1 **Anti-Inflammatory activity and *Insilco* Approaches on root extract of *Decalepis hamiltonii***
2 **Wight & Arn**

3 **ABSTRACT**

4 **Aims**: The present study was aimed to evaluate anti-inflammatory and antioxidant
5 potential of methanol root extract of *Decalepis hamiltonii*. **Results** The methanolic extract
6 showed *in vitro* anti-inflammatory activity inhibition cells 96.1%µg/ml. MTT (Thiazolyl Blue
7 Tetrazolium Bromide) assay was significant inhibited by the methanol (96.2) and inhibition
8 addition the Nitric oxide production 25µg/ml 95% inhibition. The methanol extract of *Decalepis*
9 *hamiltonii* shows a Thus, a very strong approach to In-silico docking and in vitro anti-
10 inflammatory study for whole with these compounds/extracts. **Conclusion.** From the study it is
11 concluded that the root extract of *Decalepis hamiltonii* showing a strong approach to *In-silico*
12 docking and anti inflammatory activity.

13

14 **Keywords:** *Decalepis hamiltonii;* .MTT (Thiazolyl Blue Tetrazolium Bromide); Nitric oxide;
15 Ferric reducing antioxidant power

16 **1. Introduction**

17 Medicinal plants have been used as age long remedies for human diseases because they
18 contain components of therapeutic value. The plants are naturally large source of antioxidants,
19 anticancer, antidiabetic agents they might be serve as leads for the development of novel drugs.
20 The research and analysis on plants employed as pain-relievers and anti-inflammatory agents in
21 traditional ethno medicine is one of the productive and logical strategies in the search for new
22 drugs [1-2]. Free radicals, which have one or more un-paired electrons (superoxide, hydroxyl,
23 peroxyl) are produced in normal or pathological cell metabolism and the compounds that can

24 scavenge free radicals have great potential in ameliorating the diseases and pathological cells [3-
25 6]. The increase in the prevalence of multiple drug resistance has shown down the development
26 of new synthetic anti-inflammatory drugs and the new drug is necessary to search for new anti-
27 inflammatory from alterative sources. Phytochemicals from medicinal plants showing anti-
28 inflammatory activities have the potential of filling this need because of the structures of
29 phytochemical different from those of the more studied and they're those of the more action may
30 too very likely differ [7]. In this growing interest, many of the phytochemical bioactive
31 compounds from medicinal plants have shown many pharmacological activities [8-11]
32 Inflammation are a pathological condition in which highly reactive species are produced. Nitric
33 oxide (NO) is a small diffusible molecule responsible for vasodilatation, neurotransmission and
34 inflammation. This molecule is produced by the organism at a basal concentration. Nevertheless,
35 under stimulation by pathogens, NO is generated in higher amounts by the inducible nitric oxide
36 synthase (iNOS) in activated macrophages. The over production of NO is involved in the
37 pathogenesis of septic shock, tissue damage, multiple organ dysfunctions and carcinogenesis
38 processes [12]. Natural products have contributed significantly towards the development of
39 modern medicine. Recently traditional medicine worldwide has been re-evaluated by extensive
40 research on different plant species and their active therapeutic principles. The rich wealth of
41 plant kingdom can represent a novel source of newer compounds with significant anti-
42 inflammatory activities. The major merits of herbal medicine seem to be their perceived efficacy,
43 low incidence of serious adverse effects, and low cost. This *Decalepis hamiltonii* (Wight& Arn),
44 popularly known as swallow root in English, belongs to the family *Asclepiadaceae*. It is a
45 climber with stout, smooth branches shrub and a native of the forests of Deccan peninsula and
46 Western Ghats of India. The leaves are curvaceous, orbicular or elliptical, with rounded tip. Its

47 tubers are consumed as the pickles and the juice for its alleged health promoting properties The
48 Root has a sweet sarsaparilla-like taste; contains 9.2% fleshy matter and 8% woody core [13]. In
49 this context the present research work is on antioxidant and anti-inflammatory activity of
50 Decalepis hamiltonii (Wight &Arn).

