Current Trends in Pharmacology and Clinical Trials
ISSN: 2642-0848

Academic Strive
Researcher's perception is our reality

Review Article *Volume 5 Issue 1*

Alpinia Galanga- A Review of its Ethnomedicinal, Phytochemical and Pharmacological Activity

Mohsina F P[1,2]*, Quazi Aamir[3], Faheem I P[2], Maheen S[2], Mukim M[4,5] and Siddiuque Aquil-ur-Rahim[6]

[1]Department of Pharmaceutical Science, BAMU, India

[2]Luqman College of Pharmacy, India

[3]KT Patil College of Pharmacy, India

[4]Kota College of Pharmacy, India

[5]Dr. APJ Abdul Kalam University, India

[6]Shri Bhagwan College of Pharmacy, India

***Corresponding author:** Mohsina FP, Department of Pharmaceutical science, BAMU, Aurangabad, India, Luqman College of Pharmacy, Gulbarga, Karnataka, India; Email: mohsina.patwekar@gmail.com, Orcid ID- https://orcid.org/0000-0002-5043-366X

Received Date: January 25, 2022; **Published Date:** February 24, 2022

Abstract

Traditional system of medicine has a numerous variety of herbs with wide therapeutic and pharmacological uses which can help in the development of new bioactive compounds. *Alpinia galanga (Linn.)* is one amongst these important herbal plants, which is found around the globe. Also known as 'Galanga'/'Kulanjan', and has been recognized in various traditional medicinal systems like Ayurveda, Siddha, Unani for the treatment of numerous diseases. Different parts are used traditionally for the treatment of fungal disorder, in cancer therapy, as an anthelmintic, treatment of ulcer, cardiac disorder, treatment of arthritis, antidiuretic, dyspepsia, antipyretic, diabetes, burning of liver and kidney disease to list of few. Therefore, the present review is aimed to collect the up to date and comprehensive information of *Alpinia galanga* with special emphasis on, the traditional use of parts of galanga, its phytoconstituents, and its future prospects for identifying effective therapeutic compounds as well as various scientifically documented pharmacological activities.

Keywords: *Alpinia Galangal*; Diabetes; Cardiac Disorder; Antipyretic; Antidiuretic

Abbreviations: WHO: World Health Organization; MIC: Minimum Inhibitory Concentration; MBC: Minimum Bactericidal Concentration; HIV-1: Human Immunodeficiency Virus Type-1; HCMV: Human Cytomegalovirus; HDL: High Density Lipoproteins; PAF: Platelet Activating Factor; BDMC: Bisdemethoxycurcumin; ORAC: Oxygen Radical Absorbance Capacity; DPPH: 2-Diphenyl-1-Picrylhydrazyl; TAQ: Total Aqueous Extract; TAE: Total Alcoholic Extract; OA: Osteoarthritis; NSAIDS: Non-Steroidal Anti-Inflammatory Drugs.

Introduction

Plants with medicinal activity have been used since a long era throughout the world. Which are nowadays gaining more popularity in modern society as the best source of natural products over the synthetic ones [1]. In the last few decades there has been an exponential growth in the field of herbal medicine. Herbal products are now the newer trend in many countries owing to its benefits being natural with minimum adverse reactions [2]. The present health care scenario

is burdened with multiple issues of unsafe medicines, wide range of dreadful diseases, multiple drug resistant, autoimmune disorders and degenerative disorders, in spite of scientific advances [3,4]. Majority of India population i.e. around ¾ population, nearly 1.1 billion people still depend and trust over traditional medicinal systems [5]. The World Health Organization (WHO) suggested an approximate 80% of the world population depends in either way on traditional medicines, mostly plant products in their health care [6].

Alpinia galanga is also known as Greater galanga in English and 'Kulanjan' in Hindi. Many parts of South India, where the doctors prefer the Ayurveda and Siddha mode of treatment by the help of *Alpinia Galanga* in treatment of different diseases including diabetes mellitus [8]. The harvest time period of *Alpinia galanga* is determined 3 month-intervals from 6 to 48 months after planting in Kerala, India. Harvesting for 42 months after plantation is the best way to get maximum output for realizing maximum rhizome (45.4 t/ha) and oil(127.4 liters/ha) yields, and for obtaining oil of good quality (27.1% cineole [eucalyptol]) [9]. A decent amount of oil (127.4 liters/ha) was acquired from the roots (19.5 t/ha) after 39 months of plantation. The shoot yield (40.5 t/ha) and shoot oil yield (70.61 h/a) were maximum at 18 months after plantation [10]. *A. galanga* reached a maximum height of 129.4 cm with more than 48 tillers per clump and 13 leaves per tiller in the experimental location [11].

