%, protein content of 2.45%, and carbohydrate content of 3.130%. This shows a low nutritive value of this herbal concoction. Epidemiological evidence has shown that consumption of a reasonable amount of dietary fibre (20-35 g/day) lower risk of chronic chest related diseases such as diverticular disease, coronary heart disease, obesity, type II diabetes, irritable bowel syndrome, etc.

The result shows the highest vitamin C concentration of 60.43 mg/kg and vitamin A concentration of 22.15 mg/kg. Vitamins are very essential to the body as their deficiencies may lead to various deficiency diseases by interfering with key metabolic functions. They are therefore, may be useful in boosting the immune system. Retinol (vitamin A) helps to regulate cell development, promotes bone and teeth development, boosts body immune system, good vision and healthy skin. Deficiency of vitamin A, may result in night blindness. Also, the high value of vitamin C (ascorbic acid of 22.26 mg/kg) may be a result of plant products used in the formulation.

Ascorbic acid is required for healthy skin, bones and muscles. It is very necessary for healing of wounds and its deficiency may result in scurvy.

Amazingly, this herbal concoction has a low concentration of vitamin E (Tocopherol) of 1.59 mg/kg. This does not agree with the claim by users of boosting fertility as tocopherol, helps to boost fertility.

Mineral elements are components of most foods and food drinks. Based on requirement and cellular functions, they are classified as macro or micro minerals. Macro minerals such as Sodium, Potassium, Calcium and to some extent, magnesium are those playing major cellular, structural or functional roles, while micro minerals such as Nickel, Chromium, Molybdenum, Tin, Manganese, Zinc and Copper are those required in small amounts for certain key cellular functions.

Rejuvenator energy drink contains both macro and micro minerals, all below the upper tolerable limits for the minerals. This makes it a good source of these nutrients for cellular activities. Sodium and potassium are very important in the maintenance of both extracellular and intracellular homeostasis. These are important in the maintenance of electrolyte balance and ionic distribution around the cell, for optimal cellular activities. Chromium, Manganese, Zinc and Copper are among the micro minerals that play important roles as enzyme cofactors and are key in the functionality of several enzymes.

Bone mineral serves as the ultimate reservoir for the calcium circulating in the Extracellular Fluid (ECF). Calcium enters the ECF from the gut by absorption and from bone by resorption. Calcium leaves the ECF *via* the gastrointestinal tract, kidneys, and skin and enters into bone *via* bone formation. In addition, calcium fluxes occur across all cell membranes. Many neuromuscular and other cellular functions depend on the maintenance of the ionised

calcium concentration in the ECF. Calcium fluxes are also important mediators of hormonal effects on target organs through several intracellular signalling pathways, such as the phosphoinositide and cyclic adenosine monophosphate systems.

The human body contains about 760 mg of magnesium at birth, approximately 5 g at age 4-5 months, and 25 g in adults. Of the body's magnesium, 30-40% is found in muscles and soft tissues, 1% is found in extracellular fluid, and the remainder is in the skeleton, where it accounts for up to 1% of bone ash.

Soft tissue magnesium functions as a cofactor of many enzymes involved in energy metabolism, protein synthesis, RNA and DNA synthesis, and maintenance of the electrical potential of nervous tissues and cell membranes. Of particular importance with respect to the pathologic effects of magnesium depletion is the role of this element in regulating potassium fluxes and its involvement in the metabolism of calcium. Magnesium depletion depresses both cellular and extracellular potassium and exacerbates the effects of low potassium diets on cellular potassium content. Muscle potassium becomes depleted as magnesium deficiency develops, and tissue repletion of potassium is virtually impossible unless magnesium status is restored to normal. Low plasma calcium develops frequently as magnesium status declines.

Selenium has been implicated in the protection of body tissues against oxidative stress, maintenance of defences against infection, and modulation of growth and development. The selenium content of normal adult humans can vary widely. Values from 3 mg in New Zealanders to 14 mg in some Americans reflect the profound influence of the natural environment on the selenium contents of soils, crops, and human tissues. Approximately 30% of tissue selenium is contained in the liver, 15% in kidney, 30% in muscle, and 10% in blood plasma. Much of tissue selenium is found in proteins as selenoanalogues of sulphur amino acids; other metabolically active forms include selenotrisulphides and other acid-labile selenium compounds.

Zinc is an essential component of a large number of enzymes participating in the synthesis and degradation of carbohydrates, lipids, proteins, and nucleic acids as well as in the metabolism of other micronutrients. Zinc stabilises the molecular structure of cellular components and membranes and contributes in this way to the maintenance of cell and organ integrity. Furthermore, zinc has an essential role in polynucleotide transcription and thus in the process of genetic expression. Its involvement in such fundamental activities probably accounts for the essentiality of zinc for all life forms. Zinc plays a central role in the immune system, affecting a number of aspects of cellular and Humoral immunity.

The clinical features of severe zinc deficiency in humans are growth retardation, delayed sexual and bone maturation, skin lesions, diarrhoea, alopecia, impaired appetite, increased susceptibility to infections mediated *via* defects in the immune system, and the appearance of behavioural changes.

The presence of all these mineral elements, in levels below the upper tolerable limits is a good indication of the drink being an important source of these nutrients.

CONCLUSION

This study has shown the phytochemicals, vitamins, proximate and mineral components of Rejuvenator –a local herbal concoction alleged to boost sexual performance, virility and fertility in both males and females. Further studies should be directed towards scientifically proving these claims by the users and manufacturers of this energy booster.

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