

AN OVERVIEW ON MIRACLES OF TRIKATU**Sonu Sadanandan^{1*} and Mahendra Prasad²**¹PG Scholar, Kriya Sharira Department, National Institute of Ayurveda, Jaipur.²Associate Professor, Kriya Sharira Department, National Institute of Ayurveda, Jaipur.Article Received on
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ABSTRACT

Trikatu is preliminary present in household for the purpose of dietary aspect in the form of spices. In Ayurveda it is widely used for the therapeutic and prophylactic purpose. Several Ayurvedic medicine contain trikatu. Individual components of trikatu have anti-inflammatory, mosquito larvicidal, digestion enhancer, gastroprotective, antioxidant, rejuvenative, antiviral, anticancerous, anthelmintic, hypoglycemic, hypolipidemic, carminative, immunomodulatory effect, antidyslipidemic, antihypothyroidism, antifungal, antibacterial, and much more functions have been established. The most potent and diversified study has proved that it enhances the bioavailability of drugs.

KEYWORDS: Trikatu, ushna, bioavailability, udararoga.**INTRODUCTION**

“Tri” means three, “Katu” means pungent taste. Trikatu is a combination of *Pippali* (*Piper longum* Linn.), *Maricha* (*Piper nigrum* Linn.), *Shunti* (*Zingiber officinale*) in equal proportion. It is widely used in ayurveda and household preparation. Trikatu is one of the mostly used drug in ayurvedic formulation for the purpose of treating many disease conditions during the period between 7th century B.C and 6th century A.D.^[1] It is having miraculous benefits in curing kapha and medo dhatu vitiated disease, prameha (urinary problems), kushtha (skin disease), pinasa(coryza), gulma (abdominal discomfort) and mandagni (indigestion).^[2] It has Katu rasa (pungent taste), Ushna veerya (hot potency), laghu (light), ruksha (dry), deepana(stimulating), Kapha-Vatahara property and amapachaka (digestive) effect. It is widely used for rejuvenation, splenomegaly, hepatomegaly, sthaulya, gaurav and other kaphaja related disease. Trikatu has got tremendous potential to enhance the

bioavailability of drugs and nutrients.^[3] Trikatu churna and its each component has antibacterial property. The extract of trikatu churna possess high antibacterial activity which is almost equal to the standard ampicillin solution.^[4] Trikatu is having many phytochemical components such as alkaloids, flavonoids, phytosterol and many other compounds. The latest research studies have invented that trikatu have miraculous pharmacological benefits for the promotion of health, preventing disease and therapeutic aspects. It is the time to make elaborate and summarise action of trikatu. The present study was focused on the review of important updates of research data and pharmacological benefits of trikatu.

PIPPALI (*PIPER LONGUM* LINN.)

Pippali (*Piper longum*) also called as Javanese, Indian or Indonesian *long pepper* is cultivated for the fruits dried and used as spice.^[5] The plant occurs in hotter parts of India from Central Himalayas to Assam up to lower hills of West Bengal and evergreen forests of Western ghats as wild. The cultivation of plant also seen in North East and many parts of the South. It is a small shrub with large woody root with numerous creeping jointed stems which are thickened at the nodes. The leaves of *piper longum* are alternate, spreading with blades different in size and without stipules. Flowers grow in solitary spikes and fruits are oblong blunt and blackish green. The mature spikes are collected and dried for commercial purpose. The root radix is known as *pippalimoola*.^[6]

Pharmacological Uses

Crude extract of *Piper longum* fruits are found to be active against mosquito larvae. The hexane fraction of methanol extract shows strong larvicidal activity of 100% mortality.^[7]

Ethanol extract of *Piper longum* possess superior anti-Hepatitis B Virus activity in vitro. Compound Piperine have remarkable inhibitory Hepatitis B Virus activity against secretion of Hepatitis B surface.^[8] Ayurvedic preparation Pippali Rasayana containing *Piper longum* was tested in mice infected with *Giardia Lamblia* and found to produce significant activation of macrophages.^[9] The petroleum ether extract and piperine shows significant 2,2-diphenyl-1-picrylhydrazyl [DPPH] scavenging activity (mechanism for screening antioxidant activity of plant extracts). The extract and piperine exert protective effect in the myocardial necrotic rats. They have protected myocardium from the harmful effects of lipid peroxidation and even maintained the glutathione levels to normal. The petroleum ether extract as well as piperine are useful in exerting protective activity in case of myocardial ischemia.^[10] The inhibitory effects of piperine, piperonaline, piperocadecalinine, and piperlongumine