Figure 1: *Alpinia Galanga*.

The lesser galangal (*Alpinia officinarum* Hance.), a member of the family Zingiberaceae, is a plant which is wide grown in southern China. It's an perennial herb which has a raceme of showy flowers with attractive foliage. The rhizome is small in size with strong taste and peculiar smell. This herb is widely used as condiment as a spice in cooking and also in preparation of medicine. It also gives a pungent flavor to vinegar. The greater galangal (*Alpinia galanga* (L.) Wild.) is also an perennial herb with showy flowers and beautiful foliage which is found in Indonesia, Malaysia and is also cultivated in Bengal and in some parts of south India. The essential oil like methyl cinnamate, cineol are present in the green rhizomes which are responsible for pungent taste which is similar to ginger and pepper. These green rhizomes are used as or treatment of pediatric respiratory problems. These are also used as carminative and stomachic. The light galangal (*Alpinia speciosa* (Wendl.) K. Schum) is a native of the Eastern Archipelago, off the Coromandel Coast of southeast India [12].

Kingdom	Plantae
Order	Zingiberales
Family	Zingiberaceae
Subfamily	Alpinioideae
Tribe	Alpinieae
Genus	Alpinia
Species	A. galangal

Botanical Distribution

Hindi	Kulanjan
Kannada	Dhumarasmi
Bengali	Kulingjan
Gujrati	Kulinjan
Malyalam	Arattha, Kol-inji, Pararatta
Tamil	Pera-rattai
Kannada	Dhoomraasmi
Telugu	Pedda-dhumpa

Morphology

Alpinia galanga is commonly known as Greater galangal [13]. Its root stocks are tuberous and slightly aromatic, Leaves are oblong-lanceolate, acute, glabrous, green above, paler beneath, with slightly callus white margins, sheaths are long and glabrous, and ligules are short and rounded. Flowers greenish white, in dense flowered, 30 cm Panicles; bracts ovate-lanceolate. Calyx tubular, irregularly 3-toothed [14], Corolla lobes oblong, claw green, blade white, striated with red, rather more than 1 cm long, broadly elliptic, shortly 2-lobed at the apex, with a pair of subulate glands at the base of the apex, with a pair of subulate glands at the base of claw. Fruit the size of the small cherry, orange red [15,16].

Traditional Uses of *Alpinia Galanga*

The rhizome of the plant is used as digestive tonic, carminative, antiemetic, anthelmintic, anti-fungal, antitumor,

antidiuretic, anti-ulcerative, anti-dementia. The extract of rhizome shows anti-tubercular activity, hypothermia, bronchial catarrh, tonic, stomachic and stimulant [13,10]. It is also used as pungent, stomachic, bitter, appetitive, diabetes, cardiac disorders, aphrodisiac agent, expectorant, use in heal, ache, lumbago, disinfectants, rheumatic pains, chest pain, burning of liver, kidney disease. The rhizome is also used as antimicrobial, anti-inflammatory anti-bacterial and flavoring agent [17].

Medicinal Uses

A. galangal is used for treatment of several disorders like lumbago, sore throat, rheumatic pains, and tubercular glands, pain in the chest, diabetes, and diseases of the kidney, bronchitis and catarrhal affections. It is predominantly used for treatment for digestion and relieving the pain, especially angina, heart attack and gallbladder attacks [18-22]. It acts as dyspepsic and also aids in digestion, anti-flatulence, and antiemetic. New research suggested that some flavonoid present in the plant acts as anti-cancer agent, by the mechanism of inhibition enzyme CYP1A1 and alteration of the aryl hydrocarbon receptor [23]. Some scientific research proves that the flavonoid shows protective action against the carcinogenic potential of overcooked, char-grilled foods. Galanga also act as potent preserver of the endogenous free radical scavenger glutathione, thereby playing another anti-carcinogenic role. Galangin has a proven anti-oxidative effect over certain tissues which are used for as protective antioxidants in vitamins E and C preparations [24].

