ijpbs 2020; doi 10.22376/ijpbs.2021.12.1.p21-26

International Journal of Pharma and Bio Sciences

Review Article

Pharmacology

A Review on *Zingiber capitatum Roxb.*

Ms. Pallavi Maruti Patil[1*] and Dr. Vanita G. Kanase[2]

[1]*Research Scholar, Faculty of Science, Pacific Academy of Higher Education and Research University, Udaipur*

[2]*Head of Dept. of Pharmacology, Oriental College of Pharmacy, Sanpada, Navi Mumbai-400705, India.*

Abstract: *Zingiber capitatum Roxb* is found in numerous places of India and their therapeutic capacity have been extensively examined and acknowledged in numerous conventional system. Various literature has conducted the pharmacological activity in- vitro and in–vivo which proven to have antioxidant and antimicrobial from extracts of rhizomes. Ginger is a vigorous anti-oxidant substance and may either alleviate or prevent generation of free radicals. It is considered a secure herbal medicine with minimum side effects. The medicinal properties of this plant are mainly due to the presence of gingerol, shogaols, paradol, etc which represent it as a beneficial source of medicinal compound. Preliminary phytochemical analysis depict the presence of phytoconstituents introduced in the literature such as alkaloid, cardiac glycoside, carbohydrates, tannin, saponin, ascorbic acid, phenols and flavonoids. Currently, there's an interest in ginger and a lots clinical experiments are accomplished extensively for the isolation, identification of active constituents and scientific verification of its pharmacological for the treatment of several disease and conditions. This article aims at reviewing the most salient recent reports on these investigations that deals with botanical and ayurvedic classifications, different pharmacological activity, cultivation, medicinal uses and chemical composition of essential oils from rhizomes of *Zingiber capitatum* as indicated by ayurveda and modern science. The study elaborates; ginger is effective in contagion diseases and revitalizing the body at disease conditions according to both of Ayurveda and modern concepts through increasing appetite, immunity and re-boosting weakened physiological functions of the human body. We hope that this updated review can appeal a more awareness to *Zingiber capitatum Roxb* and its further applications, together with its potential to be developed into functional foods or nutraceuticals for the precautionary and control of chronic diseases.

Keywords: *Zingiber capitatum Roxb*; Antioxidant; antimicrobial; phytochemical analysis; rhizome extracts.

Article History	Date of Receiving	13 April 2020	Date of Revision	13 December 2020
	Date of Acceptance	18 December 2020	Date of Publishing	04 January 2021

***Corresponding Author**

Ms. Pallavi Maruti Patil , Research Scholar, Faculty of Science, Pacific Academy of Higher Education and Research University, Udaipur

Funding This research work is supported and funded by Mumbai University, Grant No. APD/ICD/2019-20/762.

CItation Ms. Pallavi Maruti Patil, Dr. Vanita G. Kanase , A Review on Zingiber capitatum Roxb..(2021).Int J Pharm Sci.12(1), 21-26 http://dx.doi.org/10.22376/ijpbs.2021.12.1.p21-26

Int J Pharma Bio Sci., Volume12., No 1 (January) 2021, pp 21-26

1. INTRODUCTION

Zingiber capitatum Roxb plant is commonly known as wild ginger (Ran ale)[1], Oriya: Bana Ada[2], Hindi: Jangli adrak is found in forest area the Himalayan region (Kumaun to Sikkim), Assam, Madhya Pradesh, Orissa and many other parts of India [3-4]. *Zingiber capitatum* is a herbaceousperennial plant that spreads by rhizomes and also by seed. It is native to India and is probably also native to Bangladesh and Nepal [5-6]. It has medicinal properties and is likely to be introduced to the countries outside its native range for horticultural use. It is cultivated in Brazil and is also present in China and Vietnam [7-8]. Txanomical classification of Zingiber capitatum was first described in 1810 by Roxburgh in India[9] Kingdom- Plantae, Order- Zingiberales, Family- Zingiberaceae, Genus- Zinger, Species- Zingiber capitatum, Class- Monocotyledonae, Sub Class- Angiospermae, Phylum- Spermatophyta. It's External morphology consist of Rhizome thick, yellow inside, aromatic root tubers oblong, many. Plants 1.5-2 m. high. Leafy stem 1-1.25 m. Leaves bifarious 30-45 x 2-3.5 cm. linear, recurved, glabrous above, minutely hairy on the lower side, sheath hairy. Flowers pale yellow, 4.5-4.8 cm. long, longer than the bracts[10]. Calyx 1-1.3 x 1-1.2 cm, 3 toothed, white, membranous, apex truncate, unequally 3- toothed, short hairs on the margin. Corolla tube cylindric, c.1.5 cm. long, glabrous; lobes deep yellow, unequal, glabrous, Ovary c. 5 mm. long, Seeds many, black, arillate, aril white, lacerate[11-12]. Generally plants produce flowers and fruits in July-October. Plants mainly grow in tropical wet and dry savanna climates and warm temperate climates with dry winters. Most gingers prefer organically rich, well-drained soils. Throughout the history of formal ethnobotany, this medicinal plant has been an area of keen interest as various research is performed on *Zingiber capitatum*. A search of literature revealed rhizome of this species reports composition of essential oil[13]. Therefore, it is an attempt to provide collective information and represent it in a systematic manner.