are studied on washed rabbit platelet aggregation. These acid amides showed dose-dependent inhibitory activities on washed rabbit platelet aggregation induced by collagen arachidonic acid (AA) and platelet-activating factor (PAF). Piperlongumine exhibited stronger inhibitory effect.^[11] Administration of *piper longum* aqueous extract of 200 mg/kg for 30 days in streptozotocin induced diabetic rats resulted in a significant decrease in Fasting Blood Glucose levels with the corrections of diabetic dyslipidemia compared to untreated diabetic rats. There was a notable decrease in the activities of liver and renal functional markers in diabetic treated rats compared to untreated diabetic rats. This study indicates the protective role of *piper longum* against liver and kidney damage and its non-toxic property.^[12] The clinical studies have revealed that *Pippali* is effective against bronchial asthma in children. Long term use of *Pippali* fruit reduced the severity of bronchial asthma attacks. Piperine decreased rate and amplitude of respiration thereby showed nonspecific blockade of acetylcholine, histamine 5-hydroxy-tryptamine induced spasm on isolated guinea pig and rabbit intestine.^[13] Another study invented cardioprotective effect of methanolic extract of *Piper longum* in a rat having acute myocardial infarction induced by Isoproterenol. The extract contents are compounds alkaloids and amides, lignans, esters and volatile oil. The extract prevents the damage induced by Isoproterenol on histopathological and biochemical changes in rat model of myocardial infarction.^[14] A study on the Ethyl-Phenylpropionate induced rat ear edema significantly revealed that *Piper longum* is having anti-inflammatory activity. *Piper longum* extract of 1mg showed inhibition of rat ear edema occurrence. Injection of extract at a dose of 1200mg/kg was given to carrageenan-induced paw edema rat model. It has reduced the paw edema which again gives confirmation of the anti-inflammatory activity. Also, *piper longum* extract dose of 600mg and 1200mg/kg has reduced rectal temperature of rats which gives evidence of anti-pyretic activity of *piper longum*.^[15] The dyslipidemic and antioxidant activity of *piper longum* studied in triton and high fat diet hyperlipidemic rats. *Piper longum* extract of dose 200mg/kg, bw, po in triton WR-1339 induced hyperlipidemia and extract of 100 mg/kg in animals fed with high fat diet has lowered the serum lipid levels. *Piper longum* activates lipolytic enzymes in plasma and liver lipids. The extract has boosted faecal bile acid extraction and plasma lecithin: cholesterol acyltransferase activity.^[16] *Piper longum* extract from fruits and roots were tested against bacterial pathogens *Salix alba*, *Salmonella typhi*, *E-coli* and fungus *Aspergillus niger*. The plant extract showed more anti-bacterial effect in comparison with streptomycin. N-hexane extract and isolated constituents exhibited the effects.^[17] The plant extract is also founded as a bioenhancer in animal health care. A study in regional research institute, Jammu have

concluded that piperine act as a modulator of cell membrane dynamics and helps the transport of drugs across cell membrane barrier.^[18] A Research study conducted in the University of Karachi proposed that after neuro pharmacological screening of ethanolic extract of fruit *Piper longum* (*Piper Chaba* in Bengal & Pakistan) under acute dose founded it contains CNS depressant, sedative and mild anxiolytic effect.^[19]

MARICHA (*PIPER NIGRUM* LINN.)

Piper nigrum Linn. called as *Indian Long pepper* is flowering vine in the family of piperaceae. It is cultivated for fruits and dried and used as spice and seasoning. It is famous for its pungent taste contributed by the chemical constituent piperine which is discovered in 1819 by scientist Hans Christian. Due to its pungency, it is named as “King of Spices”.^[20] It is native of present South India. It is the common spice used in the food items for flavor. The spiciness is due to the chemical component piperine.

