



## ***Alpinia officinarum* : Phytochemistry and Pleiotropism**

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### **ABSTRACT**

Herbal drugs classification system represent as an important system of medicine for the treatment of a wide array of diseases. The medicinal plants from India provide a diverse source for health care moieties in order to prevent different pathological states. *Alpinia officinarum*, known as lesser galangal, is a world-renowned botanical, which has been used since ages because of its rich medicinal diversity. *Alpinia officinarum*, a plant from ginger family, originated in China and cultivated in Southeast Asia. The plant grows several feet high, with long leaves and reddish-white flowers alongwith spicy and aromatic rhizomes. Numerous studies reported *Alpinia officinarum* to possess anti-inflammatory, anticancer, chemoprotective, antibacterial, antifungal and diuretic properties associated with *Phyllanthus amarus*. The present review articles critically abridges about various phytochemicals associated with the plant alongwith numerous pleiotropic properties exhibited by the plant.

**Key Words:** Herbal drugs, *Alpinia officinarum*, Pleiotropic, Zingiberaceae.

### **INTRODUCTION**

It has been a comprehensive topic of debate that plants have the ability to synthesize a wide variety of chemical compounds which are used to perform various biological functions in the human body.<sup>1</sup> Scores of these phytochemicals possess various beneficial effects on long-term health, and thus, can be used effectively in order to treat human diseases.<sup>1-2</sup> *Alpinia officinarum* is a perennial herb, belonging to family zingiberaceae, originated in China and mainly cultivated in Southeast Asia.<sup>3-4</sup> The herb is also cultivated in the plains of West Bengal and Assam in Eastern Himalayas. In addition, the herb grows about ten feet high, with lanceolate leaves and reddish-white flowers. The rhizomes of this herbaceous plant, referred to as galangal, are thin and tough with orange flesh inside and a brown coating, possess an aromatic odor and a pungent flavor, which are valued for their spicy flavor and aromatic scent.<sup>5-7</sup> Numerous phytochemicals have been found to be associated with the herb which includes quercetin, kaemferol, isorhamnetin, kaemferide, galangin, alpinol, and galangol.<sup>8-9</sup> *Alpinia officinarum* has a long history of folk usage because of its rich medicinal values. The plant has been reported to possess potent anti-inflammatory, antibacterial, antifungal, antiviral, diuretic, and anticancer properties.<sup>10-11</sup> The present review article discusses about the various phytochemicals present in the plant. Moreover, the pleiotropic pharmacological properties possessed by this herbaceous plant have been delineated.

### **DESCRIPTION OF PLANT**

*Alpinia officinarum* belongs to kingdom plantae, order zingiberales, family zingiberaceae, genus *alpinia* and species *A. officinarum* with binomial name *Alpinia officinarum* Hance and synonym *linguas officinarum* (Hance). Additionally, the plant possesses various vernacular names, i.e., Sugandha bacha in bengali; lesser galangal in english; kulinjan in hindi; and kulanjana bheda in Sanskrit.<sup>5</sup> The rhizome is woody, branched, dark brown to almost black, cylindrical with distinct nodes and internodes. Nodes are provided with light brown rings, whereas the internodes are finely ridged.<sup>6</sup> Further, the transversely cut surface appears light brown in colour with central and peripheral region. The broken parts are hard, granular with strong aromatic odour.<sup>3</sup> Moreover, the transverse section under microscope depicts epidermis; which is wavy and single layered. The cuticularised epidermal cells are tangentially elongated with dark brown oleo resin content. In addition, the cortex has thick walled parenchymatous ground tissue with less intercellular space and scattered sheathed colloateral vascular bundles. Stellar region is encircled by single layer of thin walled cells devoid of starch grain.<sup>5-6</sup> Large number of sheathed collateral vascular bundles appears closely arranged in stele. Furthermore, abundant starch grains and dark brown oleoresin deposits alongwith oil containing cells and cluster of calcium oxalate are scattered throughout cortex and stele.<sup>3,5-6</sup>

