World Journal of Pharmaceutical and Life Sciences
WJPLS
www.wjpls.org
SJIF Impact Factor: 6.129

A REVIEW ON: PHARMACOGNOSTIC AND PHARMACOLOGICAL ACTIVITIES OF GARLIC

Sumit K. Musale*[1], Pradnya N. Jagtap[2], Shweta S. Bobade[3], Vaishnavi P. More[4], Ankita M. Kadam[5] and Komal D. Pol[6]

[1]Assistant Professor, Department of Pharmacology, Pune District Education Association's Seth Govind Raghunath Sable College of Pharmacy Saswad, Pune.
[2]H.O.D. of Pharmacology, Pune District Education Association's Seth Govind Raghunath Sable College of Pharmacy Saswad, Pune.
[3,4,5,6]Student of Master of Pharmacy, Department of Pharmacology, Pune District Education Association's Seth Govind Raghunath Sable College of Pharmacy Saswad, Pune.

Corresponding Author: Sumit K. Musale
Assistant Professor, Department of Pharmacology, Pune District Education Association's Seth Govind Raghunath Sable College of Pharmacy Saswad, Pune.

Article Received on 19/03/2022 **Article Revised on 09/04/2022** **Article Accepted on 29/04/2022**

ABSTRACT

Garlic (Allium sativum) has traditional dietetic and medicinal uses as an anti-infective agent. Garlic is a hardy perennial member of onion family. Studies explains that it may be originally native to asia, but has long been naturalized to Europe northern Africa, mexico and all over the world. Garlic is classified as member of family alliaceace. The name "Allium sativum" is derived from the celtic word "all", meaning burning or stinging, and the latin "sativum" meaning planted or cultivated. Allium sativum commonly called as garlic. It is belonging to family Alliceace closely related to onion, shallot. Allicin is organo sulfur compound. When fresh garlic chopped enzyme allinase converts to allin into allicin. The generated allicin is very unstable and quickly converted into other sulfur containing compound such as diallyl disulfide. Allicin have antibacterial, antiviral, antifungal, antiprotozoal activity. Allicin is an oily, slightly yellow liquid that gives odor to garlic. Garlic used in food industries as flavoring agent in sauces and salads.

KEYWORDS: Allium Sativum, Organo Sulfur, Diallyl Sulfide, Antiprotozoal.

INTRODUCTION

"The use of herbal drug is increasing. One of these plants used most intensively and widespread is garlic. Historically, garlic has been used for centuries worldwide by various societies to combat infectious disease. Garlic can be provided in the form of capsules and powders, as dietary supplements, and thus differ from conventional foods or food ingredients. Louis Pasteur was the first to describe the antibacterial effect of onion and garlic juices. Allium vegetables, particularly garlic (Allium sativum) exhibit a broad antibacterial activity against Gram-negative and Gram-positive bacteria. Antifungal activity, particularly against candida albicans. Antiparasitic activity, including some major human intestinal protozoan parasites such as Entamoeba histolytica and Giaradia lamblia. Antiviral activity besides other beneficial effects i.e., reduction of cancer risk, antioxidant effect, antimicrobial effect and enhancement of detoxification foreign compound and hepatoprotection".[1]

"Garlic (Allium sativum) has traditional dietetic and medicinal uses as an anti-infective agent. Garlic is a hardy perennial member of onion family. Studies explains that it may be originally native to asia, but has long been naturalized to Europe northern Africa, mexico and all over the world. Garlic is classified as member of family alliaceace. The name "Allium sativum" is derived from the celtic word "all", meaning burning or stinging, and the latin "sativum" meaning planted or cultivated. The use of higher plants and their extracts to treat infections is an ancient practice in traditional medicine. Many plants have been used because of their antimicrobial treats, which are chiefly synthesis during secondary metabolism of the plants. The herbal medicine may be in the form of powder, liquid or mixtures which may be raw or boiled, ointments linings and incision. Traditional medicine is the sum of the total of knowledge, skill and practice based on the theories, beliefs and experiences indigenous to different culture that are used to maintain health as well as to prevent, diagnose, improve or treat physical and mental illness".[2]

