

Medicago Sativa: A Potential Remineralizing Agent

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Abstract

Medicago sativa or alfalfa, correctly called Lucerne, are the plants of the genus Medicago, often designated by the generic term "lucerne", are Leguminosae which are widespread on the planet in temperate zones and in certain arid regions, either in the wild state or in the cultivated state as animal fodder. This herb is rich in minerals such as calcium, phosphorous, magnesium, potassium, sodium and antioxidants (vitamin A, B, C, D, E, K). Hence this medicinal herb can be used as a potential agent for remineralization of white spot lesions and incipient carious lesions.

Keywords: Medicago sativa; Dental Caries; Demineralization; Remineralization.

INTRODUCTION

Medicago sativa or Alfalfa, is called "The Father of All Plants" in Arab literature. It has excellent nutritive and therapeutic benefits in management of gastrointestinal disorders, detoxification, improving the immune response and prevention of amnesia. It is naturally high in many essential vitamins, including vitamin A (β carotene), B1, B2, B3, B5, B6, B8, B9, B12, C, D, E and K. It is also a rich in minerals such as biotin, calcium, iron,

phosphorous, magnesium, manganese, potassium, copper, zinc, silica and many others. This medicinal herb contains saponins, which is effective against various gram positive and gram negative organisms, making it an effective antifungal and antibacterial agent.¹ Studies have shown that it has antibacterial activity against gram positive bacteria *Bacillus cereus*, *B. subtilis*, *Staphylococcus aureus* and *Enterococcus faecalis*, and control some yeast-like fungi.²

Dental caries is most common disease affecting the hard tissues of the tooth. It is caused due to the imbalance between the demineralization and re-mineralization of the hard dental tissues like enamel, dentin and cementum within the oral environment. The saliva is supersaturated with calcium and phosphate with respect to the mineral phase of enamel, and as a result, calcium and phosphate ions are continually deposited on the enamel surface or are redeposited in enamel areas where they were lost. The organic acid produced by the oral micro flora produces a drop in the pH. This results in the dissolution of enamel hydroxyapatite or enamel demineralization. Change in the pH,

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from acidic to alkaline, results in deposition of calcium, phosphate, and fluoride ions in the form of fluorapatite, which is more resistant to crystal dissolution by organic acids.³ Therefore the most effective way to prevent dental caries is use of remineralization products. Natural medicinal herbs have the chemical constituents similar to the physiological function of living flora and hence they are believed to have better compatibility with the human body. Studies have shown that over 80% of people in developing countries, applies herbal remedies for curative needs.

Botanical Description⁴

Medicago sativa or alfalfa, belongs to the scientific family of Leguminosae (bean). It is a perennial herb with trifoliate dentate leaves and an underground stem that is often woody. Alfalfa grows to approximately 1 m with 5 to 15 stems. The most common colors of flowers are purple, yellow, white, and cream, which produce spiral-shaped seed pods once pollinated. It is the most cultivated legume in the world, with the United States being the largest producer. California, South Dakota, and Wisconsin are the leading states for alfalfa production.

Chemical Composition⁴

The leaves of Medicago sativa are rich in protein, calcium, trace minerals, carotene, vitamins E and K, and numerous water soluble vitamins. Alfalfa seeds contain the toxic amino acid L-canavanine, an analogue of arginine. It contains proteins such as Lysine, Tryptophan, Threonine, Cysteine, Methionine, Valine, Leucine, Isoleucine, Tyrosine and Phenylalanine. It is rich in minerals such as phosphorous, calcium, potassium, iron, sodium, magnesium, manganese, zinc and copper. It is rich in vitamins such as Beta-carotene, Vitamin E, Vitamin B9, Vitamin K (Table 1).

Table 1: Nutritional value per 100 g (3.5 oz)⁵

Energy	96KJ(23kcal)	-
Carbohydrate	2.1g	-
Dietary Fiber	1.9g	-
Fat	0.7g	-
Protein	4g	-
Vitamins	Quantity	Percentage of daily value
Thiamine (B1)	0.076 mg	7%
Riboflavin (B2)	0.126 mg	11%
Niacin (B3)	0.481 mg	3%
Pantothenic acid (B5)	0.563 mg	11%
Vitamin B6	0.034 mg	3%

Folate (B9)	36 µg	9%
Vitamin C	8.2 mg	10%
Vitamin K	30.5 µg	29%

Minerals	Quantity	Percentage of Daily Value
Calcium	32 mg	3%
Iron	0.96 mg	7%
Manganese	0.188 mg	9%
Magnesium	27 mg	8%
Phosphorus	70 mg	10%
Potassium	79 mg	2%
Sodium	6mg	0%
Zinc	0.92 mg	10%
Water	93g	-