Phytochemical Constituents

Phytochemistry

The two species i.e., *Alpinia galanga* and *Alpinia officinarum* are the most widely studied, as they have good medicinal and ethno botanical properties compared to other species [19]. *Alpinia galanga* has pharmacological properties related to phytochemicals in different types of *galanga*. Phytochemicals are heterogeneous compounds that have a variety of structures and a wide structural distribution. Judging from the mechanism of metabolic biosynthesis, many phytochemicals can be divided into three classes: terpene compounds, phenolic, and alkaloids [18,19]. *Alpinia galanga* mostly consist of terpene and phenolic compounds. The geographical distribution of *Alpinia galanga* dispersion is also very influential on the distribution of terpenes and phenolic compounds.

Phytoconstituents of Galanga

The constituents identified in the galanga rhizome include alpinine, kaempferide, methyl cinnamate, camphor, pinene, galangin, pineol, 3-dioxy 4-methoxy flavone, pmethane-1,8-epoxy-acethoxychavicol acetate, (1'S)-l-1'- acetoxyeugenol acetate, 1'-acetoxyeugenol acetate, (1'S)- 1'-acetoxychavicol acetate, 1'-acetoxychavicol acetate, chavicol acetate, chavicol, D-camphor, (1R, 3S, 4S)-trans3-hydroxy-1,8-cineole-D-glucopyranoside, (1R, 2R, 4S) 1,8-cineole, 3-hydroxy-1, 8-cineole glucopyranosides, 8- cineole-D-glucopyranosides, (4R, 1S, 2S) -trans-2- hydroxy-1, trans-p-coumaryldiacetate, trans coniferyldiacetate, di- (p-hydroxy-cisstyryl) methane, trans β-faranesene, 1'-hydroxychavicol acetate, 4- hydoxybenzyldehyde, 7-hydroxy-cytylid) 3-dethethoxy flavone, p-hydroxycinammaldehyde, kaempferol-4'-methylether, kaempferol-7'-methylether, methylcinnamate, isorhamnetin, kaempferol, eugenol acetate, campeene, borneol, zerumbone, α-terpinee, αterpinee, 4-α-erinep α-thene -menmen, α-humulene, fenchyl acetate, and bornyl acetate [20]. Two diterpens called galangal A and B, two labdane diterpens, called galanolactone and (E) -β (17), 12-labdiene-15,16-dial, were isolated from *Alpinia galanga* followed by (E)-(17)-β epoxylabd-12-ene 15.16-dial. The aromatic component of the galangal rhizome is 1'-acetoxychavicol acetate [21].

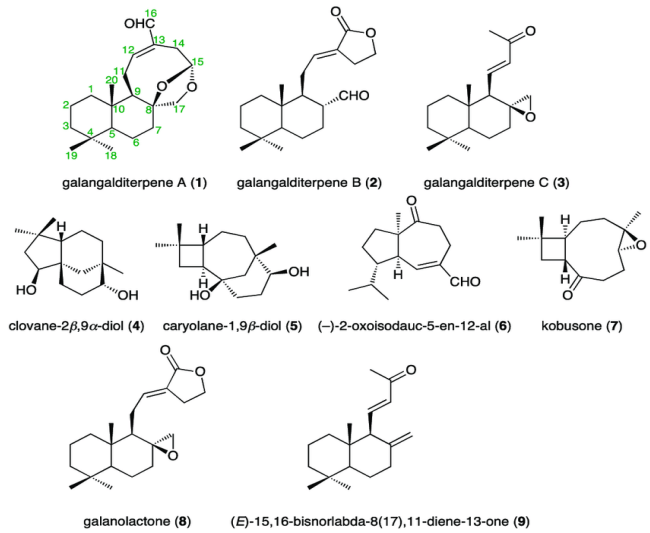

Figure 2: Some important phytochemical constituents of *Alpinia Galanga*.