"Garlic can reduce blood pressure; prevent cancer, serum LDL cholesterol and cardio vascular disease. Various researchers have shown that garlic extract exhibit the wide spectrum of antibacterial activity against gram-negative and gram-positive bacteria including species of Escherichia-Coli, salmonella, staphylococcus auerus, bacillus and clostridium. Even acid-fast bacteria such as mycobacterium tuberculosis are sensitive to garlic. No longer do you need to hope that fresh garlic is rich in allicin. So, when it is chopped the allinase enzyme will react to form allicin. The common cold is the most whispered viral infection in the world today. Over 200 different viruses cause infection and cold symptoms, the most common of which are the rhinovirus. Re-infection also very prevalent because of this wide variety of infectious viruses. Allicin reduce the symptoms of cold infection such as fatigue, headache, runny nose, sneezing, coughing, fever etc".[3]

LITERATURE REVIEW

"The contribution of diet and nutrition status to cancer risk has been a major focus of research as well as public health policy. Diet plays a significant role in cancer etiology and its prevention. Interestingly, various studies carried out have shown that the incidence of cancer can be reduced substantially by means of dietary modification. Different types of epidemiological designs have been employed to obtain sufficient proof of causal relationships between dietary modification and cancer. This offers the prospect for initiating primary and secondary prevention measures for control and prevention of cancers".[4]

"Many dietary supplements reduce the risk of cancer and garlic is one among them. The recorded use of garlic in the treatment of tumors dates all the way back to 1,550 BC when Egyptians realized the benefits of garlic as a remedy for a variety of diseases, and administered it orally and topically; the modern era, however, begins in the 1950s when demonstrated in vitro and in vivo that thiosulfinate extracts of garlic inhibited the growth of malignant cells and prevented growth of sarcoma 180 ascites tumor".[8]

"The use of garlic for medicinal purposes dates to antiquity. The Bible mentions garlic with regard to the Jew's flight from Egypt. Garlic bulbs were found in tombs of the pharaohs, in Crete, and in ancient cultures throughout the world. Indeed, Hippocrates considered garlic to be a vital part of therapeutic armamentarium".[5]

"Garlic (Allium sativum) is a bulbous perennial plant with a powerful onion such as aroma and pungent taste that has been used as a flavoring agent, condiment, and for medicinal purposes for over 5,000 years. Garlic benefits have been greatly recognized for many years by numerous health authorities and enthusiasts for its effects on promoting better health. Garlic is also known as Rocambole, ajo, Allium, stinking rose, rustic treacle, nectar of the gods, camphor of the poor, poor man's treacle, and clove garlic".[6]

Fig. 1: Garlic [8]

"Diallyl sulfide, a powerful garlic component, has been reported to inhibit oxidative stress caused by testosterone and to accelerate testosterone metabolism. It has been postulated that in the early stages of prostate cancer, when sensitivity to testosterone is retained, the predominant effect of Allium derivatives is to stimulate testosterone degradation and in the later stages, to interfere with signal transduction. Furthermore, garlic is a seleniferous plant, accumulating selenium from the soil against a concentration gradient. Selenium has many anticancer actions, particularly in control of genes involved in carcinogenesis. In addition to inhibiting primary cancer, Allium derivatives from garlic may further inhibit metastatic processes. In an androgenin-dependent prostate cancer mouse model, the water-soluble Allium derivative, S-allyllmercaptocysteine, inhibited metastases to the lung and adrenal gland by 90%".[7]

"Some anoctedent studies have even demonstrated garlic to be particularly effective in inhibiting persistent yeast infections and in treating ear infections. The allicin in garlic can help shield the stomach from the proliferation of Helicobacter pylori, a bacterium directly related to gastrointestinal cancer. Allicin is further broken down to a compound called ajoene. Ajoene contributes to the anticoagulant action of garlic. It may be the compound that prevents the clogging of blood vessels, which can lead to atherosclerosis".[10]

Pharmacognostic Profile

"Synonyms

Allium

Biological Source

This consists of bulbs of the plant known as Allium sativum Linn.

Family

Liliaceae.

Geographical Source

Lahsun is cultivated in Asia, Southern Europe, USA, and India. In India, it is found in almost all the states and cultivated as a spice or a condiment crop".[11]

Cultivation and Collection

"Garlic is cultivated in well-drained moderately clay loamy soil. It needs cool moist climatic conditions during the growth and dry period during maturity. Garlic is hardy plant with narrow flat leaves and bears white small flowers and bul-bils. The cultivation of drug is done by planting bulbs generally in the month of September to late in October. It takes about four months for harvesting. It is also taken as an alternate crop with many other vegetables. For cultivation, about 300kg of bulbs per hectare are required, and yield per hectare is about 8,000 kg".[11]