**REPORTED PHYTOCONSTITUENTS**

Extensive studies on *Alpinia officinarum* Hance reports the isolation of various chemical constituents from the plant. The alcoholic extract of rhizome showed the presence of various flavanoid which include quercetin, kaemferol, quercetin-3-methyl ether, isorhamnetin, kaemferide, galangin, isorhamnetin and galangin-3-methylether.<sup>12-13</sup> In addition, two other flavanoids, i.e., rhamnocitrin and 7-hydroxy-3,5-dimethoxyflavone have also been isolated from the plant. In addition, alpinol, galangol and tanning material are also reported from rhizome. Further, various compounds have also been reported to be present in the oil, which include, 1,8-cineol,  $\alpha$ -pinene,  $\beta$ -pinene, methyl isovalerate, camphene, limonene, p-cymene, camphor, trans- $\alpha$ -bergamotene,  $\beta$ -elemene, terpinen-4-ol and  $\delta$ -cadinene.<sup>3,12</sup> Moreover, the roots of the plants have been noted to contain quercetin-3 me ether, galangin 3-me ether, kamfero 7-me ether and 7-OH-3,5-dio-O me flavone and pungent principle like 5-OH-7(4-OH-3-OMe-ph)-1-ph-3-heptanone.<sup>14</sup> Furthermore, glycosidically bound compounds have also been isolated from the methanol extract of fresh rhizome. The benzylbeta-D-glucopyranoside, 1-O-beta-D-glucopyranosyl-4-allylbenzene, 1-hydroxy-2-O-beta-D-glucopyranosyl-4-allylbenzene, 1-O-beta-D-glucopyranosyl-2-hydroxy-4-allylbenzene, and 1,2-di-O-beta-D-glucopyranosyl-4-allylbenzene glycoside were obtained from the rhizomes.<sup>15</sup> The antioxidant compounds were isolated from the methanol extract of fresh rhizome. In addition, seven phenylpropanoids were obtained, including (E)-p-coumaryl alcohol; (E)-p-coumaryl alcohol gamma-O-methyl ether; stereoisomers of (4E)-1,5-bis(4-hydroxyphenyl)-1-methoxy-2-(methoxymethyl)-4-pentene (2a and 2b); stereoisomers of (4E)-1,5-bis(4-hydroxyphenyl)-1-ethoxy-2-(methoxymethyl)-4-pentene (3a and 3b); (4E)-1,5-bis(4-hydroxyphenyl)-1-[(2E)-3-(4-acetoxyphehyl)-2-propenoxy]-2-(methoxymethyl)-4-penten-1-ol; and (4E)-1,5-bis(4-hydroxyphenyl)-2-(hydroxymethyl)-4-penten-1-ol.<sup>16</sup> Further, two new diarylheptanoids, i.e., (5S)-5-hydroxy-7-(3,4-hydroxyphenyl)-1-phenyl-3-heptanone and (5R)-5-hydroxy-7-(3-methoxy-4,5-dihydroxy phenyl)-1-phenyl-3-heptanone were isolated from rhizomes.<sup>17</sup> In addition, other diarylheptanoids, including (3R,5R)-1(4-hydroxyl-phenyl)-7-phenylheptane-3,5diol; 1,7-diphenylhept-4-en-3-one; and 7-(4''-hydroxyl-3''-methoxy phenyl)-1-phenyl-hept-3-one alongwith 1,7-diphenyl-5-hydroxy-3-heptonone and 5-hydroxy7-(4''-hydroxy-methoxy phenyl)-3-heptanone were also isolated from the rhizomes of *Alpinia officinarum*.<sup>18-19</sup> Moreover, sorghumaol and bochmord have also been isolated from the rhizomes of the herbaceous plant.<sup>20</sup>

**DIVERSE PHARMACOLOGICAL PROPERTIES OF HERB**

*Alpinia officinarum* has a long history in herbal and folk medicinal systems to possess various beneficial properties referred to as its pleiotropic properties. It has been reported that kaemjeride, galangin, and 7-(4''-hydroxyl-3''-methoxyphenyl)-1-phenylhept-4-ene-one inhibit m-RNA expression of tyrosinase and protein level of microphthalmia associated transcription factor.<sup>21</sup> Moreover, 5-hydroxy-7-(4-hydroxyl-3-methoxyphenyl)-1-(4-hydroxyphenyl)-3-heptance has been noted to show anti-emetic properties.<sup>22</sup> The alcoholic extract of rhizome revealed antimicrobial activity against *Staphylococcus aureus*, *Bacillus subtilis*, *E.*