51

52 ## 2. Material and Methods

53 ### 2.1 Collection of material

54 The Root of *Decalepis hamiltonii* has been collected from kolli hills, Namakkal district of
55 Tamilnadu, India. The taxonomic identification of plant was done with comparing the Flora of
56 Presidency of Madras, by Gamble J.S., 1921.

57 ### 2.2 Preparation of solvent extraction

58 50gm of *Decalepis hamiltonii* root was packed in Soxhlet apparatus for extraction and
59 500 ml of methanol was used as solvent. Soxhlet was kept running for 72 hours, until the solvent
60 colour appears in the collection tube. Methanol was removed by evaporation using rotary vapour
61 at not more than 40°C. The residue was then placed in an oven at 40°C for about 48hours to
62 remove the moisture. The resulting dried mass was then powdered and used for further studies.

63 ### 2.3 Ferric Reducing Antioxidant Power

64 The Ferric reducing antioxidant power of different parts of the various crude extracts of
65 *Decalepis hamiltonii* was evaluated [14]. The samples were mixed with 2.5 ml of 0.2 M Phosphate
66 buffer (pH 6.6) and 2.5 ml of 1 per cent potassium ferric cyanide. After the mixture was incubated at 50
67 ºC for 20 min, 2.5 ml of 10 per cent Trichloroacetic acid, 2.5 ml distilled water and 0.5 ml of 0.1 per
68 cent ferric chloride was added and then the absorbance was measured at 700 nm against a blank. The

69 blank consist of all the reagents without the test sample. The reducing power of gallic acid was also
70 determined for a comparison. High absorbance of the reaction mixture indicates strong ferric reducing
71 antioxidant power.

72 **2.4 MTT assay**

73 The Peripheral blood mononuclear layer cell culture was trypsinized and the cell count
74 was adjusted to 1.0×10^5 cells/ml using medium containing 10% new born calf serum. To each
75 well of the 96 well micro titreplate, 0.1 mL of the diluted cell suspension (approximately 10,000
76 cells) was added. After 24 hours, when a partial monolayer was formed, the supernatant was
77 flicked off, washed the monolayer once and 100 µL of different drug concentrations was added
78 to the cells in microtitre plates. The plates were then incubated at 37°C for 3 days in 5% CO2
79 atmosphere and microscopic examination was carried out and observations recorded every 24
80 hours. After 72 hours, the drug solutions in the wells were discarded and 50 µL of MTT
81 (2mg/mL) prepared in Hank's balanced salt solution (HBSS) without phenol red was added to
82 each well. The plates were gently shaken and incubated for 3 hours at 37°C in 5% CO2
83 atmosphere. The supernatant was removed and 50 µL of propanol was added and the plates were
84 gently shaken to solubilize the formed formazan[15]. The absorbance was measured using a
85 microplate reader at a wavelength of 540 nm.

86 **2.5 Nitric Oxide Production**

87 The Nitric oxide (NO) production in cell culture were determined by measuring the
88 nitrite (NO_2) formation by using Griess assay [16]. Briefly, 100µL of griess reagent (Sigma-
89 Aldrich, USA) containing 1% sulfanilamide and 0.1% naphtylethyene diamine dihydrochloride
90 in 2.5% H_3PO_4 was added to 100 µl of cell culture supernatant and incubate for 15 minutes at
91 room temperature in the dark. The color density was measured at 540 nm using a microplate

92 reader (Molecular Devices, USA). A standard curve was generated in the same method using
93 $NaNO_2$.

94 The compounds namely 2-Hydroxy-4-methoxybenzaldehyde was identified by GC-MS
95 analysis were screened against the anti diabetic, anti inflammatory and cancer protein. The
96 compound details were retrieved from the Pubchem database and the chemical structures were
97 generated from SMILES notation (Simplified Molecular Input Line Entry Specification) by
98 using the Chemsketch Software (www.acdlabs.com).

99 **2.7 Protein Data Bank**

100 The Protein Data Bank (PDB) archive is the single worldwide repository of information
101 about the 3D structures of large biological molecules, including proteins and nucleic acids. The
102 Protein Data Bank (PDB) is a repository for the three-dimensional structural data of large
103 biological molecules, such as proteins and nucleic acids. The data, typically obtained by X-ray
104 crystallography or NMR spectroscopy and submitted by biologists and biochemists from around
105 the world, are freely accessible on the Internet via the websites of its member organizations
106 (PDBe, PDBj, and RCSB). The PDB is overseen by an organization called the Worldwide
107 Protein Data Bank, WWPDB.