Organoleptic Characters

"Colour – Bulbs are white to pink in colour.
Odour – Characteristic and aromatic.
Taste – Aromatic and pungent.
Size – 1.5 to 2.5cm".[11]

Chemical Constituent

"Garlic bulbs contains 29% of carbohydrates, about 56% of proteins (albumin). 0.1% of fat, mucilage, and 0.06 to 0.1% of volatile oil. It also contains phosphorus, iron and copper. Volatile oil of drug is the chief active constituent, and contains allyl propyl disulphide, diallyl disulphide, allin and allicin. Allicin by action of enzyme allinlyase is converted into allicin. Garlic oil is yellow in colour and has specific gravity of 1.046. it is optically inactive".[12]

Sr.No.	Photochemical	Aqueous extract	Ethanol extract
1	Alkaloids	+	+
2	Flavonoid	+	+
3	Glycosides	+	+
4	Reducing sugar	-	-
5	Saponin	+	+
6	Steroids	+	+
7	Phenols	+	+
8	Terpenoid	+	+
9	Anthraquinones	+	+
10	Tannins	+	+

Photochemical screening

"Garlic photochemical screening for terpenoids, flavonoids, alkaloids, reducing sugars, steroid, glycoside, phenol, and other photochemical components Standard tests for anthraquinones, saponin, and tannin were carried out as mentioned procedures Sofowora" [11] and "Trease and Evans".[14]

Qualitative photochemical screening

"The quantity of photochemical elements in the plant materials used was assessed using a variety of methodologies. Terpenoids were determined using a spectrophotometric technique. tannins, steroids, anthraquinone, and glycosides are only a few examples. Folin-Ciocalteu The phenol content was determined using a method. Flavonoids, the procedures mentioned were used to determine alkaloids and saponins".[15]

Sr.No.	Phytochemical	Qualitative Analysis (%)
1	Alkaloids	6.80±0.05
2	Flavonoid	1.90±0.05
3	Glycosides	0.05±0.00
4	Saponin	3.30±0.02
5	Steroids	0.30±0.00
6	Phenols	0.50±0.00
7	Terpenoid	0.20±0.00
8	Anthraquinones	1.00±0.00
9	Tannins	4.20±0.00

6.2.4 Extraction Method.

Aqueous garlic extract preparation

"The cloves on fresh bulbs were separated and peeled to obtain the edible portion. One kilogram of the edible portion was crushed under aseptic conditions. The homogenate was recovered by filtration through double layer of sterile fine mesh cloth and collected to make 100% extract. This was collected in an eppendroff tube and stored at 4°C until use".[16]

Garlic essential oil extraction

"In order to isolate essential oils by hydro distillation, the fresh plant material was packed in a still and a sufficient quantity of water is added and brought to a boil; alternatively, live stem in injected into the plant charge. Due to the influence of hot water and steam, the EO was freed from the oil glands in the plant tissues. The vapor mixture of water and oil was condensed by indirect cooling with water. From the condenser, distillate flows into a separator, where oil separated automatically from the distillate water. The hydro distillation was carried out in apparatus during 4 hours; EO obtained were stored at 4°C in hermetically sealed dark eppendroff tube until they were used".[16]

