IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Comprehensive Review Of The Medicinal And Pharmacological Properties Of *Solanum Lycopersicum*

Sourav[1], Mrs. Anjali Singh[2], Mr.Akash Johri[3] M. Pharm scholar[1], Innovative College of Pharmacy, Greater Noida,

[2&3]Associate Professor, Innovative College of Pharmacy, Greater Noida

Abstract: Solanum lycopersicum, commonly known as tomato, belongs to the Solanaceae family. It is an herbaceous, dicotyledonous plant found in tropical and temperate climates, including India, China, and the United States. This plant contains of arytenoids, vitamins, phenolic compound and other bioactive compound like desmethyl-sterols and α- and ɣ-tocopherols. Along with the tocopherols, delta-5-avenasterol, the desmethyl sterols, and citrostadienol that contribute to multiple biological activities, such as anti-inflammatory,antimicrobial,neuroprotective,anti-diabetic,antioxidant,cardioprotective,anti-cancer,and benefits for gut and skin health. This review aims to evaluate the hormonal potential of *Solanum lycopersicum* leaf extracts by examining their photochemical composition.

Keywords: Solanum lycopersicum, Bioactive compounds, Photochemical, Endocrine modulation, Hormonal pathways, Therapeutic implications.

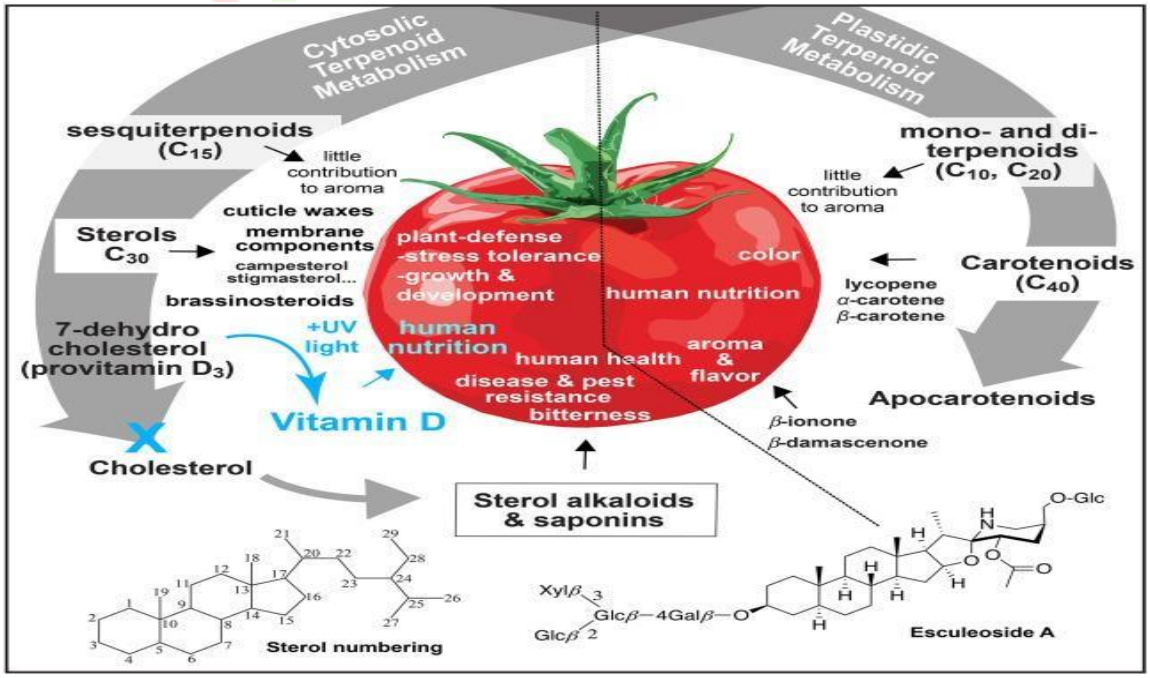


Figure 1: Chemical constituents of solanum lycopersicum

INTRODUCTION

The tomato plant (Solanum lycopersicum L.) is a member of the Solanaceae, a family that also includes eggplant, pepper and potato plants. The word "tomato" derives from the Aztecan "xitomatl" meaning "the swelling fruit". In fact, although its fruit is culinary considered a vegetable, tomato is botanically a berry (**Daria/ paolo ,et.al-2018**) The cultivated tomato, Solanum lycopersicum, is grown for its popular fleshy fruits and is known by different names worldwide like tomate (German), tomaatti (Finish), pomidoro (Italian), kamalis (Malay), jitomate (Spanish), pomidor (Russian) and tamatar (Hindi) as per (**P. Raga Amrutha et al 2019**),This plant contains of carotenoids ,vitamins, phenolic compound and other bioactive compound like desmethyl-sterolsandα-andɣ-tocopherols.Along with the tocopherols, delta-5- avenasterol, the desmethyl sterols, and citrostadienol that contribute to multiple biological activities, such as anti-inflammatory, antimicrobial, neuroprotective, anti-diabetic, antioxidant, cardioprotective, anti-cancer, and benefits for gut and skin health as per (**priya shuklaet al**, **2013** and **Hussain T**. **Bakhsh et al**, **2024**)Tomato juice (Lycopersicum commune) improves vaginal elasticity Wistar rats after ovariectomy on the dosage of 110 mg/kg/day, 220 mg/kg/day and 330 mg/kg/day as per (**Arief Widya Prasetya, *et al.