Pharmacological Activity

Antimicrobial Activities

Aqueous extract of *Alpinia galanga* has proven to be an antimicrobial agent against E.coli, S. aureus, Klebsiella pneumonia, Pseudomonas aeruginosa, and Streptococcus pyogenes except for Staphylococcus epidermidi. Essential oil had shown significant activity against Pseudomonas aeruginosa, Streptococcus suis, E.Coli, Staphylococcus aureus, Pasteurella multocida and Arcanobacterium pyogenes, the effects were attributed to 1,8-cineole, 4-allyl phenylacetate and α-bisabolene. Dried ethanolic extract

from *Alpinia galangal* flower was the most powerful against S. aureus with the minimum inhibitory concentration (MIC) ranging from 0.352–0.547 mg/ml and inhibition zone of about 26–31 mm. No antimicrobial activity was recognized on E. Coli and Salmonella. Long-term antimicrobial activity of oven-dried samples extracted with ethanol was the largest with an inhibition zone of 8.94 mm and MIC of 1.457 mg/ml. In contrast, freeze-dried samples extracted with ethanol exhibited the lowest overall antimicrobial activity (7.05 mm and 2.470 mg/ml). The *Alpinia galanga* ethanolic extract had an active inhibitory effect against S. aureus. The minimum inhibitory concentration (MIC) of the galanga extract was 0.325 mg/ml and the minimum bactericidal concentration (MBC) was 1.3 mg/ml using the broth dilution approach. *Alpinia galanga* have antifungal action similar to amphotericin B and ketoconazole. It exerted a concentration-dependent inhibition of the production of zoonotic dermatophytes and yeast-like Candida albicans. Ethanolic extracts of *A. galanga* have phytotoxic action against Lemna minor and antifungal action against Trichophyton longifusus. It also shows antifungal action against phytopathogenic fungi,Colletotric hummusae, Candida albicans, and Fusariumoxy sporum, at a concentration of 10 mg/ml. Methanolic extract of *A. galanga* and 1'S-1'-Acetoxychavicol acetate has a great inhibitory action against human immunodeficiency virus type-1 (HIV-1) and against human cytomegalovirus (HCMV). At a concentration of 1000ug/ml, chloroform extract of *Alpinia galangal* shows good inhibition against Entamoeba histolytica [25].

Anti-Ulcer Activity

A study reported Gastric antisecretory, antiulcer and cytoprotective properties of ethanolic extract of *Alpinia galanga* wild in rats. The rhizomes of *A. Galanga* are widely used in Arabian and Unani systems as a digestant as well in stomach disorders. The alcoholic extract claims to reduce gastric acid secretion and act as cytoprotective; and hence acts efficient in treatment of ulcers. Research reported that the ethanolic extract *Alpinia galanga* proved effective over cytological and biochemical changes induced by cyclophosphamide in mice. The rhizomes of *Alpinia galanga* are used as a spice and in traditional medicine to treat gastralgia, dyspepsia, sea sickness, abdominal discomfort, anti-inflammatory agent, anti-neoplastic, digestive and tonic [26,27].

Antiplatelet and Hypolipidemic Activity

Ethanolic extract of *A. galanga* at a dosage of 20mg/day for 4 weeks tested in rats showed hypolipidemic activity, with an significant increase in the serum levels of high density lipoproteins (HDL) in rats. *A. galanga* constituents exerted platelet activating factor (PAF) antagonists. Methanolic extract showed significant inhibitory effects on PAF with IC50 value of 5.5ug/ml in rabbit platelets [28].

Antitumor Activity

1,7-bis (4-hydroxyphenyl)-1,4,6-heptatrien-3-one (BHPHTO) and bisdemethoxycurcumin (BDMC) which were obtained from the rhizomes of *A. galanga* tested for their bio effectiveness on the myeloma A2058 cells and inhibited the proliferation of melanoma cells in the cell growth assay significantly. The tests to B16-F10 cell line also showed little inhibitory activity of cellular tyrosinase activities as well as melanin contents was also lowered [29].

Antidiabetic Effects

When the normal rabbits were administered with *Alpinia galanga* powder it showed significant low blood glucose level. While some of the researchers found that the ethanolic extract of *Alpinia galanga* exerted antidiabetic effects in rats. The glucose uptake by rat hemi diaphragm was significantly more in all groups tested compared to control. Rats weighing 400 mg/kg body weight were treated with *Alpinia galanga* extract and showed an increase in body weight. Blood glucose level (mg/dl) was found to lower gradually as compared to the diabetic control. In the extract treated group, the Total protein level was increased as compared to diabetic control while Serum triglyceride as well as Total cholesterol levels decreased. The ethanolic extract of *Alpinia galanga* was found to be effective in inhibiting the α-Glucosidase when compared to Acarbose [30].

