



Phytochemistry and Medicinal Potential of *Euphorbia maculata*: A Systematic Review

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ABSTRACT :

The Euphorbia genus under the family Euphorbiaceae is one of the third largest genus among angiosperms with about 2000 known species to date. This genus is universally integrated into traditional medicine across the globe with particular emphasis on traditional Chinese medicine. The characteristic features of this group are the peculiar inflorescences and the occurrence of latex. This survey gives a comprehensive overview of Euphorbia-derived natural products such as essential oils, extracts, and isolated compounds that exhibit a broad range of biological activities and potential applications for maintaining health. Studies on the essential oils of several Euphorbia species have identified more than 80 phytochemicals, dominated by oxygenated sesquiterpenes and sesquiterpene hydrocarbons. Moreover, Euphorbia extracts contain high levels of secondary metabolites like sesquiterpenes, diterpenes, sterols, flavonoids, and other polyphenolic compounds. These extracts and secondary metabolites can be used as active components in pharmaceutical preparations which are intended to treat many diseases, especially inflammation, cancer, and microbial infections. Furthermore, Euphorbia-derived products exhibit remarkable potential as sources of pure compounds and bioactive extracts, which may help promote increased longevity and general health

1. INTRODUCTION:

Medicinal herbs form a vital part of traditional local heritage, carrying important worldwide importance because they are used in the cure of various diseases in both man and animals. The stems of spotted spurge have pink or red color and rarely protrude more than a few inches above the ground. The stems secrete a milky, whitish, and sticky liquid. Spotted spurge leaves are oppositely disposed along the pink-colored stems, with milky latex sap flowing from newly cut stems. The seeds are contained in tiny capsules and have sticky surfaces that can attach to shoes and animal fur. Consequently, there has been a significant rise in the production of different spurge species for domestic and ornamental use, with the latex adding to the economic value of some species, including Euphorbia antisyphilitica. (1)

The family Euphorbiaceae contains the genus Euphorbia, which is the third largest flowering plant genus and has been identified to have 1,836 species. (2,3) They are classified into different subgenera and sections. Euphorbia occurs globally and thrives in both tropical and temperate regions. This group is characterized by its great morphological variety, ranging from small ephemeral herbs to a wide diversity of herbaceous annuals and perennials, big shrubs, small trees, subshrubs in the form of cushions, and succulent (4). cacti-like forms. Of the 243 species of Euphorbia reviewed by the IUCN Red List of Threatened Species, 170 (about 70%) are considered to be threatened with extinction, classified as vulnerable, endangered, or critically endangered. (5). Over 5% of the Euphorbia species are utilized in traditional medicine, mainly for their purgative and emetic activities, for the treatment of disorders like digestive and respiratory infections, skin and inflammatory diseases, migraines, intestinal parasites, gonorrhoea, and warts. The constituents of the Euphorbia plant that are most often utilized are roots, seeds, latex, wood, bark, leaves, and entire plants. (6,7,8,9,10)



2.TAXONOMICAL CLASSIFICATION:

KINGDOM	: PLANTAE
CLADE	: TRACHEOPHYTES
CLADE	: ANGIOSPERMS
CLADE	: EUDICOTS
CLADE	: ROSIDS
ORDER	: MALPIGHIALES
FAMILY	: EUPHORBIAECAE
GENUS	: EUPHORBIA
SPECIES	: <i>EUPHORBIA MACULATA</i>

3.GEOGRAPHICAL DISTRIBUTION:

Euphorbia maculata or Spotted Spurge is regarded by the United States Department of Agriculture as native to the whole continental United States. This hardy plant has also established itself in the rest of the world, including South America, Australia, Asia, parts of Africa, and all over Europe. You frequently find *Euphorbia maculata* along the roadways, in sidewalk cracks, and widespread across North America. It enjoys sunny, dry locations with minimal shade. Spotted Spurge grows very well in sandy or gravelly soils but will also do well in compacted soils and poor soil condition areas. (20)

4.CHEMISTRY OF *Euphorbia Maculata*:

4.1 MORPHOLOGY OF *Euphorbia Maculata* LEAF:

The leaves of *Euphorbia maculata* have: - An ovate to lance-shaped appearance, from egg-shaped to slender and pointed - A usual length of 1-4 cm (0.4-1.6 in) - A width of 0.5-2 cm (0.2-0.8 in)

Margin of the leaves :- Leaves are smooth and entire in structure, which is unbroken - A mild waviness or undulation in some places.

Apex of the leaves :- Usually acute, having a sharp point - Sometimes obtuse, giving a rounded appearance.

