Computer-Aided Screening and Comprehensive Evaluation of Drug-Like Properties of *Curcuma longa* Phytochemicals

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***Abstract* - The current study focuses on the computer-assisted assessment of phytochemicals from *Curcuma longa*, a medicinal plant well known for its therapeutic value, for drug-like qualities. Using in silico methods, 177 phytoconstituents were examined to determine their appropriateness as possible therapeutic options. The MolSoft platform was used to assess important physicochemical metrics, such as molecular weight (MW), estimated partition coefficient (cLog P), hydrogen bond acceptors (HBA), hydrogen bond donors (HBD), Lipinski's rule of five (RO5) violations, and drug-likeness score (DLS).**

The results of the investigation showed that most of the compounds had positive properties for oral bioavailability since they met the suggested thresholds for molecular weight, hydrogen bonding capacity, and RO5 compliance. Despite improving membrane permeability, a number of compounds showed high lipophilicity (cLog P > 5), which may have a negative impact on water solubility. As is common for natural compounds, drug-likeness score analysis revealed mostly negative values; however, few phytochemicals, including ascorbic acid, β-sitosterol, stigmasterol, vitamin E, and xanthorrhizol, showed comparatively higher scores. The results indicate that a number of *Curcuma longa* phytochemicals have promise drug-like characteristics, while some need structural tweaking to enhance pharmacokinetic qualities. This study supports the promise of compounds produced from turmeric for more pharmacological research and emphasizes the usefulness of computational methods in early-stage drug discovery.

***Key Words* - Drug-likeness, In silico analysis, Lipinski's rule of five, Phytochemicals, *Curcuma longa*.**

I. INTRODUCTION

Curcuma longa, commonly known as turmeric, is a perennial herb of the family Zingiberaceae. It is widely valued as a culinary spice and as an important medicinal plant in many traditional healthcare systems. The rhizome of turmeric contains several bioactive constituents, of which curcumin is the most studied. Curcumin is a polyphenolic compound reported to possess a broad range of biological activities and has been incorporated into formulations such as tablets, capsules, topical preparations, beverages, and cosmetic products. In traditional Chinese medicine, turmeric has been employed for inflammatory disorders, sore throat, skin diseases, and liver-related ailments. In Ayurveda, it is described for properties such as Kustaghna, Visaghna, and Lekhaniya, indicating dermatological, detoxifying, and metabolic benefits. [1-3]

For any compound to be considered a promising oral drug candidate, it should demonstrate suitable physicochemical and pharmacokinetic characteristics. Parameters such as aqueous solubility, membrane permeability, and systemic bioavailability play a major role in determining therapeutic success. These factors are collectively related to ADME behavior, namely absorption, distribution, metabolism, and excretion. One of the most accepted screening models for evaluating oral drug-likeness is Lipinski's Rule of Five, which considers molecular weight, lipophilicity, hydrogen bond donors, and hydrogen bond acceptors. Molecules that violate multiple criteria may show poor intestinal absorption or limited permeability[4]. Therefore, early-stage assessment of these properties is essential in identifying suitable lead compounds from natural sources[5].

Modern drug discovery increasingly relies on computational tools to reduce time, cost, and experimental burden. Computer-aided drug design methods assist in predicting molecular behavior, biological affinity, and pharmacokinetic suitability before laboratory testing. *Curcuma longa* contains numerous phytochemicals such as curcumin,

demethoxycurcumin, bisdemethoxycurcumin, turmerones, and related terpenoids. These compounds have been associated with antioxidant, anti-inflammatory, antimicrobial, and anticancer activities. [6,7] Because of such diverse pharmacological potential, turmeric-derived molecules are attractive candidates for virtual screening studies.

Several online platforms, including SwissADME, Molinspiration, and related tools, are commonly used to estimate molecular descriptors such as logP, topological polar surface area, and oral bioavailability. [8] Molecular docking is another valuable in silico approach that predicts ligand interaction with biological targets, while QSAR models correlate chemical structure with biological response. [9,10] Previous studies have shown favorable interactions of curcumin with targets such as NF-κB, COX-2, and EGFR, supporting its therapeutic relevance. [11,12] However, computational predictions must always be interpreted carefully and confirmed experimentally, since model accuracy depends on data quality and algorithm selection. [10,13]

Although turmeric has been extensively studied, a systematic evaluation of a large number of *Curcuma longa* phytochemicals for drug-likeness remains limited. Hence, the present work aims to assess selected phytoconstituents using computer-assisted methods to identify molecules with favorable oral drug-like properties and potential for further pharmaceutical development.