Anti-Oxidant Activity

The antioxidant activity was studied by oxygen radical absorbance capacity (ORAC) and the 2, 2-diphenyl-1-picryl hydrazyl (DPPH) methods. The ethanolic extract shows the highest activity of both the ORAC and DPPH when compared to the water extract and the essential oil. *Alpinia galanga* leaves and flowers showed highest chelating and beta-carotene bleaching abilities [31].

Anti-Inflammatory Activity

The anti-inflammatory activities of total aqueous extract (TAQ) and total alcoholic extract (TAE) from *Alpinia galanga* rhizomes were accessed in acute (carrageenan-induced paw edema; M1) and sub-acute (cotton-pellet-induced granuloma; M2) rat models. The methanolic extract of *Alpinia galanga* showed analgesic activity and anti-inflammatory of the topical preparation. The anti-inflammatory activity was carried out against Carrageenan-induced edema in rats and in a formalin test. Piroxicam gel and methyl salicylate ointment were used as controls for anti-inflammatory and analgesic activities, respectively. The

p-hydroxy cinnamaldehyde obtained from *Alpinia galanga* acetone extracts has a pharmacological effect on human chondrocytes. Osteoarthritis (OA) is the most familiar form of arthritis and influences millions of populations globally. Patients have habitually been treated with non-steroidal anti-inflammatory drugs (NSAIDS), but these are correlated with significant side effects, hence Alpinia has proven to have a better effect in OA treatment [32].

Antiallergic Activity

Alpinia galanga proved to be an effective anti-allergic agent and the isolated compounds which extract inhibit the release of antigen IgE mediated in passive cutaneous anaphylaxis reactions in mice [33,34].

Anti-HIV Activity

Anti-human immunodeficiency virus type 1 replication by blocking Reverse Transport from 1' S-1' acetoxychavicol acetate isolated from *Alpinia galanga* rhizomes extract [35].

Immunomodulatory Activity

Study reported Immuno-stimulating activity of the hot water-soluble polysaccharide extracts of *Alpinia galanga. Alpinia galanga* (L.) Wild were tested for their immune stimulating activity in mice [36].

Nitric Oxide (NO) Inhibition Effect

An 80% acetone-water extract of *galanga* showed NO inhibitory action in mouse peritoneal macrophages. Three neolignans have been isolated from the acetone extract (galanganal, galanganol A and B) and a seaquineolignan, galanganol-C). The NO-inhibition activity has at least partly been attributed to the neolignans. Six diarylheptanoids of galanga are reported to be inhibitors of NO production in the lipopolysaccharide-activated macrophage cell line RAW 264. Active diarylheptanoids suppressed the expression of the inducible NO synthase protein and mRNA. Such results at least partly explain the use of *galanga* for inflammation reduction. ACA has been shown to have potent NO-inhibitory activity in lipopolysaccharide-activated mouse peritoneal macrophages [37].

Conclusion

The extensive literature survey revealed that *Alpinia galanga* is a very important medicinal herb with a diverse pharmacological spectrum. The plant shows the presence of many chemical constituents which are responsible for varied pharmacological and medicinal properties. The evaluation needs to be carried out on *Alpinia galanga* in order to use and formulate of the plant in their practical clinical applications, which can be used for the welfare of mankind.

References

1. Yuan H, Ma Q, Ye L, Piao G (2016) The Traditional Medicine and Modern Medicine from Natural Products. Molecules 21(5): 559.

2. Ekor M (2014) The growing use of herbal medicines: issues relating to adverse reactions and challenges in monitoring safety. Front Pharmacol 4(1): 177-189.

3. Devasagayam TPA (2007) Introduction to serial reviews: recent advances in Indian herbal drug research. J Clin Biochem Nutr 40(2): 73-78.

4. Furman D, Campisi J, Verdin E, Bastos PC, Targ S, et al. (2007) Chronic inflammation in the etiology of disease across the life span. Nat Med 25(12): 1822-1832.

5. Vaidya AD, Devasagayam TPA (2007) Current status of herbal drugs in India: an overview. J Clin Biochem Nutr 41(1): 1-11.