*coli*, *Candida albicans*, *Trichophyten mentagrophytes*, and *Aspergillus niger*.<sup>23-24</sup> Further, the dried rootstocks of the herb have been used for treatment of skin cancer, caries, periodontal disease, bilharzias and *Pseudomonas aeruginosa* infections of skin. In addition, the flavons from rhizomes strongly shown to possess antifungal activity against wide variety of pathogenic fungi including *Trichophyton rubrum*, *Trichophyton mentagrophytes*, and *Epidermophyton floccosum*, which are responsible for major skin disease.<sup>25</sup> Another flavanoid isolated from rhizomes showed significant antifungal activity against *Langer* and *Moloch*. Moreover, it has been shown to possess activity against a number of gram positive and gram negative bacteria alongwith pathogenic and non pathogenic yeasts.<sup>24</sup> The rhizomes of *Alpinia officinarum* has been widely used as a traditional medicine in China for relieving stomach-ache, treating colds, invigorating the circulatory system and reducing swelling, which further accounts for its pleiotropic effects.<sup>17</sup> Moreover, the herbaceous plant show activity against hep G2, MCF-7 and SF-268 (ATCE) human cancer cell line, which accounts for its anticancer property.<sup>26-27</sup> Further, the acetone extract of rhizome of *Alpinia officinarum*, i.e, diarylheptanoid, has been known to inhibit 5-alpha reductase activity accounting for its therapeutic role against prostatic disease.<sup>28</sup> In addition, the rhizomes of *Alpinia officinarum* possess potent inhibitors against prostaglandin biosynthesizing enzyme, i.e., prostaglandin synthetase. Further, diarylheptanoid with catechol group showed activity against 5-lipoxygenase that accounts for its anti-inflammatory properties. Galangin and quercetin has been further shown to block prostaglandin synthesis, nitric oxide free radical formation and cyclo-oxygenase-2 enzyme activation.<sup>29</sup> Also, diarylheptanoid from *Alpinia officinarum* inhibited proinflammatory mediators via inhibition of mitogen-activated prtein kinase and nuclear factor-Kappa B.<sup>30</sup> Moreover, it has been reported that Alpina officinarum extract potentially inhibit fatty acid synthase.<sup>31</sup> Furthermore, phytoconstituents form the herb, i.e., 5-Hydroxy-7-(4''-hydroxy-3''-methoxyphenyl)-1-phenyl-3-heptanoe and 3-methylgalangil, which are obtained from rhizome of the plant, inhibited pancreatic lipase.<sup>32-33</sup> Additionally, galangil has been known to express bactericidal activity against multiple resistant bacteria like *Enterococcus* spp. and *Pseudomonas aeruginosa*, accounting for its antibacterial properties.<sup>34</sup> Further, 7-(3, 4-dihydroxy-phenyl)-1-(4-hydroxy-3-methoxyphenyl)-4-en-heptanone showed moderate cytotoxicity against human tumor cell lines, MCF-7, and SF-268.<sup>17</sup> More to the point, the drug forms an important ingredient of many preparations used in the indigenous medicine like athamadhiraadi-rasakriya vati, ashwagandha aristha, chandanadi thailam, dashamularishta kakubhadi churnam, lasha thailam, moor chitaitila, rasnaadi quatha churnam, sarnaadi thailam, rasha guggulu, and stangya sodhaka churnam.<sup>35</sup> Besides having various pharmacological activities, this herbaceous plant has also been reported to possess various medicinal uses. The herb has been shown to possess anti-tubercular, anti-diabetic and anti-inflammatory properties.<sup>36-37</sup> Moreover, the herbaceous plant is also valuable as a potent antifungal and antibacterial compound.<sup>20</sup> Further, the rhizomes have been reported as stomachic, stimulant and carminatives. It has also been used as diuretic and for the treatment of gastrointestinal disorders.<sup>25</sup> In addition, the rhizomes have been used as a traditional medicine in China

for relieving stomach-ache, treating cold, invigorating the circulatory system and reducing swelling. The plant also possesses antiplatelet, antioxidant and antihepatotoxic activities, which accounts for its wide medicinal use.<sup>17,38</sup> Besides, *Alpinia officinarum* is an ingredient of "Jawarish Jalinoos" preparation, which is reputed to be treating gastric troubles, urinary diseases and premature graying of hairs.<sup>39-41</sup>

## CONCLUSION

*Alpinia officinarum* has been used since decades because of its rich ethnomedicinal importance. Numbers of phytoconstituents have been found to be associated with the herbaceous plant that renders it as a broad spectrum medicinal valued herb. Moreover, the herb possesses a number of pleiotropic effects that makes the plant to be investigated with more doors open. In spite of the great progress observed in modern medicinal systems in recent decades, herbal drugs still make an important involvement to health care, and thus more works are warranted in order to ascertain *Alpinia officinarum* as a valuable herb for the treatment of various diseases.

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