PHYTOCHEMICAL CONSTITUENTS

The Sofowora A (1983) and Trease GE, Evans WC (1989) illustrated preliminary phytochemical data suggested that the alkaloid presents in hot aqueous extracts and sparingly presents in methanol extracts, saponin was detected in hot aqueous extracts similarly glycoside was detected in hot aqueous and acetone extracts, tannin was present largely in almost all extracts maximum in hot aqueous and methanol extracts[14-15]. Various carbohydrates were largely detected by Harborne J B (2001) in all extracts of *Zingiber capitatum* plants. The volatile oil content obtained from the rhizomes of *Zingiber capitatum* was 0.14% v/w, and it exhibited slight yellowish color with characteristics odor[16]. Ferguson LR (2001) and Balasundram N, Sundram K., et al. (2006) derived plants antioxidants such as ascorbic acid, polyphenols such as phenolic acid, flavonoid, proanthocyanidins.[17-18]

Fig. 1: *Zingiber capitatum Roxb.*

Table 1. Phytochemical Composition Present in the Plant form

Plant Form	Compounds
Fresh ginger rhizome	***Gingerols (6-, 8- and 10-gingerol), shogaols (6-, 8- and 1***0- shogaol), 3-dihydroshogaols,, ***dihydroparadols,*** ethanoyl group ***of gingerdiols, mono- and di-***phenyl ***derivatives of gingerdiols***, 1- dehydrogingerdiones, diphenyl***heptanoids, ingenol, and zingerone***[19.]
Dry ginger rhizome	The powdered rhizome carry 3-6% fatty oil, 9% protein, 60-70% carbohydrates, 3-8% crude fiber, about 8% ash, 9-12% H2O and 2-3% volatile oil. Volatile oil- Monoterpenoids (β-phellandrene, 2,2-Dimethyl-3-methylenenorbornane, cineole, geraniol, curcumene, terphineol, borneol, cineole, geranyl acetate, limonene, linalool) and sesquiterpenoids [α-zingiberene (30–70%), β-sesquiphellandrene (15–20%), β-bisabolene (10–15%), α-farnesene, zingiberol] [20.]

PHARMACOLOGICAL ACTIONS

ANTIMICROBIAL ACTIVITY

Based on the literature survey Rotimi VO, Laugh on BE, et al (1988) and Makut MD, Gyar SD, et al. (2007) studied Antimicrobial activities by a well diffusion method; the minimum inhibitory concentration (MIC) and minimum bactericidal concentration (MBC) was performed.

MINIMUM INHIBITORY CONCENTRATION (MIC)

A quality of 0.5 g of each extract was determined in 4 ml of sterile Mueller Hinton broth which yield an initial concentration of 125 mgl^{-1},subsequently, two fold of sterile dilution were made from the stock of 4 ml contain 125 mgl^{-1}. Mueller Hinton broth was used to obtain the following concentrations: 125, 62.5, 31.250, 15.65, 7.83, 1.95, 1.00, 0.50, 0.25. 0.13 mgl^{-1}. One millimeter of standardized

inoculums of each extract nutrient broth mixture and then incubated at 37°C for 24h.The concentration of the extract that inhibits the test organisms was recorded as the MIC [21].