6. Foster WA, Snaddon JL, Turner EC, Fayle TM, Cockerill TD, et al. (2011) Establishing the evidence base for maintaining biodiversity and ecosystem function in the oil palm landscapes of South East Asia. Philos Trans R Soc Lond B Biol Sci 366(1582): 3277-3291.

7. Pan SY, Litscher G, Gao SH, Zhou SF, Yu ZL, et al. (2014) Historical perspective of traditional indigenous medical practices: the current renaissance and conservation of herbal resources. Evid Based Complement Alternat Med 2014: 525340.

8. Wali AF, Jabnoun S, Razmpoor M, Najeeb F, Shalabi H, et al. (2022) Account of Some Important Edible Medicinal Plants and Their Socio-Economic Importance. In: Masoodi MH, Rehman MU (Eds.), Edible Plants in Health and Diseases. Cultural, Practical and Economic Value 1(1): 325-376.

9. Rahman MA, Islam MS (2015) Alpinia calcarata Roscoe: A potential phytopharmacological source of natural medicine. Pharmacogn Rev 9(17): 55-62.

10. Basri AM, Taha H, Ahmad N (2017) A Review on the Pharmacological Activities and Phytochemicals of Alpinia officinarum (Galangal) Extracts Derived from Bioassay-Guided Fractionation and Isolation. Pharmacogn Rev 11(21): 43-56.

11. Verma RK, Mishra G, Singh P, Jha KK, Khosa RL (2015) Anti-diabetic activity of methanolic extract of Alpinia galanga Linn. Aerial parts in streptozotocin induced diabetic rats. Ayu 36(1): 91-95.

12. Lo CY, Liu PL, Lin LC, Chen YT, Hseu YC, et al. (2013) Antimelanoma and antityrosinase from Alpinia galangal constituents. ScientificWorld Journal 2013: 186505.

13. Kaushik D, Yadav J, Kaushik P, Sacher D, Rani R (2011) Current pharmacological and phytochemical studies of the plant Alpinia galanga. Zhong Xi Yi Jie He Xue Bao 9(10): 1061-1065.

14. Ghosh S, Rangan L (2013) Alpinia: the gold mine of future therapeutics. 3 Biotech 3(3): 173-185.

15. Kolangi F, Shafi H, Memariani Z, Kamalinejad M, Bioos S, et al. (2017) Effect of Alpinia officinarum Hance rhizome extract on spermatogram factors in men with idiopathic infertility: A prospective double-blinded randomised clinical trial. Andrologia 51(1): e13172.

16. Yang X, Eilerman RG (1999) Pungent principal of Alpinia galangal (L.) swartz and its applications. J Agric Food Chem 47(4): 1657-1662.

17. Abubakar IB, Malami I, Yahaya Y, Sule SM (2018) A review on the ethnomedicinal uses, phytochemistry and pharmacology of Alpinia officinarum Hance. J Ethnopharmacol 224: 45-62.

18. Nam Hoang N, Kodama T, Nwet Win N, Prema, Do KM, et al. (2021) A New Monoterpene from the Rhizomes of Alpinia galanga and Its Anti-Vpr Activity. Chem Biodivers 18(10): e2100401.

19. Bian MQ, Kang J, Wang HQ, Zhang QJ, Liu C, et al. (2014) Three new norsesquiterpenoids from the seeds of Alpinia galanga. J Asian Nat Prod Res 16(5): 459-464.

20. Igoli NP, Obanu ZA, Gray AI, Clements C (2011) Bioactive diterpenes and sesquiterpenes from the rhizomes of wild ginger (Siphonochilus aethiopicus (Schweinf) B.L Burtt). Afr J Tradit Complement Altern Med 9(1): 88-93.

21. Lim HJ, Bak SG, Lim HJ, Lee SW, Lee S, et al. (2020) Acyclic Triterpenoid Isolated from Alpinia katsumadai Alleviates Formalin-Induced Chronic Mouse Paw Inflammation by Inhibiting the Phosphorylation of ERK and NF-κB. Molecules 25(15): 3345.