II. MATERIALS AND METHODS

Software's and Servers used

Canonical smiles are gathered and SDF files are downloaded using the Pubchem database. Drug likeness is determined using Molsoft software. [14, 15]

List of Phytochemicals

The phytochemicals used in the proposed research work are (-)-alpha-Thujene, (-)-beta-Curcumene, (-)-cis-Carveol, (+)-alpha-Cadinene, (+)-beta-Phellandrene, (+)-cis-Sabinol, (+)-Curcumenol, (+)-delta-Cadinene, (4S,5S)-Germacrone-4,5-epoxide, (E)-beta-ocimene, (E)-gamma-Bisabolene, (E)-Tagetenone, (Z)-beta-Ocimene, (Z)-Methyl jasmonate, 10-epi-gamma-Eudesmol, 1-Bisabolone, Propyl vinyl carbinol, 1-Undecanol, 2-(HydroxSymethyl) anthraquinone, p-Menth-2-en-1-ol, Carvyl acetate (Z), 2-Decanol, Linalool oxide B, 2-Heptanol, 2-Heptanone, Turmeronol B, 2-Methylisoborneol, 2-Nonanol, 2-Nonanone, 2-Octanol, 2-Undecanol, 2-Undecanone, 3,7(11)-Eudesmadiene, 3-Buten-2-OL, 3-Carene, 4,10-Epizedoarondiol, 4-Carvomenthenol, 4-Isopropylbenzyl alcohol, 4'-Methylacetophenone, 5-Hydroxy-p-menth-6-en-2-one, 6-Epi-beta-bisabolol, Allo-Aromadendrene, alpha-Atlantone, alpha-Bergamotene, alpha-Curcumene, alpha-Farnesene, alpha-Fenchene, alpha-Fenchol, alpha-Guaiene, alpha-Muurolene, alpha-Phellandrene, alpha-Pinene, alpha-Selinene, alpha-Terpinene, alpha-Terpineol, alpha-Turmerone, Anethole, ar-Turmerone, Ascorbic acid, beta-Bisabolene, beta-Caryophyllene, beta-Elemene, beta-Eudesmol, beta-Farnesene, beta-Himachalene, beta-Patchoulene, beta-Pinene, beta-Sitosterol, Bisabola-3,10-diene-2-one, Bisabolane, Bisacumol, Bisacurone, Bisdemethoxy Curcumin, Butylated hydroxytoluene, Campesterol, Camphene, Camphene hydrate, Camphor, Carvacrol, Carvone, Caryophyllene oxide, Cedrelanol, Cinnamaldehyde, Cinnamyl cinnamate, Blatter alcohol, 3-Hexenyl Acetate, cis-alpha-Bergamotene, cis-beta-Farnesene, cis-Carvotanacetol, cis-Nerolidol, Citral, Curcumenone, Curcumol, Curcuphenol, Curlone, Curzerene, Curzerenone, Cyclocurcumin, cymene-9-ol, d-Borneol, Decanoic acid, Dehydrocurdione, Dehydro-p-cymene, delta-Curcumene, delta-Elemene, Demethoxy Curcumin, Elemicin, Epiprocurcumenol, Eucalyptol, Eugenol, Farnesol, Furanodienon, gamma-Elemene, gamma-Terpinene, Geraniol, Geranyl acetate, Geranyl butyrate, Geranyl formate, Geranyl hexanoate, Germacr-1(10)-ene-5,8-dione, Germacrene B, Germacrone, Heptyl salicylate, Humuladienone, Humulene, Humulene epoxide II, Isobornyl acetate, Isogermacrene D, Isoledene, Isoprocurcumenol, Letestuianin B, Levomenol, Limonene, Linalool, Linalyl acetate, Linalyl isobutyrate, Linalyl propionate, Methyleugenol, Myrcene, Myrtenal, Myrtenol, Neral, Nerolidol, O-Cymene, Oleoresin turmeric, p-Cymene, Perilla ketone, Piperine, Piperitone, p-Mentha-1,3,8-triene, Procurcumadiol, Procurcumenol, Pulegone, Sabinene, Sabinyl acetate, Safrole, Sesquiphellandrene, Sesquisabinene, Stigmasterol, tau-Cadinol, Terpinolene, Tetradecane, Tetrahydro-Bisdemethoxy-Diferuloyl-methane, Thymol, Thymol acetate, Toluene, trans-alpha-Bergamotene, trans-Linalool oxide, trans-Sesquisabinene hydrate, Tricyclene, Tridecane,