108 **2.8 Preparation of protein structure**

109 The structural information of the macromolecules determined by x-ray crystallographic
110 and NMR methods are available in the PDB. The 3D structure protein Receptor (PDB I.D: 4IFI)
111 was downloaded from the Protein Data Bank (PDB) (http://www.rcsb.org/pdb/) the water
112 molecules were removed from protein file 4IFI before docking. Energy minimization by
113 applying for CHARMM (Chemistry at Harvard Macromolecular Mechanics) force fields, It's a

114 program for macromolecular dynamics; it can be used for energy minimization, normal modes
115 and crystal optimizations and also incorporates free energy methods for chemical and
116 conformational free energy calculations.

117 **2.9 PUBCHEM**

118 The Pubchem bioassay data (http://pubchem.ncbi.nlm.nih.gov) is a public repository for
119 biological Activities of small molecules and small interfering RNAs (siRNAs) hosted by the US
120 National Institutes of Health (NIH). It archives experimental descriptions of assays and
121 biological test results and makes the information freely accessible to the public. A Pubchem
122 Bioassay data entry includes an assay description, a summary and detailed test results. Each
123 assay record is linked to the molecular target, whenever possible, and is cross-referenced to other
124 National Center for Biotechnology Information (NCBI) database records. 'Related Bioassays'
125 are identified by examining the assay target relationship and activity profile of commonly tested
126 compounds. A key goal of PubChem Bioassay is to make the biological activity information
127 easily accessible through the NCBI information retrieval system- Entrez, and various web-based
128 PubChem services. An integrated suite of data analysis tools is available to optimize the utility of
129 the chemical structure and biological activity information within PubChem, enabling researchers
130 to aggregate, compare and analyze biological test results contributed by multiple organizations.
131 Describe the PubChem Bioassay database, including data model, bioassay deposition and
132 utilities that PubChem provides for searching, downloading and analyzing the biological activity
133 information.

134 **2.10 Preparation of Ligand structures**

135 The identified Chemical compound namely 2-Hydroxy-4-methoxybenzaldehyde was
136 derived from *Decalepis hamiltonii* Wight & arn and this compound structure were retrieved
137 from Pubchem online server both of these compounds were under investigation of Chemsketch
138 (Chemically intelligent drawing interface free ware developed by Advance Chemistry
139 Development, Inc., (http://www.acdlabs.com) was used to construct the structure of the ligands.
140 The ligand molecules were generated and the three dimensional optimizations were done and
141 then saved MOL file (a file format for holding information about the atoms, bonds, connectivity
142 and coordinates of a molecule).

143 **2.11 Drug likeliness prediction**

144 Ligand property was predicted by using "Lipinski drug Filters" (http://www.scfbio-
145 iitd.res.in/utility/LipinskiFilters.jsp). Lipinski rule of five helps in distinguishing drug-like and non-
146 drug-like properties and predicts high probability of success or failure due to drug likeliness for
147 molecules. The Lipinski filter helps in early preclinical assessment and thereby avoiding costly
148 late stage preclinical and clinical failures.

149 **2.12 Docking analysis:**

150 The docking analysis is performed by Argus lab 4.0.1 for the antidiabectic and cancer
151 protein interacts with Gas-Chromatography of *Decalepis hamiltonii* 2-Hydroxy-4-
152 methoxybenzaldehyde compound. The compound or ligand selected for based on Lipinski's rule of
153 five. Fitting points are added to hydrogen bonding groups on the protein. The interaction between
154 the binding pockets of target protein, antidiabetic protein and 3v6r inflammation protein and
155 investigation compound to find out the accurate binding model for the active site of protein. The
156 mechanism of ligand placement is based on binding site position. The protein ligand docking

157 energy values performance of this compound was based on the Scoring functions which is
158 implemented in docking program to make various assumptions and implications to fit best
159 complexes, which includes terms of hydrogen bonds employed by Argus lab 4.0.1 to rank the
160 docked bases and to assess the binding site and the number of rotatable bonds present.

