

Quercus spp. extract as a promising preventive or therapeutic strategy for cancer: A systematic review

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Abstract. Acorns have traditionally been used in the human diet and for the treatment of specific diseases. Therefore, the present study performed a systematic review of studies which investigated the effects of *Quercus* spp. extracts in cancer prevention and treatment. A systematic literature search was performed for original records which addressed the anticancer effects of *Quercus* spp. extract in *in vitro* and *in vivo* cancer models. Body composition, food consumption, tumor development and/or toxicity were evaluated in *in vivo* studies, while cytotoxicity was evaluated in *in vitro* studies. Few studies and low sample sizes presented a challenge in the drawing of solid conclusions. Overall, the results suggested a positive impact of *Quercus* spp. extract, by reducing cancer development. Therefore, more studies with different cancer cell lines and animal models to address the efficacy of the acorn extracts in several types of cancer are required. Furthermore, the effects of acorn flour, incorporated in the diet, in an animal model of mammary cancer should be evaluated.

Introduction

Cancer is a leading cause of death worldwide, accounting for approximately 10 million deaths in 2020 (1). Breast, lung, colorectal, prostate, skin (non-melanoma) and stomach are among the most frequent types of cancer worldwide (1). The increasing number of cancer cases and deaths annually, the

inefficacy of the strategies to prevent this disease and the adverse effects of the therapeutic approaches, have led an increasing number of studies to search for alternative and more effective approaches (1). According to the World Health Organization, strategies to reduce cancer risk include not using tobacco, maintaining a healthy body weight, eating a healthy diet (with fruits and vegetables), doing physical exercise regularly, avoiding harmful use of alcohol, minimizing exposure to ionizing radiation and reducing exposure to air pollution (1).

Plants have been used by humans since primitive times for food and medicines (2). Due to the presumable adverse effects of synthetic food additives on human health, in some cases resulting from antagonist synergies between the different synthetic compounds, and the increased consumer perception of this problem, there is a growing interest in obtaining natural extracts from human diet compounds (3).

Species of the genus *Quercus* spp., also known as oak, are a group of deciduous and evergreen trees of the family Fagaceae, which comprises around 600 species worldwide. They are widely distributed in temperate forests of the northern hemisphere and tropical climatic areas (4–6). These species may be found in the basin Mediterranean (Algeria, France, Italy, Morocco, Portugal, Spain and Tunisia), Asia, and North America (7). These trees, abundant in Southern Europe and in the Alentejo region in Portugal, are the basis of the sustainable agriculture system called ‘Montado’ (Portugal) or ‘Dehesa’ (Spain), a traditional silvo-pastoral land use system characterized by low density trees combined with agriculture or pastoral activities (8). Portuguese oak (*Quercus faginea*), holm oak (*Quercus ilex* or *Quercus rotundifolia*) and cork oak (*Quercus suber*) are the most common members of the Fagaceae family in Portugal (9). Almost all parts of the plants of the genus *Quercus* spp., including fruit, bark and leaves, display numerous medicinal properties. Therefore, they have been used in folk medicine in numerous countries and by numerous tribes to treat conditions, including asthma, colitis, diarrhea, furuncles, gonorrhoea, hemorrhoids, labor pains, mucosa inflammation, obesity and stomatitis (10–13).

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