*, 2015)** The World Health Organization (WHO) believes that herbal therapies are used two to three times more than conventional medications worldwide. Plants have been used for therapeutic purposes since prehistoric times and are the foundation of much modern medicine. The majority of the few effective medicines from a century ago were plant- based; therefore many conventional pharmaceuticals today are derived from plants. Examples include morphine (opium poppy), quinine (cinchona bark), dioxin (foxglove), and aspirin (willow bark). Several therapeutic compounds that were previously derived from plants are now commercially manufactured. Tetrahydro cannabinol, salicylic acid, papaverine, Ldopa, emetine, ephedrine, pseudoephedrine, caffeine, and theophylline are some of them. (**Gunjanetal**. **2015**) The members of the Solanaceae family, being annual, biennial, or perennial, are herbaceous and exhibit great floristic diversity, photochemical characteristics, and ethno botanical significance. Solanum family members have yielded variety of pharmacologically active compounds with distinct roles such as antirheumatic, antimicrobial, antioxidant, and anti-tumor as per (**Saimajan ET**, **al**, **2024**)

GEOGRAPHICAL DISTRIBUTION

Tomato is the world's largest vegetable crop and known as protective food both because of its special nutritive value and also because of its wide spread production. Tomato is one of the most important vegetable crops cultivated for its fleshy fruits. Tomato is considered as important commercial and dietary vegetable crop. Ten most promising States of the country for tomato crop have been identified and utilized for further study on various aspects of tomato crop. The maximum production and productivity have been shown by UP followed by Karnataka, Punjab, West Bengal and Assam. However, Maharashtra has increased area under tomato crop significantly as about 110% increase from year's 90-91 to95-96 and Bihar, UP with 72%, 44% respectively. Punjab is able to obtain about 114%

increase in production for a considered period. About8.3%increases has been achieved by UP followed by Assam (75%) and Karnataka (72%) in terms of the tomato production. It is produced from outside the India such as Meso America, Britain, Spain, Middle East &North Africa and North America also as per (**katyani Bajpai ET**, **al**, **and 2013**)

SYNONYMS

The cultivated tomato, Solanum lycopersicum, is grown for its popular fleshy fruits and is known by different names worldwide like

- Tomate(German)
- Tomaatti(Finish)
- Pomidoro(Italian)
- Kamalis(Malay)
- Jitomate(Spanish)
- Pomidor(Russian)
- Tamatar (Hindi)