161 **2.13 Ligand binding sites prediction**

162 After docking the docked structure was saved as ".Pdb" file and further explored to
163 predict the binding sites using "ligand explorer" software. The predicted binding sites, based on
164 the binding energy, and amino acids make up the binding cavity. Here ligand binding site
165 represents the site where the ligands most efficiently bind with the protein, among all the active
166 site.

167 **2.13 Discovery Studio Visualizer**

168 The docking results were visualized using Accelyrs Discovery Studio 4.1 Visualizer. The
169 discovery studio visualizer is also a free viewer that is designed to offer an interactive
170 environment for viewing and editing molecular structures, sequences, X-ray reflection data,
171 script and other data. DS Visualizer is handier for analyzing the docking results.

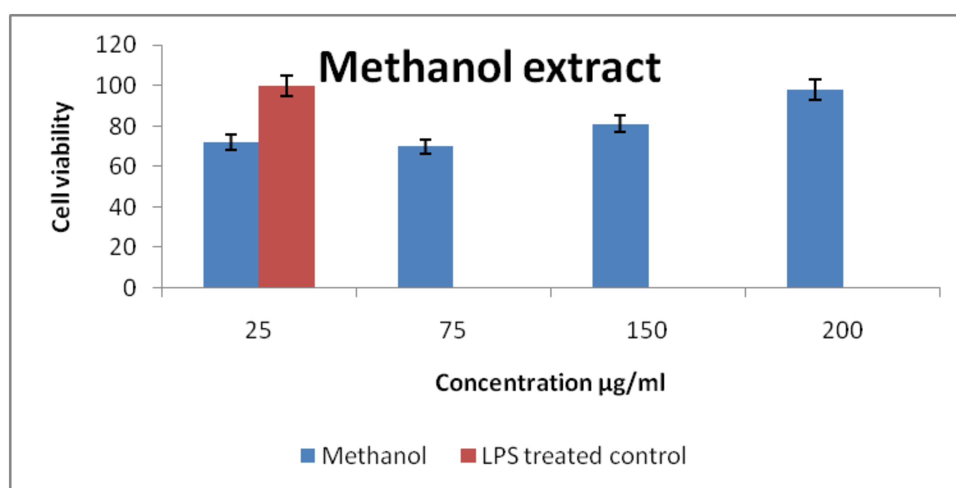
172 **3.0 Results and Discussion**

173 **3.1 In-vitro Cytotoxicity activity**

174 **Cytotoxicity effect of the root extract of *Decalepis hamiltonii* in Peripheral Blood**
175 **Mononuclear cells (PBMC)**

176 MTT (3-(4,5 dimethylthiazole- 2yl) - 2, 5-Diphenyl Tetrazolium Bromide) assay is
177 widely used in the *in vitro* evaluation of the biosafety of plant extracts. Determination of

178 cytotoxic effect of plant extracts is needed before studying the mechanism of action in various
179 cells / cell lines. The cytotoxicity activity of methanolic root extract of *Decalepis hamiltonii* on
180 cell viability was determined using cell line culture at various concentrations is shown in Fig 1.
181 The values of cell viability were found to be in the range of 68% to 98% at various concentrations
182 tested. The highest concentration of 200µg/ml showed moderate Cytoxicity. Cell viability was
183 evaluated by MTT assay, hence the concentrations of sample (cell viability ≥90) were selected for
184 subsequent iNOS inhibition experiment.



185

186 Results are expressed as mean ± Standard deviation

187 **Figure. 1 Cytotoxicity effect of the root extract of *Decalepis hamiltonii***

188 **3.2 Inhibition of Lipopolysaccharide – induced iNOS production by root extracts**

189 To investigate the inhibitory effects of the methanolic extracts from the LPS–induced
190 iNOS production in peripheral blood mononuclear cell (PBMC) the accumulation of iNOS in
191 the culture medium is measured. As shown in Figure 2, root extracts significantly suppressed
192 LPS-induced iNOS product in a dose-dependent manner. The root extract at 75µg/ml
193 significantly inhibited the production of iNOS up to 90.2±0.86.

