

# Molecular Docking Study of Some Phytosterols of *Luffa echinata* Fruits as a Anti-Asthmatic Activity

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**Abstract**— The climbing plant *Luffa echinata* ROXB. (*Curcubitaceae*) has been used traditionally to treat a number of diseases. *Luffa echinata* ROXB. Fruit has been shown in scientific studies to have antioxidant, antidepressant, anxiolytic, antiepileptic, hepatoprotective, anti-cancer, and asthmatic properties. However, there has been little research of asthmatic activity. Using AutoDock 4.2, we investigated the *Luffa echinata* ROXB. as a anti-asthmatic effect in this study. IL-13 is a powerful stimulator of all interleukins implicated in the inflammatory process connected to asthma. Due to this, phytosterols and its analogue were docked with IL-13 (PDB: 3LSX), and their binding complementarities were assessed in this study. It was found that phytosterols are well accommodated in IL-13's active site. Although the study's limited patient population, asthma can raise the incidence of COVID-19 hospitalisation in people 18 to 49 years old. Therefore, future research is necessary to investigate the ability of *Luffa echinata* ROXB. against COVID-19.

**Index Terms**— *Luffa echinata* ROXB., IL-13 docking, COVID-19, Phytosterols, Asthma disease

## 1. INTRODUCTION

Asthma is a common chronic disorder of the airways that is complex and characterized by variable and recurring symptoms, airflow obstruction, bronchial hyper-responsiveness (bronchospasm), and an underlying inflammation is defined by the National Heart, Lung, and Blood Institute of the USA.<sup>[1]</sup> Asthma is a physiologically partial, but reversible obstruction of airflow, with pathological overdevelopment of mucus glands, and thickening and shortening of the airways which is caused by inflammation, Scarring, bronchoconstriction resulting from surrounding smooth muscle tightening, Smooth muscles dysfunction and airway remodeling. The bronchia became narrowing due to Bronchial inflammation due to edema and swelling is mostly caused by an immune response to allergens. Asthma causes a recurring period of wheezing, chest tightness, shortness of breath, and coughing. The cough mostly occurs early in the morning or during the night.<sup>[2,3]</sup> Asthma influences 15-20 million of the number of inhabitants in the India, 7% of the population of the United States, 6.5% of British people and a total of 300 million worldwide.<sup>[4,5]</sup>

Since there is now no effective treatment for asthma, the majority of asthma treatments focus on easing inflammatory processes in an effort to reduce symptoms.<sup>[6,7]</sup> Asthma treatments currently available are mostly pulmonary, followed by oral or intravenous administrations, and the preferred medications include beta-adrenoceptor-2 ( $\beta_2$ ) agonists, corticosteroids, xanthines, and their derivatives.<sup>[7,8]</sup> For matic relief from asthma,  $\beta_2$  agonists are in fact the preferred therapies. Although the use of corticosteroids may promote children's growth, the currently available anti-asthmatic medications cause a variety of side effects, including headaches, nausea, convulsions (xanthenes)<sup>[9]</sup>,

cardiovascular effects ( $\beta_2$  agonists)<sup>[10]</sup>, vomiting (phosphodiesterase type 4 inhibitors)<sup>[11,12]</sup>, adrenal supression, myopathies, osteoporosis, and metabolic disturbances.<sup>[9,10,12]</sup>

Natural conduits should therefore be investigated as a good option. Herbal medicine is still the mainstay of about 75%-80% of the world population, mainly in the developing countries, for primary health care because of better cultural acceptability with the human body and the lesser side effect. India is perched on a gold mine of very much recorded and all around rehearsed learning of customary natural medicine. World health organization (WHO) has recently defined traditional medicine as comprising therapeutic practices that have been in existence, often for hundreds of years, before the development and spread of the modern medicine and are still in use today.<sup>[13]</sup>

Upregulation of Th2-like cytokines is intimately related to the inflammation of the airways brought on by the recruitment of polymorphonuclear cells.<sup>[14]</sup> In the asthmatic mouse, basophils release IL-4 in the first instance, which triggers the development of native T lymphocytes into Th2 cells. This additional IL-4 promotes the differentiation of Th2 cells.<sup>[15,16]</sup> Additionally, IL-4 participates in the immunoglobulin E (IgE) primary synthesis. IL-13 is a powerful activator and one of the interleukins implicated in the inflammatory process connected to asthma. Numerous studies have shown that IL-13 signalling has a role in the overexpression of chitinase, the hyperregulation of mucin, and fibrosis.<sup>[17,18]</sup> In fact, the biological functions of IL-13 and IL-4 are quite similar in the complex network of receptors and in signalling. IL-13 also has a significant impact on the regulation of inflammatory cells. The formation of IL-5 in the smooth muscles of the lung airway can be induced by IL-13, which in turn regulates eosinophil recruitment.<sup>[19]</sup> Because of this, IL-13 and *Luffa echinata*

ROXB. auto docked, and their binding complementarities were examined in this work.