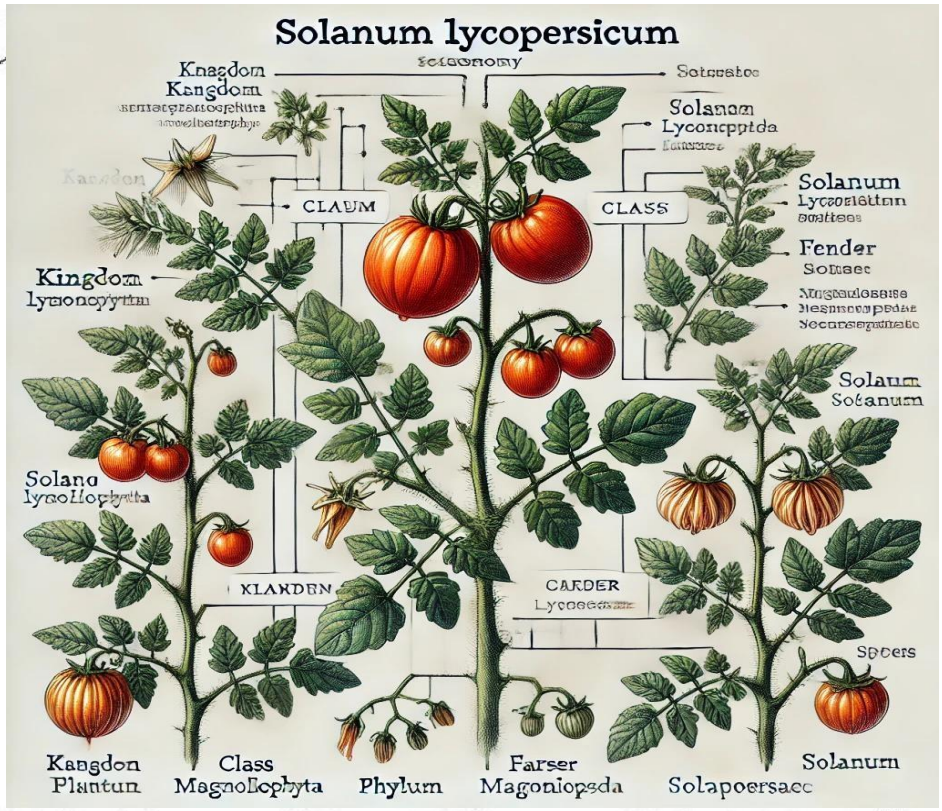
HABITAT

China, the largest producer, accounts for about one quarter of the global output followed by India and United States as per (P. Raga Amrutha et al2019).It is produced from outside the India such as Mesoamerica, Britain, Spain, Middle East & North Africa and North America also as per (Priya shukla et al 2013).

CHEMICAL CONSTITUENTS

This plant contains of carotenoids, vitamins, phenolic compound and other bioactive compound like desmethyl-sterols and α-andɣ-tocopherols.Along with the tocopherols, delta-5-avenasterol, the desmethyl sterols, and citrostadienol that contribute to multiple biological activities, such as anti-inflammatory, antimicrobial, neuroprotective, anti-diabetic, antioxidant, cardioprotective, anti-cancer, and benefits for gut and skin health as per(Priya Shukla et al,2013and HussainT. Bakhsh et al, 2024)

Carotenoids [22, 23]



TAXONOMY

Figure 2 : Taxonomy of S.lycopersicum

Category	Classification
Kingdom	Plantae
Division	Magnoliophyta(Angiosperms)
Class	Magnoliopsida(Dicotyledons)
Order	Solanales
Family	Solanaceae(Nightshades)
Genus	Solanum
Species	Solanum lycopersicum

MACROSCOPIC CHARACTERSTICS

Solanum lycopersicum L. is a perennial herbaceous plant characterized by its sprawling growth habit and serrated