MINIMUM BACTERICIDAL CONCENTRATION (MBC)

All the tubes that showed no microbial growth (No turbidity) after 24 hrs of incubation where sub cultured onto the surface of freshly prepared Mueller Hinton Agar and incubated at 37°C for another 24h. The MBC was regarded as the lowest concentration of the extract that did not permit a visible bacterial 24h incubation [22].

ANTIOXIDANT ACTIVITY

Studies has reported the antioxidant properties of *Zingiber capitatum* rhizome extracts were evaluated using different methods (α, α-Diphenyl-β-Picryl-hydrazyl, Hydrogen peroxide, Ferric reducing antioxidant power).

DETERMINATION OF DPPH RADICAL SCAVENGING CAPACITY

The study was designed by Shimada K, Fujikawa K, et al. (1992) carried out, briefly taking one ml of all four extracts (Chloroform Extract, Methanolic Extract, Acetone Extract, Hot Aqueous Extract) taken separately and 5 ml of freshly prepared 0.1 mm DPPH (Diphenyl Picryl-hydrazyl). Methanolic solutions were thoroughly mixed and kept in dark for 60 minutes at 517 nm was prepared by replacing samples. Scavenging activities were calculated as follows[23]:

$$Scavenging\ activity(\%)\ \frac{1 - A_{517}nm\ sample\ \times 100\%}{A_{517}nm\ blank}$$

SCAVENGING OF HYDROGEN PEROXIDE

Investigation in research articles conducted by Gulcin I, Oktay M. et al. (2003) showed the ability of plant rhizome extract to scavenge hydrogen peroxide (H_2O_2) was determined according to standard method with minor modification. Briefly rhizome extract and standard Butylated Hydroxy toluene (BHT) in ethanol (1.06, 2.05, 3.30, 4.20, 5.00 and 1.2 mg/l respectively) were added to hydrogen peroxide solution (2.9 ml, 20 mm). Then, the mixture was incubated at room temperature for 30 minutes and absorbance of hydrogen peroxide was measured at 240 nm. The percentage of scavenging was calculated from control value[24].

TOTAL ANTIOXIDANT ACTIVITY (FRAP)

Another report has shown that Katalinic A, Rosch C (2004) performed the working on FRAP (Ferric Reducing Antioxidant Power) reagents were prepared by mixing 10 volumes of 1.0 mol/l acetate buffer, pH 3.6 with 1 volume of 10 mm/l TPTZ (2, 4, 6-Tripyridyl-S-triazine) in 40 mmol/l hydrochloric acid and 1 volume of 20 mmol/l ferric chloride in a reaction tube, 100 µl of sample solution of and 30 µl of deionizer water were added into 3 ml of FRAP reagent. Absorbances were measured after 8 minutes. A standard curve was prepared with different concentrations of $FeSo_4.7H_2O$ (100-1000µm/l). The antioxidant efficiency of the sample solution was calculated with reference to the standard curve given by a Fe^{2+} solution of known concentration. Ferric reducing power of the sample was expressed in Mol Fe^{2+}/l [25].

SIGNIFICANT EFFECTS ON VARIOUS DISEASES DIABETES

Ginger (Zingiber) is a significant herb that unveil many medicinal and ethno- medicinal properties. It's been analyzed by several clinical trials that ginger has significant effects on diabetes[26]. A major pungent component, Gingerol, of ginger significantly reduces diabetes[27], it also enhances the insulin activity[28]. In a research a metaanalysis and five randomized clinical trials were determined, the supplementation of ginger lowered fasting blood glucose concentrations significantly[29].

NAUSEA AND VOMITING

Ginger, during pregnancy, is very effective for vomiting and Nausea[30,31,32]. In 2005, a review assay was carried out that 33 studies to appraise the productiveness of the ginger in alleviating of vomiting and nausea induced at the time of the pregnancy. A meta-analysis and five randomized trials were conducted in 2006, in a study administer on 363 patients, to appraise the use of the ginger for vomiting and nausea, unveiled, ginger was effectual than the placebo[33,34]. Two of these studies discovered to be resemblent to vitamin B6, which has been found to be helpful in treatment of nausea induced in pregnancy. The review emerged that there were no negative impacts of ginger on outcomes of pregnancy[35].

VASCULAR CONDITIONS

Research has revealed that using 5g of ginger powder after dietary supplementation has an articulate increase in fibrinolytic activity, although, another study demonstrated that ginger doesn't affect the International Normalized Ratio (INR)[36,37].