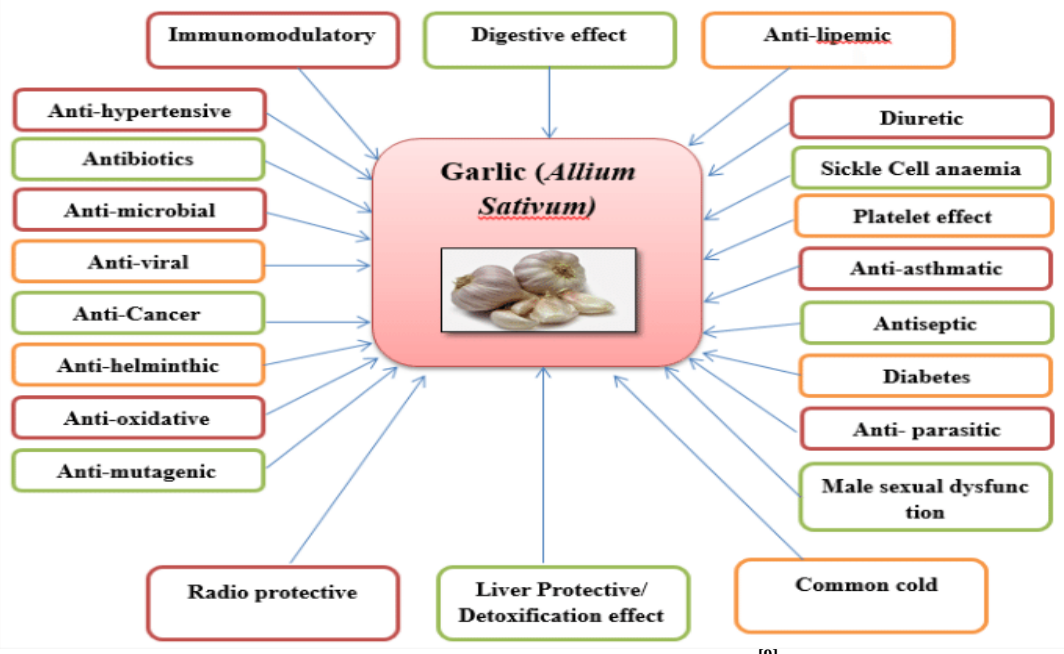

Fig. 2: Pharmacological actions of Garlic.[9]

Pharmacological Activities

"Garlic may well be one the most famous of all plants in human history- dating back to use by the pharaohs and many ancient cultures. Garlic has generated interest throughout the countries as medicinal panacea. Broad ranges of pathological organism, including bacteria, fungi, protozoa and virus have been shown to be sensitive to crushed garlic. Research also shows that the garlic can reduce blood cholesterol and has proven anti-cancer effects. This beneficial effect may be due to part of garlic's unusual concentration of sulfur-containing compounds".[16]

"For over a century, some of garlic's key sulfur compounds called allyl sulfides have been known. However, not until 1944 was the chief, highly anti-infective compound of garkic discovered, an oxygenated sulfur compound named allicin, from the latin name of the plant, Allium sativum".[17]

"The debate about whether allicin existed in crushed garlic clove vs. its absence in whole, uncrushed clove was resolved in 1947, when researchers found high amount of an oxygenated sulfur amino acid present in raw garlic cloves. Allin was found to the stable precursor that is converted to allicin by the action an enzyme called allinase, also present in garlic cloves. Although allin was found to be the stable precursor that is converted to allicin by the action of enzyme allinase, also present in garlic cloves. Although allin has no antimicrobial properties itself, when garlic clove is crushed, the allin is transformed via the allinase enzyme into the biologically active allicin molecule within seconds of crushing a clove".[18]

"Garlic clove are odor-free until crushed. Fascinating cross-section studies shows that the substrate, allin and the enzyme allinase are located in different compartments of the same clove. When the clove is crushed, the allin and allinase then come in contact with each other to rapidly form allicin. However, the reactive allicin molecules produced have a very short half-life, as they react with many surrounding proteins. Thus, consuming stabilized allicin with its unusually high amount of stable allicin allows for a veritable all-out attack on existing pathogenic organism for a superior clinical response completely safe and effective without harmful or toxic side effects".[19]

Antifungal activity of Allicin

"Research shows that garlic extract has a strong antifungal effect and inhibit the formation of mycotoxins like the aflatoxin of aspergillus parasiticus. Another study showed the fungistatic and fungicidal activity of highly concentrated garlic extract against Cryptococcus neoformans. Pure allicin was found to have a high anti-candida activity and was effective against various species of candida, Cryptococcus, trichophyton, Epidermophyton

and microsporum. Allicin inhibited the germination of spores and growth of hyphae".[20]

Antiparasitic Properties of Allicin

"Many ancient cultures where aware of the antiparasitic effects of freshly crushed garlic. More recently, Albert Schweitzer, a famous medical doctor and humanitarian, used freshly crushed garlic to treat people suffrering from dysentery or intestinal worms. One traditional Chinese medical treatment for intestinal disease is an alcoholic extract of crushed garlic. Recent research shows that allicin is also effective against Entoameba histolytica, a human intestinal protozoan parasite. Stabilized allicin has also very efficiently inhibited the growth of other protozoan parasite such as Giardia lambila, Leishmania major, Leptomonas colosoma and Crithidia fasciculate".[21]

Antiviral Activity of Allicin

"Fresh garlic extract in which allicin has been tested to be the main active component, have shown in vitro and in vivo antiviral activity, including effectiveness against the human cytomegalovirus, influenza B, herpes simplex virus type 3, vaccinia virus, vesicular stomatitis virus and human rhinovirus type 2. Stabilized allicin has also been shown to be effective against Molluscum contagiosum viral infections. The allicin condensation product, ajoene, appears to have more antiviral activity in general than allicin. Ajoene was found to block the intergin-dependent processes in a human immunodeficiency virus-influenced cell system".[22]