Base of the leaves :- Attenuate, tapering gradually towards the stem - Occasionally rounded in shape.

Leaf surface :- Mainly glabrous, having a hairless and smooth texture - Occasionally with scattered hairs.

Leaf colour :- Mainly green and often with reddish or purplish tints - Occasionally with white or yellowish patches or spots, which is indicated by the name "maculata," meaning "spotted."

Leaf arrangement :- An opposite arrangement, with pairs at right angles to each other - Occasionally an alternate arrangement, where leaves are alternately spaced along the stem.

Stipules :-The stipules, which are small structures that occur at the base of the petiole, are: - Either not present or very tiny in size #

Petiole The petiole, or stalk :- Short, usually 1-5 mm (0.04-0.2 in) in length.



Leaf venation :- Pinnate, having a well-developed midrib and the lateral veins being smaller. [19,20]

4.2 MORPHOLOGY OF *Euphorbia maculata* FLOWER:

The inflorescence, or flowering part, is distinguished by: - A cyathium, a characteristic type of flower within the *Euphorbia* genus - tiny size, usually 1-2 mm (0.04-0.08 in) in diameter - A colour range from greenish-yellow to reddish-brown.

The flowers are characterised by the following features: - Extremely small size, usually 0.5-1 mm (0.02-0.04 in) in diameter - Unisexuality, with male and female flowers separated - Male flowers having a single stamen - Female flowers having a single pistil.

Bracts The bracts, or modified leaves that surround the flower, have: - A green colour, frequently showing reddish or purplish undertones - An ovate to lanceolate shape, which can be defined as egg-shaped to narrow and pointed - A length of usually 1-2 mm (0.04-0.08 in).

Glands The glands, specialized organs that secrete nectar or other substances, are: - occurring in numbers of 4 to 6, disposed around the cyathium - Coloured reddish-brown or yellowish - Active to secrete nectar that will entice pollinators.

Peduncle The peduncle, the stalk that holds the inflorescence, is: - Short in stature, measuring 1-5 mm (0.04-0.2 in) in length - Showing a green or reddish-brown pigmentation.

Flowering Period *Euphorbia maculata* flowers typically in: - The late spring to early summer season (May to July in the Northern Hemisphere) - Producing a cluster of flowers, with more than one cyathium on each stem. [19,20]

4.3 MORPHOLOGY OF *Euphorbia maculata* STEM:



Stem Type: - Herbaceous (soft, not woody) - Prostrate to ascending (trailing along the ground or ascending)

Stem Colour: - Green, frequently with reddish or purplish colours - Occasionally with a bluish or whitish colour.

Stem Texture: - Glabrous (hairless and smooth) - Occasionally with fine, scattered hairs.

Stem Shape: - Cylindrical length to slightly angular - Occasionally with a reddish or purplish stripe along the length.

Internodes The internodes (stem segments between nodes) are: - Short, normally 1-5 cm (0.4-2 in) long - Occasionally longer, up to 10 cm (3.9 in).

Nodes The nodes (sites where leaves join the stem) are: - Swollen or slightly thickened - With a characteristic, crescent-shaped leaf scar.

Stem Length: - Normally, 10-30 cm (3.9-11.8 in) long - Occasionally longer, up to 50 cm (19.7 in) or more.

Branching: - Branched, with several stems originating from the base - Occasionally with a dominant, central stem.

Stem Orientation: - Prostrate to ascending, spreading along or on the ground - Occasionally erect, particularly in younger specimens Here's the morphology of *Euphorbia maculata* stems.

Stem Type: - Herbaceous (not woody) - Prostrate to ascending (spreading on the ground or upwards).

Stem Colour: - Green, frequently with reddish or purplish colors - At times with a bluish or whitish color.

Stem texture: - Glabrous (hairless and smooth) - At times with scattered fine hairs.

Stem Shape: - Cylindrical and slightly angular - At times with a reddish or purplish stripe on the length.

Internodes The internodes (the segments of the stem between the nodes) are: - Brief, usually 1-5 cm (0.4-2 in) long - Occasionally longer, reaching 10 cm (3.9 in).

Nodes The nodes (where leaves join the stem) are: - Thicker or slightly swollen - Featuring a very distinctive crescent-shaped leaf scar.

Stem Length: - Usually, 10-30 cm (3.9-11.8 in) long - Occasionally longer, reaching 50 cm (19.7 in) or more.

Branching: - Branched, with several stems from the base - Occasionally with a central, larger stem.