**PLANT PROFILE**<sup>[20,21,22]</sup>

**Plant Name :** *Luffa echinata* Roxb.

**Plant Introduction :**



(A)



(B)

**Figure 1 : *Luffa echinata* Roxb. (A) Whole plant (B)**

**Dried fruit**

**Scientific classification :**

- Kingdom : Plantae
- Division : Tracheophyta
- Class : Magnoliopsida
- Order : Cucurbitales
- Family : Cucurbitaceae
- Genus : Luffa
- Species : Echinata

**Plant name in different languages :**

- English : Bristy luffa
- Sanskrit : Akhu vishaka, bandala, dali, chaturangaka
- Gujarati : Kukurvel,
- Hindi : Bindaal, Ghagarabela, bidali, kakora
- Marathi : Devatali
- Telgu : Paanibira, panibira

**Chemical constituents :**

- The dynamic constituents of the plant incorporate Saponins, Hentriacontane, Gypsogenin, Sapogenin Cucurbitacin-B and E,  $\beta$ -Sitosterol, Echinatol-An and B, Oleanolic corrosive, Elaterin glycoside, Chrysoeriol-7-glucoside, Sitosterol glycosides, Carbohydrate, Alkaloids, and so forth.
- The dynamic constituents like Cucurbitacin, Saponin, Echinatin, Stigmaterol,  $\beta$ -Sitosterol, Oleanolic acid and flavonoids have important

- Biological name : *Luffa echinata* Roxb.
- Family : Cucurbitaceae
- Parts used : Fruit

pathophysiological effects on the human body.

- *Luffa echinata* fruits contain Cucurbitacin B, Cucurbitacin E, Isocucurbitacin B, 2-deoxycucurbitacin B, Elaterin 2-O-B-D-Glucopyranoside, Two flavonoids glycoside,  $\beta$ - sitosterol glucoside, Graveobioside B, Luteolin, Oleanolic acid, Gypsogenin ,Elaterin, Chrysoeriol and  $\beta$ -Sitosterol, Saponin.
- *Luffa echinata* seeds contain Cucurbitacin B, Amarinin, Triterpene, Saponin, oleanic acid as sapogenin.

**Therapeutic used :**

- *Luffa echinata* Roxb. also protects oxidative damage of biomolecules and modulates antioxidant enzyme activity, Anti-arthritis activity, Hepatoprotective activity, anti-inflammatory, But so far no systemic study for Anti-asthmatic activity was reported. The Fruits of *Luffa echinata* ROXB. Contain phytosterols (like stigmaterol and  $\beta$ -sitosterol) which possess beneficial effect in immune-inflammatory disorders.
- Hence, phytosterols of *Luff echinata* ROXB. auto docked with IL-13 and their find out the binding affinity for asthmatic activity.

## DOCKING STUDIES

### Ligand and protein preparation

Phytosterols (like stigmasterol and  $\beta$ -sitosterol) of *Luffa echinata* ROXB. was selected for screening for against Anti-asthmatic activity, and its three-dimensional (3D) structure was retrieved from PubChem (<https://pubchem.ncbi.nlm.nih.gov/>) in the SDF format. They converted into PDB format by using Discovery Studio Visualizer (version 3.1). After that, the file was stored in pdbqt format to perform docking study.

Protein PDB ID 3L5X (crystal structure of IL-13 complexed with H2L6 FAB) structure was obtained from protein data bank ([www.rcsb.org](http://www.rcsb.org)). The crystal structure consists of chain H, chain L and chain A. The co-factor, chain H, chain L and water molecule removed and hydrogen was added then saved into pdb format by using Discovery Studio Visualizer (version 3.1). After that, the file was stored in pdbqt format to perform docking study Figure 2.