MEDICINAL USES

Zingiber capitatum is known to possess many healing properties like asthma and cold. Roots and rhizomes are used as antiseptics and in skin care [38]. The nutraceutical has been found to possess cardiotonic activity due to compounds such as gingerol and the related compound shogaol as well as providing benefits in the treatment of dizziness and vestibular disorder. It is also effective in the treatment of nausea and other stomach disorders, but the traditional use has not been rationalized in the term of its experimental verification either in vitro or in vivo [39]. Essential oil from this rhizome is widely used in folklore remedies like fever and rheumatism[40].

THERAPEUTIC POTENTIALS OF ZINGIBER

Being one of the mostly consumed nutritious condiments, Ginger's medicinal properties are striking. The health aids ofginger are as a natural remedy for the treatment of numerous diseases and health conditions.

Table 2. Health benefits of ginger

Sr.No.	Medical condition	Benefits
1.	Antifungal	Treatment of yeast analogous infections such as athlete's foot, mouth infections etc[41].
2.	Antiulcer	Inhibits development of stomach ulcers such as ulcer caused by aspirin intakes[42]
3.	Reduce Menstrual Pains	Reduces intensity and time span of dysmenorrhea (period cramps) and associated headaches[43]
4.	Anticancer	Inhibits cancer cell growth of ovarian colorectal, pancreatic and prostate cancer by inducing apoptosis and auto-phagocytosis[44,45]
5.	Reduces Joint/ Muscle Pain	Diminish inflammation and joins/muscle pain associated with arthritis and osteoarthritis [46.]
6.	Reduces Cholesterol Levels	Instinctively reduces high cholesterol and triglyceride levels[47].
7.	Improves Cognitive Functions	Retard brain aging and cognitive decline[48.]
8.	Antibacterial	Effective against bacteria causing pneumonia, urinary tract infections, bronchitis and drugresistant bacteria[49].
9.	Anti-inflammatory	Hinder blood clotting Treatment of rheumatoid arthritis and osteoarthritis Suppress pro-inflammatory compounds such as chemokines and cytokines [50,51.]
10.	Stimulates Proper Digestion	Reduces problems like dyspepsia pain, heartburn and discomfort [52,53.]

2. CONCLUSION

The present review tries to summarize and document the phytochemical, pharmacological and medicinal uses of Z. *capitatum Roxb.* It can be concluded that *Zingiber capitatum Roxb* is a promising medicinal plant having wide ranges of pharmacological activities and used traditionally as antioxidant and antimicrobial potential. Experimental Studies has proven to have antioxidant properties; hence it will emerge as Immunomodulatory potential in treatment of immunodeficiency disorders. We hope this review can facilitate all concerning the past analysis research and therefore necessary information about the enormous pharmacological activities of *Zingiber capitatum Roxb* and a lot of elaborated clinical research seems worthy to determine it as a standard drug.

3. AUTHORS CONTRIBUTION STATEMENT

The author wishes to thank and acknowledge the guide Dr. Vanita Kanase who has been throughout responsible for this study support described in this paper. Also, authorities of Oriental College of Pharmacy for providing support to the study and other necessary facilities like libraries, internet surfing and other technical support to write a review article.

4. FUNDING ACKNOWLEDGEMENT

We acknowledge financial support for the study was provided by Mumbai University for granting Minor Research grant (Grant Number - APD/ICD/2019-20/762).

5. CONFLICT OF INTEREST

Conflict of interest declared none.