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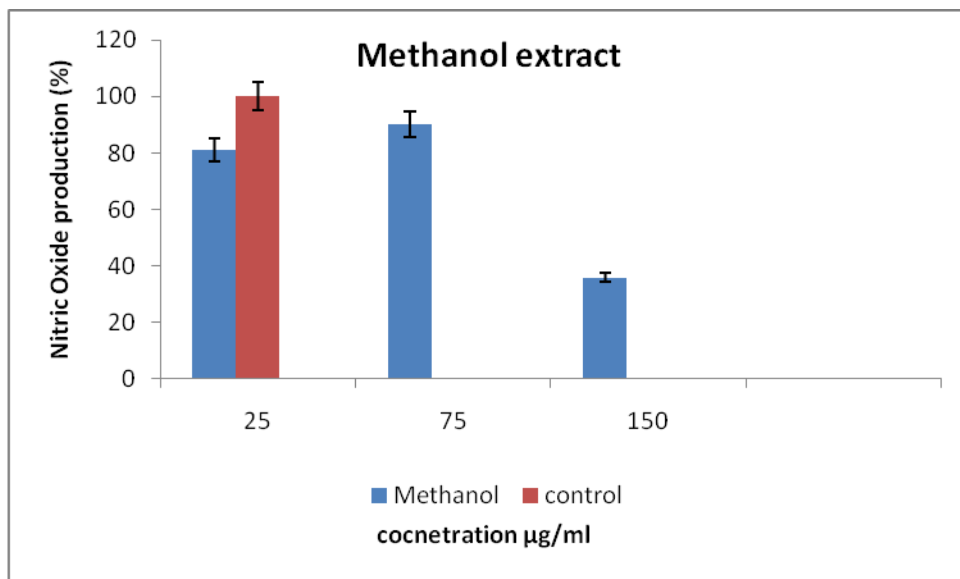

195 Results are expressed as means ± standard deviation

196 **Fig. 2 Nitric oxide effect of the root extract of *Decalepis hamiltonii***

197 3.3 **Ferric reducing antioxidant power**

198 Ferric reducing antioxidant power of Petroleum ether, Chloroform, Ethyl acetate and
199 Methanol extracts of root plant parts of *Decalepis hamiltonii* is shown in Fig. 3. IC_{50} values were
200 calculated as the amount of antioxidant present in the sample necessary to decrease the initial
201 ferric reducing antioxidant concentration by 50%. Petroleum ether, Chloroform, Ethyl acetate
202 and Methanol root extracts of *Decalepis hamiltonii* exhibited the highest activity. The IC_{50}
203 values of Methanol extracts of *Decalepis* root and Gallic acid values were 392.7, 442.5, 311.4
204 and 171.02 µg/ml respectively.

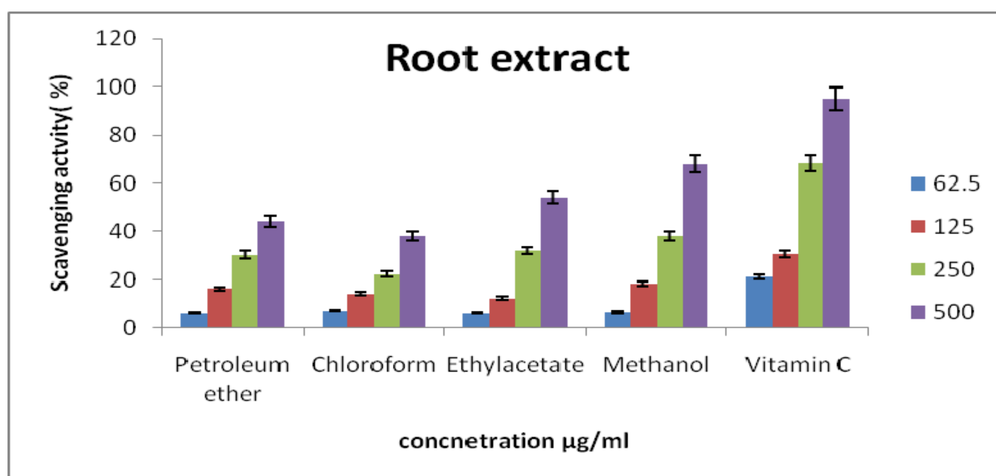

Fig. 3 In silico* analysis of anti- inflammatory activity of 2-hydroxy-4-methoxybenzaldehyde from root extract of *Decalepis hamiltonii