Antibacterial activity of allicin

"The antibacterial properties of crushed garlic have been known for a long time. Various garlic preparations have been shown to exhibit a wide spectrum of antibacterial activity against Gram-negative and Gram-positive bacteria including species of Escherichia, Salmonella, Staphylococcus, streptococcus, Klebsiella, Proteus, Bacillus and Clostridium. Even acid-fast bacteria such as Mycobacterium tuberculosis are sensitive to garlic. Garlic extract are also effective against Helicobacter pylori, the cause of gastric ulcers. Garlic extract can also prevent the formation of Staphylococcus enterotoxins A, B, and C1 and also thermonuclease. On the other hand, it seems that garlic is not effective against toxin formation of Clostridium botulinum. Cavallito and Bailey were first to demonstrate that the antibacterial action of garlic is mainly due to allicin. The sensitivity of various bacterial and clinical isolates to pure preparations of allicin is very significant. In most cases the 50% lethal dose concentrations were somewhat higher than those required for some of the newer antibiotics. Interestingly, various bacterial strains resistant to antibiotic such as methicillin-resistant Staphylococcus aureus as well as other multidrug-resistant enterotoxicogenic strains of Escherichia coli, Enterococcus, Shigella dysenteries, S. flexneri, and S. sonnei cells were all found to be sensitive to alicin.

A synergistic effect of allicin against M. tuberculosis was also found with antibiotics such as streptomycin or chloramphenicol. A very interesting aspect of the antibacterial activity of allicin is the apparent inability of most bacteria to develop resistance to it because the mode of action is completely different from the that of the other antibiotic substances. It has been proposed that the development of resistance to beta-lactum antibiotics is1000-fold easier than development of the resistance to allicin". [23]

Modes of Action

"Several modes of action have been proposed. These include

1. Effect on drug metabolizing enzymes (that is induction of phase II detoxification enzymes, including glutathione transferases, quinine reeducates, epoxide hydrolase and glucuronosyl transferase that inactivate toxic substances and facilitate their excretion)" [25]
2. "Antioxidant activity (garlic preparations exhibit radical scavenging activity and decrease lipid peroxidation, which is relevant in the light of the observation that tumor promotion may involve oxygen radicals)
3. Tumor growth inhibition that has been documented in several carcinoma cell lines, including prostate carcinoma cells
4. Induction of apoptosis, which coincides with an increase in the percentage of cells blocked in the G2/M phase of the cell cycle (possibly through a depression in p34cdc2 kinase)
5. Effective stimulation of the immune response (Organosulfurcompounds (OSC) stimulates proliferation of lymphocytes and macrophage phagocytosis, induce the infiltration of macrophages and lymphocytes in transplanted tumors, induce splenic hypertrophy, stimulate the release of interleukin-2 (IL-2), tumor necrosis factor-α (TNF-α) and interferon-γ, enhance natural killer cell, killer cell and lymphokine-activated killer cell activity)".[25]

CONCLUSION

"A recent increase in the popularity of alternative medicine and natural products has renewed interest in garlic and their derivatives as potential natural remedies. This review may be useful to increase our knowledge of garlic therapeutic effects and improve our future experimental and clinical research plans. Although it is shown that garlic may have a significant clinical potential either in their own right or as adjuvant therapy in different disorders, however, due to some issues, such as methodological inadequacies, small sample sizes, lack of information regarding dose rationale, variation between efficacy and effectiveness trails, the absence of placebo comparator, or lack of control groups more standard experiments and researchers are need to confirm the beneficial effect of garlic in various disease.

Although garlic is believed to be a safe substance, long-term trails of reasonable duration would provide insights into the possible side-effects of different garlic extract".[26]