6. REFERENCES

1. Sharma BD. Flora of Karnataka: analysis. Botanical Survey of India. Department of the Environment; 1984. Available from: https://catalog.hathitrust.org/Record/009087000.
2. Singh V, Kumar S. Asteraceae of Sikkim. 2001:1-83. doi: 10.1007/s12045-017-0477-y.
3. Kulkarni DK, Bhusare S, Kasarkar AR, Sabu M. New report of Zingiber capitatum Roxb. from Mendha Lekha, Maharashtra. Sci res report. 2013;3(1):49-52.
4. Sharma BD, Karthikeyan S, Singh NP. 1996:1-793. doi: 10.1186/1746-4269-3-20.
5. Rahman MA, Yusuf M. Zingiber Salarkhanii (Zingiberaceae), A new species from Bangladesh. Bangladesh J Plant Taxon. 2013 Dec 22;20(2):239-42. doi: 10.3329/bjpt.v20i2.17398.
6. Press JR, Shrestha KK, Sutton DA. Annotated checklist of the flowering plants of Nepal. Nat Hist Museum Publications; 2000. Available from: https://www.cabi.org/ISC/abstract/20013054791.
7. GBIF HJ. Global Biodiversity Information Facility, University of Ulm; 2001. doi: 10.13039/50110000027.
8. Acevedo-Rodr P, Strong MT. Monocotyledons and gymnosperms of Puerto Rico and the Virgin Islands. Washington, DC: Smithsonian Institution;. 415 p.(Contributions from the United States National Herbarium; 52); 2005. Available from: https://www.fs.usda.gov/treesearch/pubs/30275.
9. Cheek M, Arcate J, Choung HS, Herian K, Corcoran M, Horwath A. Three new or resurrected species of Leptonychia (Sterculiaceae-Byttneriaceae-Malvaceae) from West-Central Africa. Kew Bull. 2013 Dec 1;68(4):579-90. doi: 10.1007/s12225-013-9469-6.
10. Flowers of India; updated 2005 May [cited Aug 23 2016]. Available from: https://www.flowersofindia.net.
11. Henry AN, Vivekananthan K, Nair NC. Rare and Threatened flowering plants of south India. J Bombay Nat Hist Soc. 1978;75(3):684-97. doi: 10.1023/A:1024184814545.
12. Hooker JD, Thomson T. The flora of British India. 1894;6. doi: 10.11646/phytotaxa.175.3.8.
13. Ravindran PN, Babu KN, editors. Ginger: the genus Zingiber. CRC press; 2016 Apr 19. doi: 10.1201/9781420023367.