The molecular interaction between the ligand and the protein (receptor) was investigated using the Ligand fit protocol. The 2-Hydroxy- 4 -Methoxy Benzaldehyde was docked with active site inflammation receptor protein 3V6R-docking energy-17.45 kcal/mol. 3D structure and 2D structure interaction to interact with Targeted protein; amino acid region and distance. The docking studies further confirmed the anti-diabetic property of the bioactive compounds via GC-MS analysis and suggested that first time demonstrated a strong 3v6r (Inflammation) inhibitory property of this extract, maybe due to the identified bioactive compounds (Figure.4).

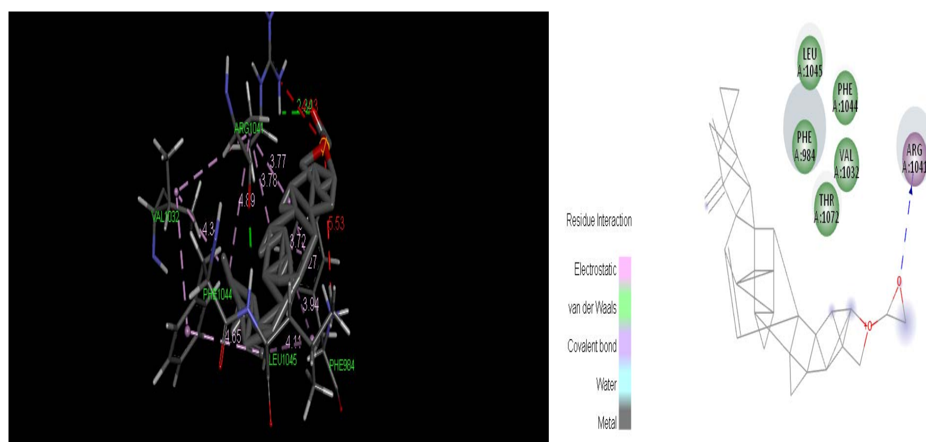

Figure.4 3D and 2D structures for amino acid regions for 2-Hydroxy-4- Methoxy Benzaldehyde interact with Targeted protein

In the present study methanolic root extract of *Decalepis hamiltonii* was found to have maximum inhibition concentration (99.5% at 200 µg/ml. Similar results were observed [17], who had shown moderate cytotoxicity of *Polygonum chinensis* extracts (400- 125 µg/ml). [18] also compared root, stem and leaf extracts of *Jatropha curcas* in anti-inflammatory activity study towards carrageen an induced *rat paw edema*. Groups of albino rats were injected by inflammation inducer (Carrageenan) and the levels of inflammation mediators (histamine, serotonin and kinin) were monitored. Their results showed that root extract inhibited histamine, serotonin and kinin released up to 70% - 80% compared to leaf (50% - 55%) and stem (40% - 45%). However, these studies did not indicate the nature of compounds involved in the anti-inflammatory activity.

Ferric reducing properties are generally depend on the presence of reductions which have been shown to exert antioxidant activity by breaking the free radical chain by donating a hydrogen atom [19].The present study of the ferric radical activity of the all the extracts of the *Decalepis hamiltonii* leaves, stem and root were analyzed. The root extract was found to increase in a concentration depended manner. Among all the four extracts, methanol root extract was recorded the highest scavenging activity of 78.0% at a concentration of 500µg/ml. The results suggest that methanol extracts have more reducing power than ethyl acetate, petroleum ether and chloroform but not as efficient as standard gallic acid. Similar type of work has also been carried out in *Azima tetracantha* [20]. It is believed that antioxidant activity and reducing power are related [21]. Reuctones donate a hydrogen atom and inhibit LPO by donating a hydrogen. Atom and there by terminating the free radical chain reaction [22].

3.5 Conclusion

Thus, a very strong approach to *In-silico* docking and in vitro anti-inflammatory study for whole with these compounds/extracts. Further studies regarding isolation and characterization of bioactive principles responsible for this action may be further carried out in future.

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