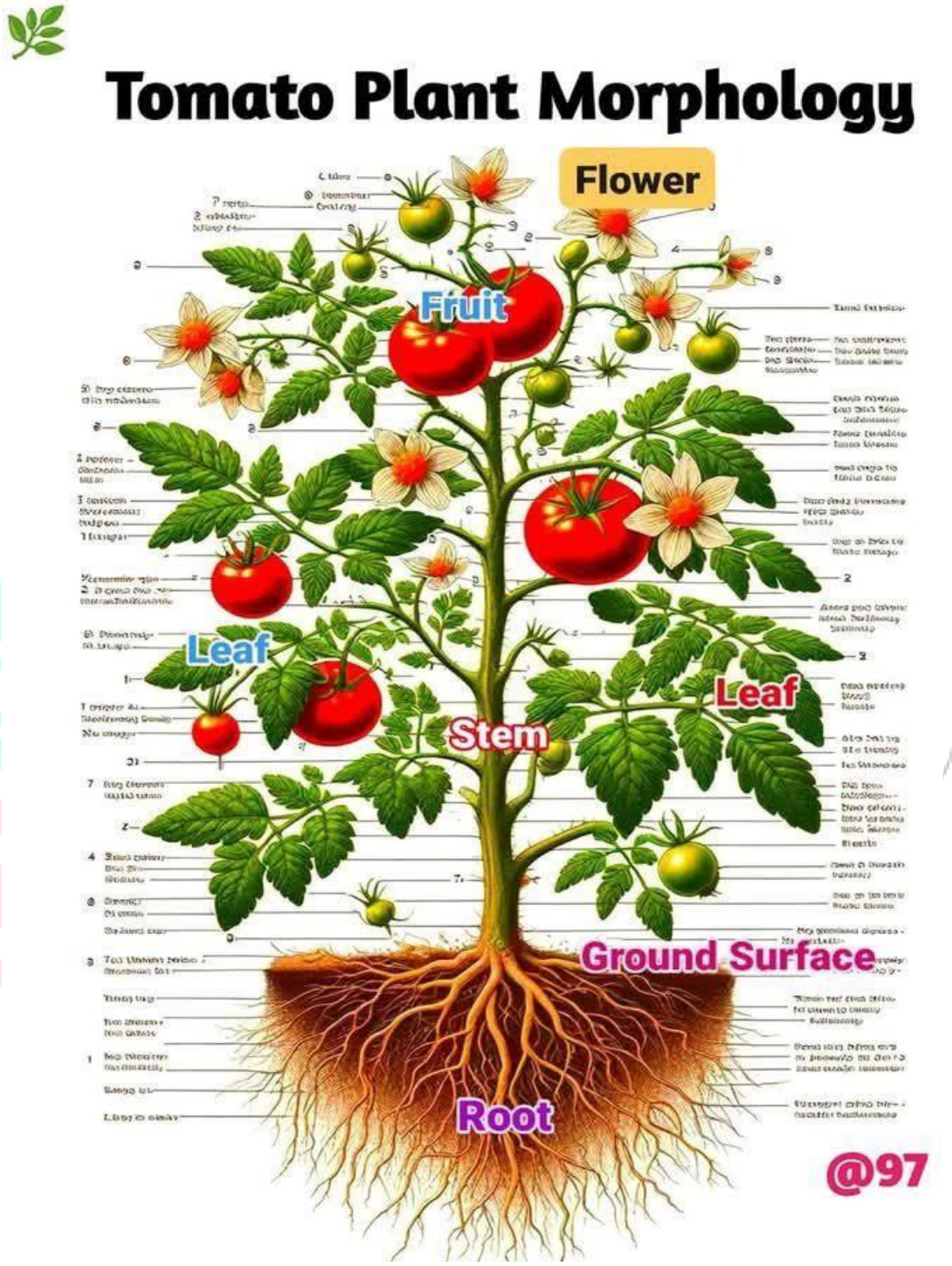


Figure 3 : Morphology of S.lycopersicum

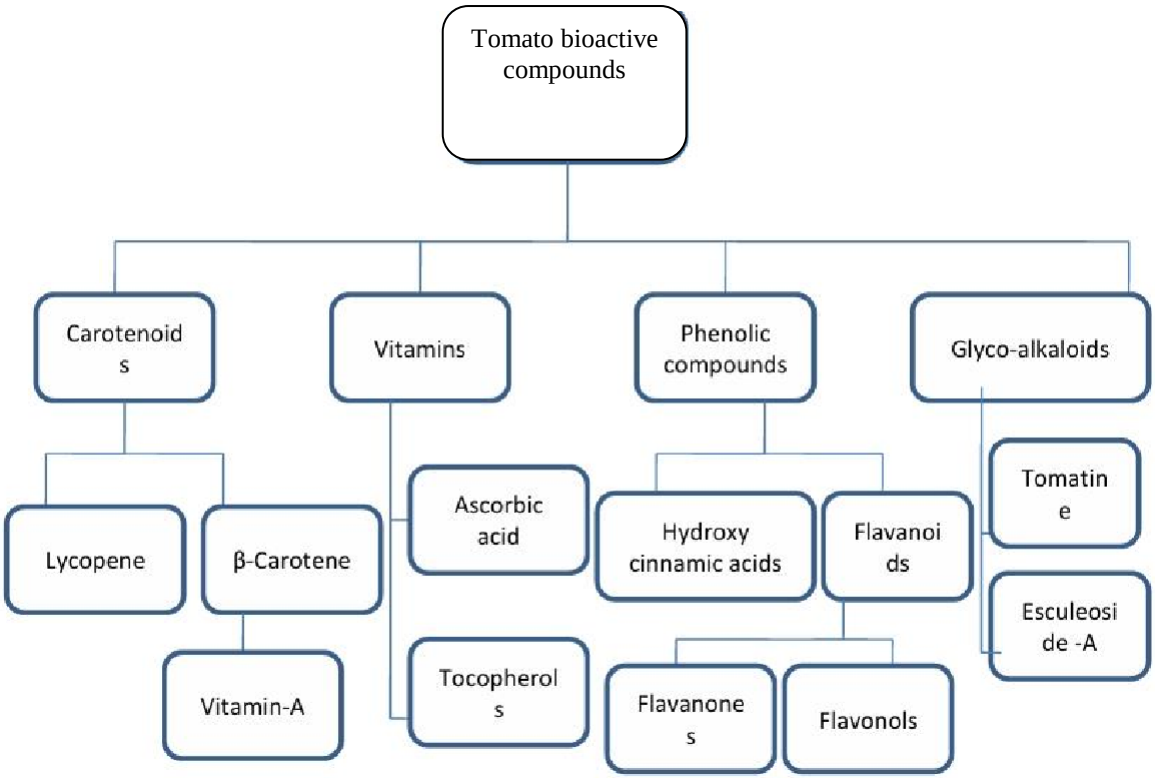
leaves. The plant typically reaches a height of one to three meters and Produces yellow flowers that develop into fleshy, red or yellow fruits known as tomatoes. The leaves are alternate and pinnate, with prominent veins and hairy surfaces. The fruit of Solanum lycopersicum L. varies in size, shape, and color depending on the cultivar, with some varieties exhibiting round, oblong, or pear-shaped fruits.

TOXICITY STUDIES

On the safe use in humans, several studies have shown that tomatine is not toxic when consumed orally in moderate amounts(Fried man et al.,2007).For example, Peruvians consume a tomato variant very rich in tomatine (0.5–5mg/g dry weight) without presenting visible signs of toxicity (Rick et al.,1994).In mice, LD50 values of 1000,500,25–33.5and18mg/kg body weight have been reported for α-tomatine by subcutaneous, oral, intra peritoneal and intravenous routes, respectively (Wilson et al

.,1961;Friedman,2002).All these data contribute to the evidence for the safe therapeutic use of tomatine in humans (Cesar Echeverría et al, 2022)

PHYTO CHEMISTRY



PHARMACOLOGICALACTIVITY

1. Anti helmintic activity of tomato leaf: The methanolic extract of the tomato leaves showed significant anti helminthic activity. The methanolic extract of the tomato leaves was more effective even at lower concentrations in causing paralysis and death of earthworms than the Standard drug, Albendazole. It can be concluded that active constituents responsible for anti helmintic activity are present in the methanolic extract of leaves of Solanum lycopersicum.