Pharmacological Uses

Piperine content in *piper nigrum* helps in the lipase activity, pancreatic amylase activity, chymotrypsin activation and protease activation.^[21] Studies have reported that *piper nigrum* possess anti-cancerous potential in different cancer cell lines and animal models. Other constituents piperlongumine, piperine and piperine have markable anti-cancer properties. Piperine free preparation exhibits higher anticancerous activity.^[22] In vitro antioxidant activity of volatile oil and oleoresins of pepper was observed in a study.^[23] A Research result confirmed larvicidal activity of isobutyl amides alkaloids piperine, guineensine, piperine, retrofractamide A by spectroscopic analysis identified in *piper nigrum* fruits against larvae of *Culex pipiens pallens*, *Aedes aegypti* and *A. togoi*.^[24] Piperine content have action against viral proteins. It inhibits Methyltransferase (PDB id 1L9K) of dengue and VP35 interferon inhibitory domain (PDB id 3FKE) of Ebola virus in comparison with antiviral Ribavirin.^[25] Piperine extract of pepper have in vitro acaricidal activity against adults engorged females of *Rhipicephalus (Boophilus) microplus* and an additional effect on the reproductive physiology of ticks by inhibiting oviposition.^[26] A research study suggested that *Piper nigrum* ethanol extract has therapeutic potential for treating allergic asthma through inhibiting Th2/Th17 responses and mast cells activation.^[27] Another study on piperine revealed that to obtain effective therapeutic potential nano formulation of *piper nigrum* is good alternative than conventional dosage forms.^[28] Piperine, trachyone, piperine and isopiperolein isolated compounds from *piper nigrum* are active against *Bacillus subtilis*,

bacillus sphaericus and *staphylococcus aureus* among gram negative bacteria and *Klebsiella aerogenes* and *Chromobacterium violaceum* among gram -ve bacterial strains.^[29] A new insecticidal amide piptigrine was isolated from dried ground seeds of *piper nigrum*.^[30] Kusunokinin and piperlonguminine isolated from *piper nigrum* have potent cytotoxic effects on breast cancer cells (MCF-7 and MDA-MB-468) and colorectal cells (SW-620).^[31] A study result found that in the treatment of vitiligo, *piper nigrum* extract and bioactive compounds have more remarkable effect than pure piperine.^[32] A study concluded isopropyl piperate from pepper is an outstanding compound that can be developed into a UV protection agent.^[33] *Piper nigrum* can work as control against lepidopteran and European pine sawfly larvae and will work as a short-term repellent and feeding deterrent (chemical agent that inhibits feeding without killing the insect directly & dies through starvation).^[34] An update on *piper nigrum* concluded that it shows potential as a larvicide for the control of certain malaria vector species.^[35] Piperine shows biochemical and chemo preventive activities without significant cytotoxic effects on normal cells, at least at doses less than of 250 microgram/ml.^[36] Chemical constituents of crude extracts of *Piper nigrum* can be considered as a new source of larvicide for the control of *Aedes Aegypti*.^[37] A study found *black pepper* chloroform extract (BPCE) have anti-microbial activity against *Escherichia coli* and *staphylococcus aureus*. BPCE inhibits tricarboxylic acid pathway of the bacteria. It destroys the permeability of cell membrane which causes metabolic dysfunction, inhibits energy synthesis, and triggers cell death.^[38] A research was done on antiadipogenic activity of *black pepper* extract and piperine in 3T3-L1 preadipocytes. Piperine attenuates fat cell differentiation by down-regulating Peroxisome Proliferator-activated receptor gamma activity (PPAR) (type 2 nuclear receptor i.e., protein regulating genes) and suppress PPAR gamma expression and leads to potential treatment for obesity related diseases.^[39] *Black pepper* suppresses the effect of body fat accumulation mainly through the action of piperine.^[40] Piperine is the active compound in *black pepper* which reduces cholesterol uptake by internalizing the cholesterol transporter proteins.^[41] It is considered as a novel therapeutic spice for the treatment of colorectal carcinoma.^[42] Piperolein B and piperchabamide isolated from *piper nigrum* are major constituents having insecticidal properties for the control of *Plutella xylostella* larvae.^[43] Presence of piperine in *piper nigrum* have the capacity to stimulate pigmentation in the skin.^[44] Methanolic extracts of *piper nigrum* have memory enhancing and antioxidant properties. Studies suggest that plant extract ameliorates amyloid beta (1-42) induced spatial memory impairment by attenuation of oxidative stress in the rat hippocampus.^[45]

SHUNTI (ZINGIBER OFFICINALE)