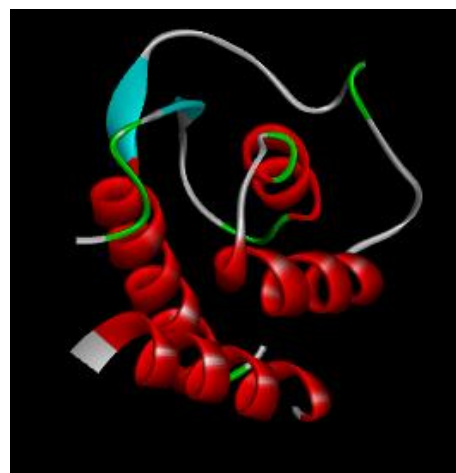
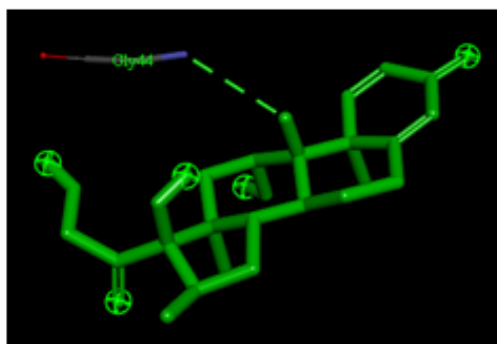


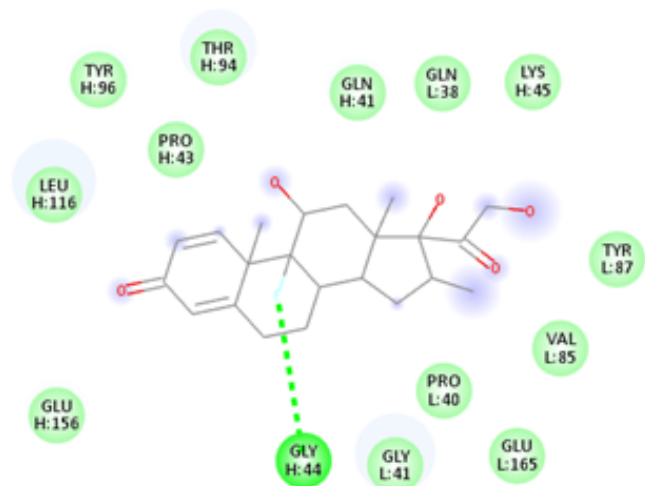
Figure 2 : Crystal structure of IL-13 (PDB ID 3L5X)

### Methodology of molecular docking

Using the AutoDock 4.2 docking programme, grid boxes sans water molecules were produced. The grid maps were centred on the appropriate ligand binding site in the protein structure. After docking was completed, an output file containing the ideal computational binding pose was generated. This output file was opened with Discovery Studio Visualizer (version 3.1), which built 3D and 2D ligand-receptor interaction modes using the relevant receptor (PDB ID : 3L5X).



(A)



(B)

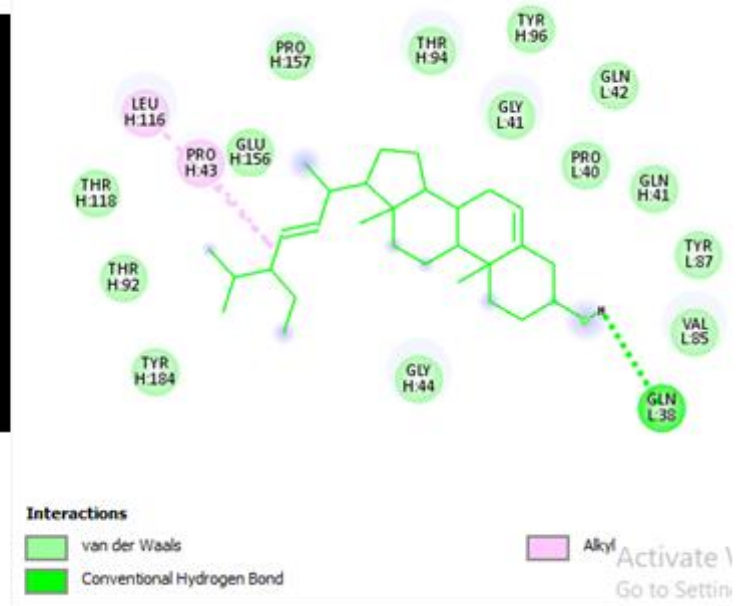
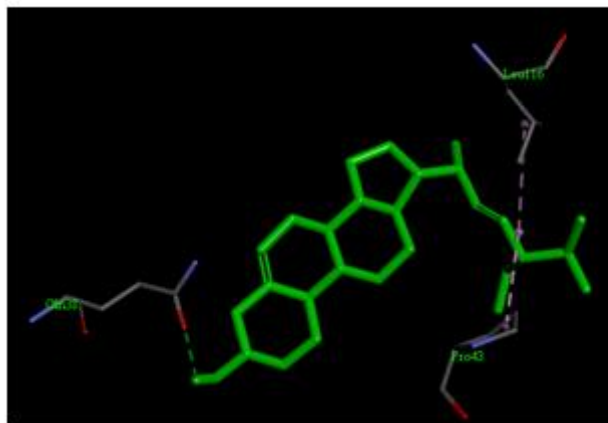
Interactions  
van der Waals