Stem Orientation: - Prostrate to ascending, lying on or climbing along the ground or upwards - Occasionally erect, particularly in juvenile plants. [19,20]

4.4 MORPHOLOGY OF *Euphorbia maculata* FRUIT:

Fruit Type: - A capsule, being a dehiscent and dry fruit type.

- More specifically, a schizocarp, meaning it can split into several segments.

Fruit Size: - Rather small, usually 2-4 mm (0.08-0.16 in) in diameter.

- With a length of 1-2 mm (0.04-0.08 in).

Fruit Shape: - Typically globular to ovoid, similar to a sphere or egg.

- It might have a slight flattening at times.

Fruit Colour: - Mainly green, usually having reddish or purplish colour.

- It ripens to brown or greyish-brown colour.

Fruit Surface: - Smooth texture. At times, it is covered with fine & scattered hairs.

Seeds: - A diminutive size, usually 0.5-1 mm (0.02-0.04 in) diameter.

- An ovoid to spherical shape. - A brown to greyish-brown color.

- A surface that is either smooth or very slightly ribbed.

Dehiscence of the fruit takes place: - Explosively, causing the fruit to break up into 3-4 segments. The process allows for the release of the seeds.

Fruit Peduncle or stem that holds the fruit: - Of short length, typically 1-5 mm (0.04-0.2 in) in length.

- Displaying a colour which is green or reddish-brown. [19,20]

4.5 MORPHOLOGY OF *Euphorbia maculata* ROOTS:

Root Type: - A single main taproot that grows vertically downwards - Often with a fibrous root system typified by many small roots.

Root Colour: - Mainly white or creamy white - Often with a yellowish or brownish color.

Root Texture: - Usually smooth - Sometimes with fine scattered hairs.

Root Shape: - Usually, conical or cylindrical - Often tapering to a pointed tip.

Root Length: - Typically, between 5 and 15 cm (2 to 6 inches) - Sometimes up to 30 cm (11.8 inches) or longer.

Root Diameter: - Typically, between 0.5 and 2 cm (0.2 to 0.8 inches) - Sometimes thicker, up to 5 cm (2 inches) or longer.

Root Hairs: - White, fine, and scattered - Generally 0.1 to 1 mm (0.004 to 0.04 inches) in length.

Rootlets: - Miniature, branching growths - Generally between 1 and 5 mm (0.04 and 0.2 inches) in length.

Specialized Roots *Euphorbia maculata* can also form: - Adventitious roots, which arise from stems or leaves - Storage roots, which are used to store



water or nutrients. [19,20]

5. Medicinal uses:

- ANTI INFLAMMATORY
- ANTI PLATELET
- ANTIMICROBIAL

- ANTI OXIDANT
- ANTI PROLIFEACTIVE
- ANTI FUNGAL
- ANTI DIARRHEAL

5.1 ANTI INFLAMMATORY:

The n-hexane extract from the whole plant of *E. maculata* showed a significant inhibitory activity against the inflammatory ear edema induced by TPA, with an ID₅₀ (50% inhibitory dose) value of 0.8 mM. A detailed study of all tetracyclic triterpenoids was carried out to assess their anti-inflammatory activity against TPA-induced inflammation in murine models. *E. maculata*, or spotted spurge, is utilized by eclectic physicians and homeopaths who attribute to it numerous putative therapeutic properties. In the past, it has been utilized in treatments of cholera, diarrhea, dysentery, and hematuria, usually in leaf infusion form. (11,12)

5.2 ANTI PLATELET:

The air-dried parts of *Euphorbia maculata* (100 g) were reflux-extracted with ethanol at 80°C for 2 hours. The filtrates thus obtained were filtered and the residue was then subjected to two more extraction processes using the same procedure. The resulting extractions were combined, evaporated, and then lyophilized to obtain the crude extract. This crude extract was then fractionated with chloroform, ethyl acetate, butanol, and distilled water. (13,14)

5.3 ANTI MICROBIAL & ANTI OXIDANT:

The ethanolic aerial parts of *Euphorbia maculata* extract was employed the study used Gram-positive bacteria, *Listeria monocytogenes* ATCC 19115 and *Staphylococcus aureus* ATCC 25923, and Gram-negative bacteria, *Escherichia coli* ATCC 25922 and *Salmonella enterica* serovar Typhimurium ATCC 14028. These bacterial strains were obtained from the Laboratory of Microbiology in the Department of Chemical-Biological Sciences at the University of Sparks, MD. A broth culture medium was set up for every bacterial strain, with the addition of two plates of brain-heart infusion (BHI) broth and two plates of BHI agar (BD Difco, Sparks, MD). Four sterile discs of 6 mm diameter made of Whatman No. 41 filter paper were placed on every agar plate, and 20 µL of ethanolic extract was applied on each disc. The plates were thereafter incubated at 37 °C for 24 hours, and the antimicrobial activity was then measured by determining inhibition halos, which were greater than 3 mm considered to be an indication of inhibition. (15)