2. Anti-inflammatory Activity of tomato leaf: Methanolic extract of tomato leaves (0, 20, 50 and 100 µg/ml) showed significant anti- inflammatory activity.PGE2 is also known to be pro-inflammatory mediator in many different acute and chronic inflammatory diseases as well as in normal defense reactions. In general, prostaglandin E2 is considered as one of the strongest inflammatory mediators in inflammatory response. It was transformed from arachidonic acid via the cyclooxygenases 2 catalytic reactions. The anti-inflammatory action of Solanum lycopersicum extract on lipopolysaccharide (LPS)-stimulated macrophages, its inhibitory and inflammation activity was investigated by observing the prostagland in E2 production. At the highest concentration of tomato leaves extract tested, the PGE2 production is reduced.
3. Oxidative Stress and Antioxidant activity of tomato leaf: Tomato leaf biomass and relative leaf growth rate decreased as a result of higher concentration in the root medium. Both cultivars also showed an increase in the total and free concentration, a reduction in growth and increase of concentration in the plant tissues as a consequence of toxicity has previously been observed in tomato. The malondialdehyde (MDA) and H2O2 concentrations were measured in leaves as an indicator of oxidative stress.
4. Anti fungal activity of tomato leaf: Tomato leaves extract using the Porapak Q method posse's antifungal activity. The antifungal activity of tomato leaf volatiles (TLV) was investigated against three types of plant pathogenic fungi of Botryotinis fuckeliana,Glomerella cingulata and Fusarium oxysporum

f. sp. melonis.The growth of B. fuckeliana and G. cingulata was completely inhibited by TLV extract volumes corresponding to 12 and 17 g of tomato leaves, respectively. These results suggest the presence of a defense response against plant pathogenic fungi in tomato plants and that TLV are efficacious as a biological control agent.