14. Trease GE, Evans WC. Pharmacognosy. 11th ed. Braille Tirida Canada Macmillan Publishers; 1989. p. 257. doi: 10.1002/jps.2600690550.
15. Sofowora A. Medicinal plants and traditional medicine in Africa. 2nd ed. Ibadan, Nigeria: Spectrum Books Ltd. p. 19939-25. doi: 10.1089/acm.1996.2.365.
16. Harborne JB, Baxter H, editors. Chemical dictionary of economic plants. John Wiley & Sons; 2001 Aug 30.
17. Ferguson LR. Role of plant polyphenols in genomic stability. Mutat Res. 2001 Apr 18;475(1-2):89-111. doi: 10.1016/s0027-5107(01)00073-2, PMID 11295156.
18. Balasundram N, Sundram K, Samman S. Phenolic compounds in plants and Agri–Industrial By-Products: antioxidant activity, occurrence, and potential uses. Food Chem. 2006 Jan 1;99(1):191-203. doi: 10.1016/j.foodchem.2005.07.042.
19. Semwal RB, Semwal DK, Combrinck S, Viljoen AM. Gingerols and shogaols: important nutraceutical principles from ginger. Phytochemistry. 2015 Sep 1;117:554-68. doi: 10.1016/j.phytochem.2015.07.012, PMID 26228533.
20. Zadeh JB, Kor NM. Physiological and pharmaceutical effects of Ginger (Zingiber officinale Roscoe) as a valuable medicinal plant. Eur J Exp Biol. 2014;4(1):87-90.doi, doi: 10.5829/idosi.aejaes.2015.15.5.12593.
21. Makut MD, Gyar SD, Pennap GR, Anthony P. Phytochemical screening and antimicrobial activity of the ethanolic and methanolic extracts of the leaf and bark of Khaya senegalensis. Afr J Biotechnol.. 2008;7(9), doi: 10.1007/s11056-010-9241-9.
22. Rotimi VO, Laughon BE, Bartlett JG, Mosadomi HA. Activities of Nigerian chewing stick extracts against Bacteroides gingivalis and Bacteroides melaninogenicus. Antimicrob Agents Chemother. 1988 Apr 1;32(4):598-600. doi: 10.1128/AAC.32.4.598, PMID 2897830.
23. Shimada K, Fujikawa K, Yahara K, Nakamura T. Antioxidative properties of xanthan on the autoxidation of soybean oil in cyclodextrin emulsion. J Agric Food Chem. 1992 Jun;40(6):945-8. doi: 10.1021/jf00018a005.
24. Gülçın İ, Oktay M, Kıreçcı E, Küfrevıoğlu Öİ. Screening of antioxidant and antimicrobial activities of anise (Pimpinella anisum L.) seed extracts. Food Chem. 2003 Nov 1;83(3):371-82. doi: 10.1016/S0308-8146(03)00098-0.
25. Katalinic A, Rösch C, Ludwig M, German ICSI Follow-Up Study Group. Pregnancy course and outcome after intracytoplasmic sperm injection: a controlled, prospective cohort study. Fertil Steril. 2004;81(6):1604-16. doi: 10.1016/j.fertnstert.2003.10.053, PMID 15193484.
26. Li Y, Tran VH, Duke CC, Roufogalis BD. Preventive and protective properties of Zingiber officinale (ginger) in diabetes mellitus, diabetic complications, and associated lipid and other metabolic disorders: a brief review. Evid Based Complement Altern Med. 2012 Jan 1;2012:516870. doi: 10.1155/2012/516870, PMID 23243452.
27. Semwal RB, Semwal DK, Combrinck S, Viljoen AM. Gingerols and shogaols: important nutraceutical principles from ginger. Phytochemistry. 2015 Sep 1;117:554-68. doi: 10.1016/j.phytochem.2015.07.012, PMID 26228533.
28. Rani MP, Padmakumari KP, Sankarikutty B, Cherian OL, Nisha VM, Raghu KG. Inhibitory potential of ginger extracts against enzymes linked to type 2 diabetes, inflammation and induced oxidative stress. Int J Food Sci Nutr. 2011 Mar 1;62(2):106-10. doi: 10.3109/09637486.2010.515565, PMID 20874376.
29. Daily JW, Yang M, Kim DS, Park S. Efficacy of ginger for treating Type 2 diabetes: A systematic review and meta-analysis of randomized clinical trials. J Ethn Foods. 2015 Mar 1;2(1):36-43. doi: 10.1016/j.jef.2015.02.007.
30. Jewell D, Young G. Interventions for nausea and vomiting in early pregnancy. Cochrane Database Syst Rev. 2003;4. doi: 10.1002/14651858.CD000145.pub2.
31. Viljoen E, Visser J, Koen N, Musekiwa A. A systematic review and meta-analysis of the effect and safety of ginger in the treatment of pregnancy-associated nausea and vomiting. Nutr J. 2014 Dec 1;13(1):20. doi: 10.1186/1475-2891-13-20, PMID 24642205.
32. Ernst E, Pittler MH. Efficacy of ginger for nausea and vomiting: a systematic review of randomized clinical trials. Br J Anaesth. 2000 Mar 1;84(3):367-71. doi: 10.1093/oxfordjournals.bja.a013442, PMID 10793599.
33. Chaiyakunapruk N, Kitikannakorn N, Nathisuwan S, Leeprakobboon K, Leelasettagool C. The efficacy of ginger for the prevention of postoperative nausea and vomiting: a meta-analysis. Am J Obstet Gynecol. 2006 Jan 1;194(1):95-9. doi: 10.1016/j.ajog.2005.06.046, PMID 16389016.
34. White B. Ginger: an overview. Am Fam Phys. 2007 Jun 1;75(11):1689-91. PMID 17575660.
35. Borrelli F, Capasso R, Aviello G, Pittler MH, Izzo AA. Effectiveness and safety of ginger in the treatment of pregnancy-induced nausea and vomiting. Obstet Gynecol. 2005 Apr 1;105(4):849-56. doi: 10.1097/01.AOG.0000154890.47642.23, PMID 15802416.
36. Verma SK, Bordia A. Ginger, fat and fibrinolysis. Indian J Med Sci. 2001 Feb;55(2):83-6. PMID 11482162.
37. Jiang X, Williams KM, Liauw WS, Ammit AJ, Roufogalis BD, Duke CC, Day RO, McLachlan AJ. Effect of ginkgo and ginger on the pharmacokinetics and pharmacodynamics of warfarin in healthy subjects. Br J Clin Pharmacol. 2005 Apr;59(4):425-32. doi: 10.1111/j.1365-2125.2005.02322.x, PMID 15801937.
38. Joshi B. Medicinal Plants of submontane forest in a part of Tarai and Bhawar of Kumaun Himalaya. Nat Sci. 2011;9(5):95-9.
39. Holt S, inventor. Composition and method for treating the effects of diseases and maladies of the upper digestive tract. United States patent application US. 2005 Oct 27;11/024:092. doi: 10.1155/2019/6757524, PMID 30792972.
40. Ayyanar M, Ignacimuthu S. Herbal medicines for wound healing among tribal people in Southern India: ethnobotanical and Scientific evidences. Int J Appl Res Nat Prod. 2009 Sep 15;2(3):29-42.
41. Borrelli F, Capasso R, Aviello G, Pittler MH, Izzo AA. Effectiveness and safety of ginger in the treatment of pregnancy-induced nausea and vomiting. Obstet Gynecol. 2005 Apr 1;105(4):849-56. doi: 10.1097/01.AOG.0000154890.47642.23, PMID 15802416.
42. Al-Yahya MA, Rafatullah S, Mossa JS, Ageel AM, Parmar NS, Tariq M. Gastroprotective activity of ginger Zingiber officinale rosc., in albino rats. Am J Chin Med. 1989;17(1-2)(01n02):51-6. doi: 10.1142/S0192415X89000097, PMID 2589236.