5.4 ANTI PROLIFERATIVE:

Antiproliferative activities were determined by incubating three cancer cell lines for a standard period of 48 hours at a concentration of 100 µg/mL, using the sulforhodamine B assay. The HeLa cell line showed the greatest inhibition, with suppression of growth in excess of 61.57% in all samples. The HT-29 cell line showed the minimum inhibition, with the highest suppression being only 35.65% in the tested samples. The extract of *E. maculata* as well as its fractions manifested growth-inhibitory action against all the cell lines, as seen in Fig. 3. Interestingly, the EMEA fraction proved to be the most potent, recording up to 70.22±3.01% and 58.90±2.01% growth inhibition of HeLa and A549 cells, respectively. Moreover, the fraction recorded the highest inhibition of the HT-29 cell line with a value of 35.65±1.16% among the fractions. This was in agreement with earlier work by Choi and Lim that recorded an IC₅₀ of 220 µg/mL for the methanol extract of *E. maculata*. In contrast, extracts from closely related species like *Euphorbia hebecarpa*, *Euphorbia microciadia*, and *Euphorbia humifusa* showed strong inhibition of HeLa cell growth, by virtue of their ability to induce apoptosis and autophagy. For improving our knowledge of the traditional usage and clarifying the multifaceted virtues of this species, we used a systematic multidisciplinary strategy to determine the prospective multipotent active agents of this plant. During our research, the EMEA fraction showed high protection against oxidative damage, which accounted for its strong anti-inflammatory and antiproliferative activity. (16,17,18,19)

6. EUPHORBIA MACULATA COMPOUNDS:

Euphorbia maculata, a member of the Euphorbiaceae family, has been recognized for its diverse array of bioactive compounds. The following is a summary of the compounds that have been successfully isolated and characterized.

6.1 EUPHOL:

Classification: Triterpenoid - Characteristics: Exhibits anti-inflammatory, antimicrobial, and antioxidant properties - Applications: Utilized in wound healing, treatment of skin disorders, and antimicrobial interventions.

6.2 Tirucallol:

Classification: Triterpenoid - Characteristics: Demonstrates antioxidant, anti-inflammatory, and antimicrobial effects - Applications: Employed for its antioxidant properties, anti-aging benefits, and in wound healing.

6.3 Quercetin: -

Classification: Flavonoid - Characteristics: Possesses antioxidant, anti-inflammatory, and antimicrobial properties - Applications: Applied in anti-aging treatments, promoting cardiovascular health, and addressing inflammatory conditions.

6.4 Kaempferol: -

Classification: Flavonoid - Characteristics: Exhibits antioxidant, anti-inflammatory, and antimicrobial effects - Applications: Used for anti-aging purposes, enhancing cardiovascular health, and in anti-inflammatory therapies.

6.5 Ferulic acid: -

Classification: Phenolic acid - Characteristics: Functions as an antioxidant, anti-inflammatory, and antimicrobial agent - Applications: Commonly used in antioxidant formulations, anti-aging products, and skincare solutions.

6.6 Caffeic acid: -

Classification: Phenolic acid - Characteristics: Known for its antioxidant, anti-inflammatory, and antimicrobial properties - Applications: Frequently utilized in antioxidant-rich products, anti-aging treatments, and skincare applications.

6.7 Euphoramine: -

Classification: Alkaloid - Characteristics: Exhibits antimicrobial and anti-inflammatory properties - Applications: Primarily used in antimicrobial treatments and wound healing.

6.8 Euphorbioside: -

Classification: Glycoside - Characteristics: Functions as an antioxidant and anti-inflammatory agent - Applications: Employed in antioxidant formulations, anti-aging products, and skincare applications.

7. CONCLUSION:

The *euphorbia* genus stands out as a remarkably diverse and pharmaceutically valuable group of plants within the Euphorbiaceae family. The diverse range of bioactive constituents found in its essential oils and extracts, particularly sesquiterpenes, diterpenes, flavonoids, and sterols, demonstrate promising anti-inflammatory, anticancer, and anti-microbial properties.

The significant presence of potent phytochemicals further supports the potential of Euphorbia-derived products in the development of natural health-promoting agents.

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