REFERENCES

1. Shridevi Adaki, Raghavendra Adaki, Kaushal Shah, Amol Karagir, Garlic: Review of Literature. Indian Journal of Cancer, 2014, 51(4): 577-581.
2. WCRF, AICR. Food, Nutrition and the Prevention of Cancer: A Global Perspective. Washington DC: World Cancer Research Fund and American Institute for Cancer Research, 1997.
3. Mohammad Shafiur Rahaman, Allicin and Other Functional Active Components in Garlic: Health Benefits and Bioavailability. International Journal of Food Properties, Volume 10, Issue 2: Functional Foods, 2007; 245-268.
4. Thomson M, Ali M. Garlic Allium Sativum: A Review of Its Potential Use as an Anti-Cancer Agent. Curr Cancer Drug Targets, 2003; 3: 67-81.
5. Mohsen Azanlou, Shahab Bohlooli, Introducing of green garlic plants as a new source of allicin, May 2010; 120(1): 179-183.
6. Murthy Ns, Mukherjee S, Ray G, Ray A. Dietary Factors and Cancer Chemoprevention: An Overview of Obesity-Related Malignancies. J Postgrad Med, 2009; 55: 45-54.
7. Yona Shadkchan, Einav Shemesh, David Mirelman, Talia Miron, Aharon Rabinkov, Meir Wilchek and Osherov. Efficacy of allicin, the reactive molecule of garlic, in inhibiting Aspargillus spp. In Murine model of dissemination aspargillosis. Journal of Antimicrobials Chemotherapy, 2004; 53: 832-836.
8. Chethana Prakasan, Health benefits of garlic: 10 proven benefits of eating garlic: May 20, 2017. https://www.india.com/lifestyle/health-benefits-of-garlic-10-proven-benefits-of-eating-garlic-2150128/
9. Mital B. Kansara, Ashutosh J. Jani, Possible interactions between garlic and conventional drugs a review, 2017; 4(2): 73-81.
10. Izzo Aa, Capasso R, Capasso F. Eating Garlic and Onion: A Matter of Life or Death. Br J Cancer, 2004; 91: 194.
11. Dr.C. K. kokate, A. P. Purohit, S. B. Gokhale, PHARMACOGNOSY, Nirali prakashan, fifty second edition, 14.45-14.46.
12. Larry D. Lawson and Z. Jonathan Wang. Allicin and Allicin-Derived Garlic Compounds Increases Breath Acetone through Allyl Methyl Sulfide: Use in Measuring Allicin Bioavailability. J.Agric. Food Chem. 2005, 53, 6, 1974-1983.
13. Sofowora A (1993) Medicinal Plants and Traditional Medicine in Africa. Spectrum Books Ltd. (2nd Edn), 26-100.
14. Trease Ge, Evans Wc Phytochemicals. In: Pharmacognosy. (15th Edn), Saunders Publishers, London, 2002; 42-44, 221- 229, 246- 249, 304-306,331-332, 391-393.
15. Adeniyi Sa, Orjiekwe Cl, Ehiagbonare Je Determination of Alkaloids and Oxalates in Some Selected Food Samples in Nigeria. African Journal of Biotechnology, 2009; 8(1): 110-112.
16. Moshtaq Talip Al-mohanna. PATHOGENESIS OF BACTERIAL INFECTION, April 2016; 40-60.
17. Mohsen Azanlou, Shahab Bohlooli, Introducing of green garlic plants as a new source of allicin, May 2010; 120: 179-183.
18. Murthy Ns, Mukherjee S, Ray G, Ray A. Dietary Factors and Cancer Chemoprevention: An Overview of Obesity-Related Malignancies. J Postgrad Med, 2009; 55: 45-54.
19. Lamm dl, riggs dr. Enhanced immunocompetence by garlic: role in bladder cancer and other malignancies. J nutr, 2001; 131: 1067-70.
20. Rivlin rs. Can garlic reduce risk of cancer? Am j clin nutr, 2009; 89: 17-8.
21. lanzotti v. The analysis of onion and garlic. J chromatogr a, 2006; 1112: 3-22.
22. Shukla y, kalra n. Cancer chemoprevention with garlic and its constituents. Cancer let, 2007; 247: 167-81.
23. Thomson m, ali m. Garlic allium sativum: a review of its potential use as an anti-cancer agent. Curr cancer drug targets, 2003; 3: 67-81.
24. Bergès R, Siess MH, Arnault I, Auger J, Kahane R, Pinnert MF, et al. Comparison of the chemopreventive efficacies of garlic powders with different alliin contents against aflatoxin, 1953–1959.
25. WCRF, AICR. Food, Nutrition and the Prevention of Cancer: A Global Perspective. Washington DC: World Cancer Research Fund and American Institute for Cancer Research, 1997.
26. Murthy NS, Mukherjee S, Ray G, Ray A. Dietary factors and cancer chemoprevention: An overview of obesity-related malignancies. J Postgrad Med, 2009; 55: 45-54.