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Medicago: A Promising Source of Bioactive Compounds

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COLUMN ARTICLE

The Leguminosae includes a high variety of plants with significant economic value, such as soybean, alfalfa, clover, pea, peanut and different beans, often proposed as potential natural sources of specific bioactive components, such as phenolic compounds [1]. The genus *Medicago* is part of the botanical family of *Leguminosae* and includes about 56 different species mainly distributed in Mediterranean climatic conditions areas. Alfalfa (*Medicago sativa*) is the main *Medicago* species widely grown throughout the world, predominantly as a source of high quality forage for livestock [2,3]. It is also a source of phytochemicals being, for this reason, used as a human food ingredient, as sprouts in salads, sandwiches or soups [4], as leaf protein concentrates [5], or as food supplements [6]. Despite these uses, other different pharmacological activities have been reported for alfalfa, leading to their use in health dysfunctions, such as anaemia, diabetes, endometriosis, stomach ulcers, osteoporosis, menopausal symptoms, breast and prostate cancers and low bone density [7,8]. Nevertheless, the major applications of *Medicago* species are as grazing food for cattle and other Several authors reported that *Medicago* species are important sources of phytochemicals, including carotenoids, saponins or phytoestrogens, which are known to act as antimicrobial agents, phytoanticipins, phytoalexins, structural barriers, modulators of pathogenicity, plant defence genes activators or fungi toxic agents [1,3,9]. Over this panoply of compounds, phytoestrogens are the most interesting for different industries, such as nutraceutical or cosmetic ones. The term *phytoestrogen* is generally used to define a wide variety of compounds that are non-steroidal and are either of plant origin or derived from the *in vivo* metabolism of several plants used as food [9]. Isoflavones are phenolic compounds with antioxidant activity and structural similarity to estradiol molecule [10,11], being primarily found in plants of the Fabaceae family, including soy, lentils, bean plant, chickpeas, alfalfa and red clover [12]. A number of epidemiological studies associate the consumption of isoflavone-rich foods with low incidence of the major hormone-dependent cancers [13], cardiovascular diseases [14], osteoporosis [11], and climacteric complaints [15]. Because of their structural similarity to ß-estradiol, health benefits of isoflavones have been evaluated in age-related and hormone-dependent diseases [16]. Biochanin A (5,7-dihydroxy-4'-methoxyisoflavone) and formononetin (7-hydroxy-4'-methoxyisoflavone) are methylated precursors of genistein and daidzein, respectively, and present high amounts in alfalfa [17,18]. Therefore, estrogens can slow down the aging process of the skin in postmenopausal women. For this reason, isoflavones are also very interesting compounds for cosmetic formulations. When incorporated in creams, natural estrogens could result in morphological modifications to the aged skin, characterized mainly by an increased number of fibroblasts and glycosaminoglycans (GAGs), and, consequently, collagen and hyaluronic acid. Rodrigues., *et al.* evaluated hydroalcoholic extracts of seven species of *Medicago* (*M. minima*, *M. tornata*, *M. truncatula*, *M. rigidula*, M. *scutelata*, *M. segitalis* and *M. sativa*) in what concerns antioxidant and

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antimicrobial activities as well as cytotoxicity in skin cell lines [19]. Results revealed the richness of these extracts in polyphenol compounds, representing a potential source of natural compounds with low cytotoxicity for skin cells as well as antimicrobial activity at concentrations of 500 µg/mL against important skin strains (such as *Staphylococcus aureus*) [19]. In another study, Rodrigues., *et al.* evaluated different extracts (aqueous, hydroalcoholic and alcoholic) of the same *Medicago* species regarding the isoflavones composition. According to the authors, genistin, daidzein and Feinstein were the most abundant isoflavones, being the highest genistin concentration observed in the extracts of *M. scutelata* [18]. Also, the extractability of compounds significantly increased from aqueous to alcoholic extracts [18]. These results are in accordance with Soto-Zarazua., *et al* [20].

In what concerns food incorporation of *M. sativa* extracts, Soto-Zarazua., *et al.* characterized the nutritional composition, as well as the *in vitro* and *in vivo* effects of two *M. sativa* extracts used as ingredients for nutraceutical products [21,22]. The extracts were able to decrease the *in vivo* glucose concentration to normal levels in rats and no *in vivo* acute toxicity was observed at the recommended human daily intake Nevertheless, some *in vitro* cytotoxicity on Caco-2 cells were reported at high concentrations [21].

In conclusion, *M. sativa* has an enormous potential as active ingredient for different industries, such as nutraceutical and cosmetic. The researches performed until now revealed it richness in bioactive compounds as well as it low cytotoxicity. Further studies are needed to evaluate the *in vivo* effects of different extracts, not only in a short period but also during long term studies.

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