Turmerol, Turmeronol A, Viridiflorol, Vitamin E, Xanthorrhizol, Zingiberene [16, 17].

Retrieval of Canonical SMILES for Selected Phytochemicals from PubChem

To obtain the canonical SMILES of the selected phytochemicals, the PubChem database was utilized. Each phytochemical was individually searched by entering its name into the search bar. After identifying the correct compound from the results, its detailed compound summary page was opened. Within this page, the "Chemical and Physical Properties" section was examined, where the "Canonical SMILES" entry is typically listed under "Molecular Descriptors." The SMILES notation was then recorded, and this procedure was systematically repeated for all selected phytochemicals.

Calculating the Drug Likeness Score

The drug-like properties of phytocompounds were predicted using MolSoft web servers (https://molsoft.com/mprop/). Lipinski's rule of five, which specifies that molecules should have a molecular weight of 500, a C logP of 5, less than 10 hydrogen bond acceptors, and less than 5 hydrogen bond donors, was used to calculate drug-like properties. The canonical simplified molecular line-entry systems (SMILES) were obtained from PubChem and entered into the MolSoft online server in order to predict drug-like properties of compounds [18-21].

III. RESULTS

Molecular weight (MW), hydrogen bond acceptors (HBA), hydrogen bond donors (HBD), Clog P, violations of Lipinski`s rule of five (RO5), and drug likeness score (DLS) were among the criteria used to assess the drug-likeness of phytochemicals from *Curcuma longa* (Table 1). The majority of compounds showed favorable absorption and interaction potential, with MW < 500 Da and acceptable HBA and HBD values. Despite improving membrane permeability, a number of compounds displayed high Clog P (>5), indicating enhanced lipophilicity, which may decrease water solubility. Only a small number of phytochemicals showed several breaches that could restrict bioavailability, whereas the majority of phytochemicals comply with Lipinski`s rule of five (RO5), displaying zero or one violation. Compounds including ascorbic acid, beta-sitosterol, stigmasterol, vitamin E, and xanthorrhizol had comparatively higher scores, although overall DLS values were negative, indicating moderate drug-likeness. Many phytochemicals satisfy the fundamental requirements for drug-likeness, their therapeutic potential may be limited by high lipophilicity and low DLS, underscoring the need for more modification.

Table 1: Drug Likeness Profile of Phytochemicals

Sl.	Phytochemicals	MW	Clog *P*	HBA	HBD	Number of Violations	DLS
		<500	<5	<10	<5	<1	<1.0
1	(-)-alpha-Thujene	136.13	3.27	0	0	0	-0.94
2	(-)-beta-Curcumene	204.19	6.13	0	0	1	-0.78
3	(-)-cis-Carveol	152.12	3.14	1	1	0	-1.22
4	(+)-alpha-Cadinene	204.19	5.55	0	0	1	-0.88
5	(+)-beta-Phellandrene	136.13	3.76	0	0	0	-1.35
6	(+)-cis-Sabinol	152.12	1.89	1	1	0	-1.26
7	(+)-Curcumenol	234.16	3.71	2	1	0	-1.09
8	(+)-delta-Cadinene	204.19	5.48	0	0	1	-1.1
9	(4S,5S)-Germacrone-4,5-epoxide	234.16	3.97	2	0	0	-1.31
10	(E)-beta-ocimene	136.13	4.32	0	0	0	-1.63
11	(E)-gamma-Bisabolene	204.19	6.28	0	0	1	-0.58
12	(E)-Tagetenone	150.1	2.91	1	0	0	-1.95