Ginger is a flowering plant with its rhizome known as *ginger root* or *ginger* is used commonly as a spice and one of the main drugs used in the ayurvedic drug formulations. It is the first spice exported from Asia to Europe with spice trade and used by ancient Greeks and Romans. *Shunti* is a dried rhizome of *Zingiber officinale* Roxb. widely cultivated in India, rhizomes drug in January-February, buds and roots removed, soaked overnight in water, and sometimes treated with lime and dried.^[46]

Pharmacological Uses

In recent studies found that *shunti* possess free radical scavenging, antioxidant, inhibition of lipid peroxidation properties. This have contributed to the gastroprotective effects of *shunti*.^[47] Fresh *ginger* can inhibit Human Respiratory Syncytial Virus-induced plaque formation in both human upper (HEp-2) and low respiratory tract(A549) cell lines. Fresh *ginger* of high concentrations stimulates mucosal cells to secrete IFN-beta that possibly function against viral infection and perform internalization.^[48] *Ginger* is effective in obesity management through potential mechanisms including increasing thermogenesis, increasing lipolysis, suppression of lipogenesis, inhibiting intestinal fat absorption and controlling appetite.^[49] *Ginger* supplementation in oxidative stress condition increases testosterone production in males. *Ginger* components enhance luteinizing hormone production, increasing level of cholesterol in testes, reducing oxidative stress and lipid peroxidation in the testes, promoting the activity of antioxidant enzymes, normalizing blood glucose, increasing blood flow in testes, increasing testicular weight and recycling testosterone receptors.^[50] It enhances semen quality and improves the sperm concentration, viability, motility, and morphology. Increases the level of gonadal hormones, decreases the oxidative damage to the cell, increase production of nitric oxide, also due to hypoglycemic response of *ginger* and presence of valued nutrients.^[51] *Shunti* reduces the severity and incidence of postoperative nausea and vomiting and thus useful as alternative for antiemetic medication.^[52] Use of *ginger* in primary dysmenorrhea have significant effect on relieving intensity and duration of pain.^[53] *Ginger* is effective against wide range of metabolic syndromes (MetSs). It ameliorates hyperlipidemia, hyperglycemia, oxidative stress, and inflammation. These effects are mediated by transcription factors peroxisome proliferator-activated receptors, adenosine monophosphate-activated protein kinase and nuclear factor kB.^[54] A study reported decoction of *ginger* rhizome having main phytochemicals *ginger* 6-gingerol,8-gingerol and 6-shogaol have effect on cardiovascular parameters and on vascular and intestinal smooth muscle.^[55] Gingerol and

shogaol derivatives can penetrate the Blood brain barrier via passive diffusion. This contributes to the positive effects of ginger extracts in the Central Nervous System.^[56] *Ginger* extract and gingerol derivative exert action through important mediators and pathways of cell signaling. The extract or compounds exhibit antiproliferative, antitumor, invasive, and anti-inflammatory activities.^[57] Gingerol is having cytotoxic effect on human colon cancer cells.^[58] It is having anticancer activities by the effect on a variety of biological pathways involved in apoptosis, cell cycle regulation, cytotoxic activity and inhibition of angiogenesis.^[59] *Ginger* is having anti-inflammatory role which also reduce pain in conditions such as osteoarthritis.^[60] It shows antidiabetic therapeutic effects by increasing insulin sensitivity, protecting beta cells of pancreatic islets, reducing fat accumulation, decreasing oxidative stress and increasing glucose uptake by the tissues. Study proved it also have protective effects against several diabetes-linked complications such as nephropathy, diabetic cataract by acting as antioxidant and antiglycating agent.^[61] Steamed ginger preparation act against acute gastric ulcers in a rat model. This suggests protective mechanisms of ginger by enhancement of gastric defensive mechanisms evidenced by increased mucosal Prostaglandin E2 synthesis and total nitric oxide, enhancement of gastric antioxidation capability and inhibition of inflammation.^[62] Gingerols can be used as a medicinal food derivative used for treating or preventing chronic diseases.^[63] In a study it is found to have anti-obesity effect in mice fed a high fat diet due to inhibition of intestinal absorption of dietary fat by the active compounds.^[64] It is reported to be useful in neurological disorders. So, *ginger* exerts abortive and prophylactic effects in migraine without any side effects.^[65] Daily consumption of raw and heat-treated ginger helps to reduce muscle pain following exercise-induced muscle injury.^[66] *Ginger* root extracts containing gingerols inhibit the growth of *Helicobacter pylori* Cag A positive strains and contributes to chemo preventive effects.^[67] Benzene fraction of petroleum ether extract of dried rhizomes of ginger possess anticonvulsant, anxiolytic and antiemetic activity.^[68] *Ginger* have better therapeutic and prophylactic detoxication effects on liver cadmium accumulation.^[69] 6-gingerol, 6-shogaol, 6-paradol, zingerone and dehydrozingerone are effective for ameliorating the neurological symptoms and pathological conditions of age related neurological disorders by modulating cell death or cell survival signaling molecules.^[70] Zingerone is an immunostimulant and possess biological actions like increasing respiratory burst, phagocytic activity and disease resistance against pathogen. It is an excellent appetizer and help in growth and maintenance of the body.^[71]