5. Bypassing Kinase Activity of the Solanum lycopersicum leaf: The tomato protein kinase confers resistance to Pseudomonas syringae tomato bacteria expressing the Avr P to and Avr P to B effectors proteins. Activity of P to as Kinas e is specifically and potently inhibited by ATP-competitive Small Molecules. The current study results that P to kinase activity plays an important role through auto phosphorylation in the stabilization of the P to molecule in the proper conformation for interacting with bacterial effectors, but not in Pto- Mediated signal transduction. Finally, the chemical-genetic strategy used here to develop small-molecule inhibitors that specifically target the kinase activity of P to.
6. Biological activities and isolation of genes in tomato fruit: α-tomatine is a steroidal saponin, constituted by a tetra saccharide group attached to the a glycone tomatidine.This compound is especially abundant in leaves and immature fruits of tomato, and has been found to inhibit the growth of various plant pathogens. The main objectives of the present work are the study of biological activities of α–tomatine and the isolation of genes involved in the pathway. All the tomato genotypes tested significantly inhibited the growth of Rhizoctonia solani, Fusarium solani, Fusarium oxysporum, and Xantho monasaxonopodispv.vesicatoria.Other genes involved in anabolism and catabolism of α-tomatine have been investigated utilizing similar cloning strategies.
7. Anti carcinogenic activity of tomato fruit: R.C. Agrawal etal used Croton oil to induced carcinoma in mice. When S.lycopersicum extract is given one hour before the each treatment of croton oil, the incidence and the number of skin papillomas are significantly decreased. The appearance time of papillomas was also prolonged in the S .lycopersicum experimental groups in comparison to the carcinogen treated animals. The reduction in tumor counts may be due to effect in the promotional phase of tumor genesis which prevents the reduction of free radicals. This result is important because the tomato is an important vegetable in Indian diet and considerable important has been given for the role of tomato and lycopene in prevention of prostate and other type of cancers.
8. Cryptic Introgression in Tomato green fruit: Introgression is the transfer of genes of one species into the gene pool of another via hybridization. In plants, introgression is a key concept tin study of the risks of contamination of natural populations by genetically modified (GM) crops. Genotyping of populations sampled from these regions would provide evidence to re-examine whether introgression from these wild tomato species into S. lycopersicum has played a role in the crop's evolutionary history.
9. Endo-beta- mannanase Activity in Tomato fruit: Endo-mannanase is present in the seeds of monocots, di cots, and gymnosperms, often in numerous is o forms. It is an endo enzyme that hydrolyzes mannans, galactomannans and glucomannans, and may be involved in the germination of some seeds. During extraction of the fruit enzyme, the presence of a protease inhibitor results in only the additional pI is form, whereas, in its absence, there was a third is form. We presume that this additional is form was the result of limited proteolysis during extraction, and was not present within the fruit.
10. Enzymatic Activity in Tomato fruit: Adaptation of plants to several types of stress depends upon a complex cellular sign system where reactive oxygen species (ROS), salicylates and cellulose and chitin oligomers intervene. Presence of these elicitors, activate the anti oxidant and cellular defense systems against a biotic and biotic stress, as well as fulfilling some development regulation functions and tomato fruit. Ripening. Highest values of activation of the enzymatic activity were obtained when fruits were treated with chitosan.
11. Cyclophosphamide-induced chromosome aberrations in tomato fruit: The clastogenic effect of Solanum lycopersicum fruit extract has been evaluated against cyclophosphamide (CP)-induced chromosomal aberrations in the bone marrow cells of the mice. The present observation supports the mutagenic potential of S.lycopersicum extract in mammalian test system.