Units=µg-microgram, mg-milligram. Percentages are roughly approximated using US recommendations for adults. *Source:* USDA FoodData Central

PHARMACOLOGICAL BENEFITS^{6,7}

Anti-inflammatory effects

Animal studies have shown that the production of nitric oxide from lipopolysaccharide (LPS)-induced inflammation in macrophages was reduced in the presence of alfalfa extract. Additionally, LPS-stimulation of interleukin-6 and tumor necrosis factor alpha production was also decreased with chloroform extracts of alfalfa. Pretreatment with a chloroform extract of alfalfa was found to improve 2-day survival rates in mice injected with LPS.

Antioxidant effect

It contains a variety of antioxidants which help in reduction of free radicals, improvement of immune system and management of inflammation.

Anxiolytic effects

Animal studies on mice have shown that the methanolic extract of M. Sativa was found to exert anxiolytic effects as noted by the average time spent and number of entries in open arms as part of an elevated plus-maze test.

Reduction in cholesterol

The saponin and fiber of alfalfa plant bind large quantities of cholesterol in vitro. Studies on animals have shown that the ingestion of alfalfa reduces cholesterol absorption and atherosclerotic plaque formation in animals. In a study of hypercholesterolemic rabbits, alfalfa given for 12 weeks decreased triglycerides, low density lipoproteins, and glucose. It also increased high-

density lipoproteins. A reduction in the formation of fatty streaks in the right and left coronary arteries and the aorta was also noted in animals receiving a diet supplemented with alfalfa.

In addition to demonstrating a cholesterol-lowering effect, alfalfa administration was also found to exert hepatoprotective effects in rats intoxicated by carbon tetrachloride as noted by the ability to suppress increases in glutamic-oxaloacetic transaminase, glutamic pyruvic transaminase, gamma-glutamyl transferase, alkaline phosphatase, and bilirubin contents.

HYPOGLYCEMIC EFFECTS

The manganese content of *M. Sativa* are believed to be effective in producing the hypoglycemic effect. In streptozocin-induced diabetic mice, lucerne 62.5 g/kg in the diet was found to decrease hyperglycemia. Additionally, the aqueous extract of lucerne was associated with an increase in glucose uptake, carbon dioxide production, and glycogenesis.

REDUCTION IN MENOPAUSAL SYMPTOMS

Administration of *M. Sativa* and *Salvia officinalis* was associated with a reduction to a complete resolution of hot flushes and night sweats in 30 menopausal women.

Re-mineralization Potential

Alfalfa is rich in calcium, iron, copper, manganese, phosphorus, potassium, silicon, zinc and many vitamins. Alfalfa is high in mineral content and, because of this, it is ideal for bones, joints and skin. Research have shown that it promotes both bone and teeth health. According to a recent *in vitro* study, the alfalfa extract, re-mineralized subsurface lesion. There mineralization potential of alfalfa is believed to be due to its rich calcium content.⁸ The dental hard tissue is composed of hydroxyapatite crystals. The crystals are basically made of calcium and phosphate. Each calcium phosphate phase possesses its own thermo dynamical solubilities. For example, at pH=7 and 37°C, HA is the most stable phase. The stability of the calcium phosphates is the characteristics of the solution in which these salts are formed or placed, namely the solution supersaturation in free calcium and phosphate ions. At a given pH and temperature, a free calcium and phosphate ion containing solution can be categorized in three different states: (i) the stable (undersaturated)

zone, where crystallization is impossible, (ii) the metastable zone (supersaturated), where spontaneous crystallization of calcium phosphate salt is improbable, although the concentrations are higher than the ones corresponding to the salt solubility. If a crystal seed were placed in such a metastable solution, growth would occur in the seed; (iii) the unstable or labile (supersaturated) zone, where spontaneous crystallization of calcium phosphate is probable, but not inevitable. Extracellular fluids that are supersaturated for calcium and phosphate may induce the nucleation and growth of new calcium phosphate crystals.⁹ The alfalfa extract as the liquid tincture provide a supersaturated solution of minerals especially calcium, thus helping in remineralisation.¹⁰

CONCLUSION

Alfalfa has various health benefits along with its role in remineralizing the enamel subsurface demineralization. As it's a natural herb it can be considered as an economical substitute to commercially available chemical remineralizing agents. More *in vitro* and *in vivo* studies need to be conducted focusing on the standardization of alfalfa. It is also important to exploit its maximum potential in the field of dental sciences for its novel and fruitful application.

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