TRIKATU

Trikatu is having potent anti-inflammatory agent for treating autoimmune inflammatory disorders like rheumatoid arthritis with immunosuppressive property.^[72] A research study done on a patient having hypertension and coma suggests that nasya with trikatu churna for seven days have astonishing results. It resulted in positive changes in Glasgow Coma Scale (GCS).^[73] Trikatu exerts potent anti-inflammatory effect in gouty arthritis inflammation.^[74] Possess immunomodulatory, antiviral, expectorant, carminative, hypolipidemic, hypoglycemic, antiemetic and anti-inflammatory potential. Have tremendous potential to increase the bioavailability of drugs and nutrients.^[75] Trikatu churna is effective in the treatment of hypothyroidism due to its property of thermogenesis and its action as bioavailability enhancer.^[76] Ethanolic extract of trikatu possesses hepatoprotective activity.^[77] Trikatu Churna is having anthelmintic activity by means of aqueous and ethanol extract component.^[78] In an experimental study it was concluded that trikatu churna have anti-inflammatory activity.^[79] The three ingredients of trikatu are warming and expectorant which makes the combination effective in respiratory infection and due to bronchodilator properties effective in respiratory problems. By stimulating the various enzymes in the stomach, it helps in improving digestive fire and digestion. Due to detoxifying properties, it is useful in joint pains and stiffness in case of gout.^[80] Trikatu thaila nasya is effective in Kaphaja Shirashoola. Trikatu due to krimigna property controls the infection in shirashoola, due to kaphahara property scrapes out the waste collection of the sinuses and due to shoologna property pacifies the headache.^[81] Generally, trikatu acts against deposition of lipids and cleans the eventually blocked channels. So trikatu capsules blocks the formation of different cholesterol at various stages in the biosynthetic pathway and because of the rasayana property it increases the HDL level also. It was clearly seen in the research study Triphala kwatha with madhu and trikatu capsules are effective in the treatment of medoroga(dyslipidemia) combination.^[82] Several studies reported bioavailability of drugs vasicine, spartein rifampicin phenytoin, sulphadiazine propranolol, theophylline, oxyphenylbutazone, oxytetracycline, indomethacin and, pefloxacin, when administered with trikatu or its individual ingredients. It enhances the rate of absorption of drugs into the bloodstream and increases the availability at the site of action. Hence it is found that the bioavailability enhancing property of trikatu helps in altering the therapeutic dosages of certain drugs or routes of drug administration.^[83] Trikatu churna is found to be very effective against certain bacterial and fungal isolates *Escherichia coli*, *Staphylococcus aureus*, *Aspergillus niger* and *Mucor* species and promises antimicrobial and moderate analgesic activities.^[84] A clinical observation treatment of

Shadbindu taila nasya and trikatu dhoomapana showed effective result in Atropic Rhinitis.^[85]
Trikatu churna and Kanchanara kwatha combination is very effective in dhatvagni vikara and hypothyroidism.^[86]

CONCLUSION

Trikatu is having anti-viral, anti-fungal, anti-helminthic, antioxidant, analgesic, antibacterial, mosquito larvicidal, thyroxin stimulation, CNS stimulant, hepatoprotective, adjuvant in absorption and assimilation of drugs, antiobesity, antiemetic role in the body. Hence it is concluded that due to the preventive and therapeutic approach and multifunction of trikatu it is beneficial in many body metabolic functions.

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