22. DeFilipps RA, Krupnick GA (2018) The medicinal plants of Myanmar. PhytoKeys 10(2): 1-341.

23. Sun Y, Kurokawa M, Miura M, Kakegawa T, Motohashi S, et al. (2016) Bioactivity and Synthesis of Diarylheptanoids From Alpinia officinarum. Studies in Natural Products Chemistry 49: 157-187.

24. Ibrahim SRM, Agamy DSE, Abdallah HM, Ahmed N, Elkablawy MA, et al. (2018) Protective activity of tovophyllin A, a xanthone isolated from Garcinia mangostana pericarps, against acetaminophen-induced liver damage: role of Nrf2 activation. Food Funct 9(6): 3291-3300.

25. Weerakkody NS, Caffin N, Lambert LK, Turner MS, Dykes GA (2011) Synergistic antimicrobial activity of galangal (Alpinia galanga), rosemary (Rosmarinus officinalis) and lemon iron bark (Eucalyptus staigerana) extracts. J Sci Food Agric 91(3): 461-468.

26. Mitsui S, Kobayashi S, Nagahori H, Ogiso A (1976) Constituents from seeds of Alpinia galanga Wild, and their anti-ulcer activities. Chem Pharm Bull (Tokyo) 24(10): 2377-2382.

27. Gong J, Zhang Z, Zhang X, Chen F, Tan Y, et al. (2018) Effects and possible mechanisms of Alpinia officinarum ethanol extract on indomethacin-induced gastric injury in rats. Pharm Biol 56(1): 294-301.

28. Achuthan CR, Padikkala J (1997) Hypolipidemic effect ofAlpinia galanga (Rasna) and Kaempferia galanga (Kachoori). Indian J Clin Biochem 12(1): 55-58.

29. Ahlina FN, Nugraheni N, Salsabila IA, Haryanti S, Dai M, et al. (2020) Revealing the Reversal Effect of Galangal (Alpinia galanga L.) Extract Against Oxidative Stress in Metastatic Breast Cancer Cells and Normal Fibroblast Cells Intended as a Co- Chemotherapeutic and Anti-Ageing Agent. Asian Pac J Cancer Prev 21(1): 107-117.

30. Verma RK, Mishra G, Singh P, Jha KK, Khosa RL (2015) Anti-diabetic activity of methanolic extract of Alpinia galanga Linn. aerial parts in streptozotocin induced diabetic rats. Ayu 36(1): 91-95.

31. Tungmunnithum D, Tanaka N, Uehara A, Iwashina T (2020) Flavonoids Profile, Taxonomic Data, History of Cosmetic Uses, Anti-Oxidant and Anti-Aging Potential of Alpinia galanga (L.) Willd. Cosmetics 7(4): 89.

32. Li CY, Cheng SE, Wang SH, Wu JY, Hsieh CW, et al. (2021) The Anti-inflammatory Effects of the Bioactive Compounds Isolated from Alpinia officinarum Hance Mediated by the Suppression of NF-kappaB and MAPK Signaling. Chin J Physiol 64(1): 32-42.

33. Trakranrungsie N, Chatchawanchonteera A, Khunkitti W (2008) Ethnoveterinary study for antidermatophytic activity of Piper betle, Alpinia galanga and Allium ascalonicum extracts in vitro. Res Vet Sci 84(1): 80-84.

34. Matsuda H, Morikawa T, Managi H, Yoshikawa M (2003) Antiallergic principles from Alpinia galanga: structural requirements of phenylpropanoids for inhibition of degranulation and release of TNF-alpha and IL-4 in RBL-2H3 cells. Bioorg Med Chem Lett 13(19): 3197-3202.

35. Ye Y, Li B (2006) 1'S-1'-acetoxychavicol acetate isolated from Alpinia galanga inhibits human immunodeficiency

virus type 1 replication by blocking Rev transport. J Gen Virol 87(7): 2047-2053.

36. Ilina T, Skowrońska W, Kashpur N, Granica S, Bazylko A, et al. (2020) Immunomodulatory Activity and Phytochemical Profile of Infusions from Cleavers Herb. Molecules 25(16): 3721.

37. Morikawa T, Ando S, Matsuda H, Kataoka S, Muraoka O, et al. (2005) Inhibitors of nitric oxide production from the rhizomes of Alpinia galanga: structures of new 8-9' linked neolignans and sesquineolignan. Chem Pharm Bull (Tokyo) 53(6): 625-630.