AGRICULTURE & ENVIRONMENT
E-NEWSLETTER
agrinenv.com

Article ID: AEN-2022-03-06-008

Ephedrine – An Alternate Source for Human Body Weight Loss

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Recent studies have reported that globally, more than 1.9 billion adults are overweight and 650 million are obese. Approximately 2.8 million deaths are reported as a result of being overweight or obese. Due to the consumption of energy dense food *i.e.* unhealthy food habits, sedentary life style, lack of health care services and financial support, the developing countries are facing high risk of obesity and their adverse consequences *i.e.* diabetes, ischemic heart disease, *etc*. In India, more than 135 million individuals were affected by obesity. The prevalence of obesity in India varies due to age, gender, geographical environment, socio-economic status, etc. In India, abdominal obesity is one of the major risk factors for cardiovascular disease (CVDs). Various studies have shown that the prevalence of obesity among women were significantly higher as compared to men. Obesity is one of the main medical and financial burdens for the government. This problem of obesity can be preventable by spreading public awareness about obesity and its health consequences. Governmental agencies should promote the benefits of healthy life style, food habits and physical activity.

Highlights

•More than 135 million individuals were affected by obesity in India.
•Prevalence of obesity in India is varying from rural to urban and state-wise.
•Urban population and states with high socio-economic status were found to be having higher obesity prevalence.

Ephedra is a genus of gymnosperm shrubs. The various species of *Ephedra* are widespread in many arid regions of the world, ranging across southwestern North America, southern Europe, northern Africa, southwest and central Asia, northern China and western South America. It is the only extant genus in its family, **Ephedraceae**, and order, **Ephedrales**, and one of the three living members of the division Gnetophyta alongside *Gnetum* and *Welwitschia.* In temperate climates, most *Ephedra* species grow on shores or in sandy soils with direct sun exposure. Common names in English include joint-pine, joint-fir, Mormon-tea or Brigham tea.

Kingdom	:	Plantae
Clade	:	Tracheophytes
Division	:	Gnetophyta
Class	:	Gnetopsida
Order	:	Ephedrales
Family	:	Ephedraceae
Genus	:	*Ephedra*

Botanical Description

The family Ephedraceae, of which *Ephedra* is the only genus, are gymnosperms, and generally shrubs, sometimes clambering vines, and rarely, small trees. Members of the genus frequently spread by the use of rhizomes.

The stems are green and photosynthetic. The leaves are opposite or whorled. The scale like leaves fuse into a sheath at the base and this often sheds soon after development. There are no resin canals. The plants are mostly dioecious, with the pollen strobili in whorls of 1–10, each consisting of a series of decussate bracts. The pollen is furrowed. The female strobili also occur in whorls, with bracts which fuse around a single ovule. Fleshy bracts are white (such as in *Ephedra frustillata*) or red. There are generally 1–2 yellow to dark brown seeds per strobilus.

Taxonomy

The genus *Ephedra* was first described in 1753 by Carl Linnaeus, and the type species is *Ephedra distachya*. The family, Ephedraceae, was first described in 1829 by Dumortier.

Distribution

The genus is found worldwide, in desert regions, but not in Australia.

Ecology

Ephedraceae are adapted to extremely arid regions, growing often in high sunny habitats, and occur as high as 4000 m above sea level in both the Andes and the Himalayas.

Ephedra

Various Asian plants, particularly ma huang (*Ephedra sinica*), have been used as sources of the drug ephedrine. Ephedra has been a common herbal medicine in China for thousands of years, and several species are important in Ayurvedic medicine.

Ephedrine

Ephedrine is a sympathomimetic amine, derived from various plants in the genus *Ephedra*, commonly used as a powerful stimulant, weight loss supplement, and appetite suppressant. It helps the body lose fat by way of raising the body's core temperature through the process of thermogenesis, thereby increasing the metabolic rate speed and burning more calories (Rios-Hoyo *et al.*, 2016; Uckoo *et al.*, 2011).

Weight loss

Ephedrine promotes modest short-term weight loss, specifically fat loss, but its long-term effects are unknown. In mice, ephedrine is known to stimulate thermogenesis in the brown adipose tissue, but because adult humans have only small amounts of brown fat, thermogenesis is assumed to take place mostly in the skeletal muscle. Ephedrine also decreases gastric emptying. Methylxanthines such as caffeine and theophylline have a synergistic effect with ephedrine with respect to weight loss. This led to creation and marketing of compound products. One of them, known as the ECA stack, contains ephedrine with caffeine and aspirin. It is a popular supplement taken by bodybuilders seeking to cut body fat before a competition.