43. Ding M, Leach MJ, Bradley H. A systematic review of the evidence for topical use of ginger. Explore NY. 2013 Nov 1;9(6):361-4. doi: 10.1016/j.explore.2013.08.001, PMID 24199775.
44. Rahman S, Salehin F, Iqbal A. In vitro antioxidant and anticancer activity of young Zingiber officinale against human breast carcinoma cell lines. BMC Complement Altern Med. 2011 Dec 1;11(1):76. doi: 10.1186/1472-6882-11-76, PMID 21933433.
45. Shukla Y, Singh M. Cancer preventive properties of ginger: a brief review. Food Chem Toxicol. 2007 May 1;45(5):683-90. doi: 10.1016/j.fct.2006.11.002, PMID 17175086.
46. Srivastava KC, Mustafa T. Ginger (Zingiber officinale) in rheumatism and musculoskeletal disorders. Med Hypo. 1992 Dec 1;39(4):342-8. doi: 10.1016/0306-9877(92)90059-l, PMID 1494322.
47. TANABE M, CHEN YD, SAITO KI, KANO Y. Cholesterol biosynthesis inhibitory component from Zingiber officinale Roscoe. Chem Pharm Bull. 1993 Apr 15;41(4):710-3. doi: 10.1248/cpb.41.710, PMID 8508473.
48. Saenghong N, Wattanathorn J, Muchimapura S, Tongun T, Piyavhatkul N, Banchonglikitkul C, Kajsongkram T. Zingiber officinale improves cognitive function of the middle-aged healthy women. Evid Based Complement Altern Med. 2012 Jan 1;2012: 383062. doi: 10.1155/2012/383062, PMID 22235230.
49. Malu SP, Obochi GO, Tawo EN, Nyong BE. Antibacterial activity and medicinal properties of ginger (Zingiber officinale). Glob J Pure Appl Sci. 2009;15(3-4):(3-4). doi: 10.4314/gjpas.v15i3-4.48561.
50. Penna SC, Medeiros MV, Aimbire FS, Faria-Neto HC, Sertié JA, Lopes-Martins RA. Anti-inflammatory effect of the hydralcoholic extract of Zingiber officinale rhizomes on rat paw and skin edema. Phytomedicine. 2003 Jan 1;10(5):381-5. doi: 10.1078/0944-7113-00271, PMID 12834002.
51. Grzanna R, Lindmark L, Frondoza CG. Ginger—an herbal medicinal product with broad anti-inflammatory actions. J Med Food. 2005 Jun 1;8(2):125-32. doi: 10.1089/jmf.2005.8.125, PMID 16117603.
52. Abascal K, Yarnell E. Clinical uses of Zingiber officinale (ginger). Alternat Complimentary Ther. 2009 Oct 1;15(5):231-7. doi: 10.1089/act.2009.15501.
53. Goel RK, Sairam K. Anti-ulcer drugs from indigenous sources with emphasis on Musa sapientum, tamrahbasma, Asparagus racemosus and Zingiber officinale. Indian J Pharmacol.. 2002 Jan 1;34(2):100-10. doi: 10.1186/1472-6882-13-305.