12. High invertase activity in tomato fruit: In tomato, fruit number, fruit weight, and seed number per fruit were markedly decreased at daily mean temperatures of 29'C compared with those at 25'C. The data provide correlative evidence that a high capacity for sucrose import and INV activity could contribute to heat tolerance in young tomato fruit possibly through increasing glucose signaling activities repressing the PCD pathway. In conjunction with previous work these findings indicate that the INV mediated PCD pathway through sugar signaling is conserved in reproductive organs between the eudicotyledonous species of tomato and them on ocotyledonous maize in response to heat and water stress, respectively.
13. Metabolic engineering of flavonoids in tomato fruit: Flavonoids comprise a large and diverse group of polyphenolic plant secondary metabolites. In plants, flavonoids play important roles in many biological processes such as pigmentation of flowers, fruits and vegetables, plant-pathogen interactions, fertility and protection against UV light. Building up and exploiting prior knowledge of pathway control mechanisms opens up new possibilities for metabolic engineering of the tomato flavanoid pathway.
14. Platelet anti-aggregation activity and endothelial protection from tomato fruit: It has been observed that the tomato has platelet anti-aggregation activity in vitro and in vivo by inhibiting platelet aggregation induced by ADP and collagen.The platelet anti-aggregation activity of aqueous and methanol extracts of tomatoes in vitro were similar. Both types of extract showed inhibition of platelet aggregation induced by ADP.In the study by aqueous and methanol extracts under various temperatures maintained their platelet anti-aggregation activity. Indicating that the active compounds with platelet anti- aggregation activity present in the two extracts were not affected by heat treatment.
15. Anti obesity activity of Solanum lycopersicum fruit: Ethanolic extract of Solanum lycopersicum used for antiobesity activity Obesity is increasing at alarming rates in industrialized and „industrializing" world and is considered to be a disorder of energy balance. Solanum lycopersicum is known to have lipid-lowering effects and antioxidant activities. The Solanum lycopersicum paste also decreased the plasma levels of malondialdehyde and increased the activities of superoxided is mutase, catalase and glutathione peroxidase in hamsters. Tomatine, a major component of green tomato, decreased serum LDL cholesterol through the formation of tomatine-cholesterol complex. Solanum lycopersicum (250mg/kg/day, 500mg/kg/day) significantly decreases the food intake (kcal), body weight, body mass index (BMI), lee index, weight of the adipose tissue. The anti obesity effect of various doses of ethanolic extract of Solanum lycopersicum is produced due to the antioxidant effect produced from the plants.
16. Effects of a tomato extract on the labeling of blood constituents with technetium-99m: Blood constituents labeled with radio nuclides have been used in procedures in nuclear medicine. This study suggests that the aqueous tomato extract, in a concentration that is found in human diet, has the ability to reduce the radio labeling on plasma proteins. Probably this occurs due to chemical substances of the tomato extract that could have action on reducing agent (stannous ion) used in the labeling process and/or the ability to interact with plasma proteins, occupying its binding sites. Although these experiments were performed in rats, the results suggest that caution should be taken with the interpretation of the data obtained from nuclear medical diagnosis and tests when patients consume tomato extracts or its derivatives in food.
17. Sub optimal-temperature tolerance of Solanum lycopersicum seed: The vegetative growth rate of tomato at suboptimal temperature is for a significant part limited by its poor root development. Root-zone heating and grafting on to a low-temperature tolerant rootstock appeared to be useful tools for tomato to increase shoot grow that suboptimal cultivation temperatures by stimulation of the leaf expansion rate. Such new rootstocks may help to broaden the temperature optimum of elite tomato cultivars and so to increase the energy efficiency of tomato green house cultivation in the temperate climate zone.

Conclusion:

S.lycopersicum is wonderful plants having enormous range of medicinal activity in this article have assembled almost all information related to different research activity of plant. Although it is mentioned as a component in several popular poly herbal formulations in the form of alcoholic or hydro alcoholic extracts, it is an attractive candidate plant for formulating targeted drugs. It will help to researchers & scholars to go deep in this area as plant indicate vast range of photochemical related to origin so it can be suggested the further work can be done on S. lycopersicum.

Future Scope

The medicinal potential of Solanum lycopersicum (tomato) is gaining attention due to its rich bioactive compounds, including flavonoids, alkaloids, and glycol alkaloids. Tomato leaves show promise in hormonal regulation, potentially aiding in menopause management and reproductive health. Their antioxidant, anti-cancer, and anti-inflammatory properties suggest applications in cardiovascular, neurodegenerative, and metabolic disorders. Additionally, tomato leaf extracts exhibit antimicrobial activity, offering potential in natural antibiotics. Future research and clinical studies could further validate their therapeutic applications; making tomato leaves a valuable resource in plant-based medicine and pharmaceuticals.

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