Ephedrine Sources

Agricultural

Ephedrine is obtained from the plant *Ephedra sinica* and other members of the genus *Ephedra*, from which the name of the substance is derived. Raw materials for the manufacture of ephedrine and traditional Chinese medicines are produced in China on a large scale. As of 2007, companies produced for export US$13 million worth of ephedrine from 30,000 tons of ephedra annually, or about ten times the amount used in traditional Chinese medicine.

Synthetic

Most of the l-ephedrine produced today for official medical use is made synthetically as the extraction and isolation process from *E. sinica* is tedious and no longer cost effective.

Biosynthetic

Ephedrine was long thought to come from modifying the amino acid L-phenylalanine.L-Phenylalanine would be decarboxylated and subsequently attacked with alpha-aminoacetophenone. Methylation of this product would then produce ephedrine. This pathway has since been disproven. A new pathway proposed suggests that phenylalanine first forms cinnamoyl-CoA via the enzymes phenylalanine ammonia-lyase and acyl CoA ligase. The cinnamoyl-CoA is then reacted with a hydratase to attach the alcohol functional group. The product is then reacted with a retro-aldolase, forming benzaldehyde. Benzaldehyde reacts with pyruvic acid to attach a 2 carbon unit. This product then undergoes transamination and methylation to form ephedrine and its stereoisomer, pseudoephedrine.

Mechanism of action

Ephedrine, a sympathomimetic amine, acts on part of the sympathetic nervous system (SNS). The principal mechanism of action relies on its indirect stimulation of the adrenergic receptor system by increasing the activity of norepinephrine at the postsynaptic α and β receptors.The presence of direct interactions with α receptors is unlikely, but still controversial.L-ephedrine, and particularly its stereoisomer norpseudoephedrine (which is also present in *Catha edulis*) has indirect sympathomimetic effects and due to its ability to cross the blood-brain barrier, it is a CNS stimulant similar to amphetamines, but less pronounced, as it releases noradrenaline and dopamine in the substantia nigra.

The presence of an *N*-methyl group decreases binding affinities at α receptors, compared with norephedrine. Ephedrine, though, binds better than *N*-methylephedrine, which has an additional methyl group at the nitrogen atom. Also the steric orientation of the hydroxyl group is important for receptor binding and functional activity.

	
Ephedra ciliate ***(Pollen cones with seed)***	*Ephedra ciliate* (Pollen cones)
	
Ephedra distachya (Ripe female cones with seeds)	*Ephedra fragilis* (Pollen cones)

Economic botany and alkaloid content

The earliest uses of *Ephedra* species (mahuang) for specific illnesses date back to 5000 BC. Ephedrine and its isomers were isolated in 1881 from *Ephedra dystachia* and characterized by the Japanese organic chemist Nagai Nagayoshi. His worked to access *Ephedra's* active ingredients to isolate a pure pharmaceutical substance led to the systematic production of semi-synthetic derivatives thereof is relevant still today. Three species, *Ephedra sinica*, *Ephedra vulgaris*, and to a lesser extent *Ephedra equisetina*, are commercially grown in Mainland China as a source for natural ephedrines and isomers for use in pharmaceuticals. *E. sinica* and *E. vulgaris* usually carry six optically active phenylethylamines, mostly ephedrine and pseudoephedrine with minor amounts of norephedrine, norpseudoephedrine as well as the three methylated analogs. Reliable information on the total alkaloid content of the crude drug is difficult to obtain. Based on HPLC analyses in industrial settings, the concentrations of total alkaloids in dried *Herba Ephedra* ranged between 1 and 4%, and in some cases up to 6%.

Summary

Ephedrine can also boost the fat-burning process in your body. The plant ephedra (*ma huang*) contains multiple chemical compounds, but the most notable is ephedrine. This molecule impacts several bodily processes and was used as a popular dietary supplement. Ephedrine, a major component of ephedra, can increase the number of calories your body burns. Research has shown

this results in greater weight and fat loss over weeks to months, though long-term studies are limited. Ephedrine plus caffeine may increase metabolic rate and fat loss more than either ingredient alone.

References

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