Conventional Hydrogen Bond

Figure 3. Binding interaction of Dexamethasone (A) 3D docked view (B) 2D docked view

Binding affinity of Dexamethasone is -6.0 kcal/mol and Binding interaction showed fluorine atom formed conventional hydrogen bond with GLY H:44 and other vander waals interaction are formed Figure 3.





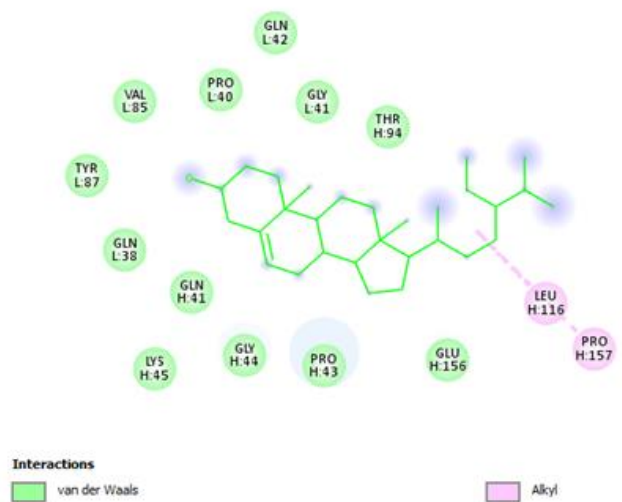
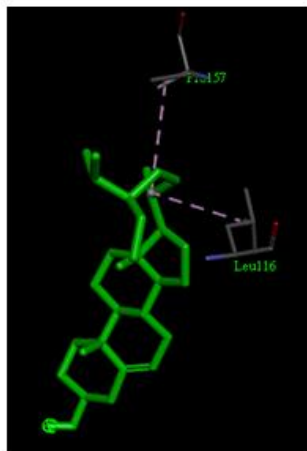
(A)

(B)

**Figure 4. Binding interaction of stigmasterol (A) 3D docked view (B) 2D docked view**

Binding affinity of stigmasterol -6.4 kcal/mol and interaction of stigmasterol indicated hydroxyl group formed

conventional hydrogen bond with GLN L:38 and also shown alkyl interaction LEU H:116 and PRO H:43 Figure 4.



**Figure 5. Binding interaction of  $\beta$ -sitosterol (A) 3D docked view (B) 2D docked view**

Binding affinity of  $\beta$ -sitosterol -6.1 kcal/mol and interaction of  $\beta$ -sitosterol indicated vander waals bond and also formed alkyl bond with PRO H:157, LEU H:116 Figure 5.

(like stigmasterol and  $\beta$ -sitosterol), which are reported to possess beneficial effect in immune-inflammatory disorders. Here, the molecular docking study was performed for Anti-asthmatic activity of *Luffa Echinata* ROXB., The docking study showed that the phytosterols (stigmasterol and  $\beta$ -sitosterol) having a good binding affinity and well-accommodated in the active site of IL-13 compared to standard dexamethasone. The phytosterols to show a good affinity to the 3L5X receptor protein, which may be contributed by both van der Waal and hydrogen bonding interactions. Hence, based on the docking results, it can be confirmed that *Luffa echinata* ROXB. may inhibit IL-13 (3L5X) protein where the anti-asthmatic activity may be due

Phytosterols (like stigmasterol and  $\beta$ -sitosterol) have a best binding affinity and they are well accommodated in active site of IL-13 compared to dexamethasone. The binding affinity confirmed that the *Luffa echinata* ROXB. having potential to act as a anti-asthmatic activity.

### CONCLUSIONS

The Fruits of *Luffa Echinata* ROXB. contains phytosterols

to inhibition of 3L5X. Also, future study should focus on investigating *Luffa echinata* ROXB. against COVID-19, since it may be a potent compound against asthmatic patients suffering from viral infections.

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