13	(Z)-beta-Ocimene	136.13	4.32	0	0	0	-1.63
14	(Z)-Methyl jasmonate	210.13	2.42	3	0	0	-0.54
15	10-epi-gamma-Eudesmol	222.2	4.25	1	1	0	0.02
16	1-Bisabolone	220.18	4.96	1	0	0	0.22
17	Propylvinylcarbinol	100.09	1.69	1	1	0	-1.34
18	1-Undecanol	172.18	4.62	1	1	0	-0.92
19	2-(Hydroxymethyl)anthraquinone	238.06	2.72	3	1	0	-0.53
20	p-Menth-2-en-1-ol	154.14	2.71	1	1	0	-0.82
21	Carvyl acetate (Z)	194.13	3.69	2	0	0	-1.12
22	2-Decanol	158.17	3.89	1	1	0	-1.16
23	Linalool oxide B	170.13	2.47	2	1	0	-1.29
24	2-Heptanol	116.12	2.37	1	1	0	-1.16
25	2-Heptanone	114.1	1.96	1	0	0	-1.28
26	Turmeronol B	232.15	4.09	2	1	0	-0.23
27	2-Methylisoborneol	168.15	2.5	1	1	0	-1.32
28	2-Nonanol	144.15	3.38	1	1	0	-1.16
29	2-Nonanone	142.14	2.98	1	0	0	-1.28
30	2-Octanol	130.14	2.88	1	1	0	-1.16
31	2-Undecanol	172.18	4.39	1	1	0	-1.16
32	2-Undecanone	170.17	3.99	1	0	0	-1.28
33	3,7(11)-Eudesmadiene	204.19	5.30	0	0	1	-0.4
34	3-Buten-2-OL	72.06	0.8	1	1	0	-1.09
35	3-Carene	136.13	4.47	0	0	0	-1.47
36	4,10-Epizedoarondiol	252.17	2.24	3	2	0	-0.5
37	4-Carvomenthenol	154.14	3.39	1	1	0	-0.11
38	4-Isopropylbenzyl alcohol	150.1	2.68	1	1	0	-1.47
39	4'-Methylacetophenone	134.07	2.24	1	0	0	-1.92
40	5-Hydroxy-p-menth-6-en-2-one	168.12	1.91	2	1	0	-0.75
41	6-Epi-beta-bisabolol	222.2	5.22	1	1	1	0.48
42	Allo-Aromadendrene	204.19	5.22	0	0	1	-1.3
43	alpha-Atlantone	218.17	4.88	1	0	0	-0.99
44	alpha-Bergamotene	204.19	5.63	0	0	1	-0.54
45	alpha-Curcumene	202.17	6.01	0	0	1	-0.19
46	alpha-Farnesene	204.19	6.51	0	0	1	-1.47
47	alpha-Fenchene	136.13	3.8	0	0	0	-1.58
48	alpha-Fenchol	154.14	3.08	1	1	0	-1.38

49	alpha-Guaiene	204.19	4.93	0	0	0	-1.24
50	alpha-Muurolene	204.19	5.55	0	0	1	-0.88
51	alpha-Phellandrene	136.13	4.01	0	0	0	-1.23
52	alpha-Pinene	136.13	4.49	0	0	0	-1.45
53	alpha-Selinene	204.19	5.59	0	0	1	-0.77
54	alpha-Terpinene	136.13	4.23	0	0	0	-1.3
55	alpha-Terpineol	154.14	3.3	1	1	0	-1.05
56	alpha-Turmerone	218.17	4.64	1	0	0	-1.09
57	Anethole	148.09	3.27	1	0	0	-1.68
58	ar-Turmerone	216.15	4.7	1	0	0	-0.67
59	Ascorbic acid	176.03	-1.59	6	4	0	0.74
60	beta-Bisabolene	204.19	6.14	0	0	1	-0.71
61	beta-Caryophyllene	204.19	5.35	0	0	1	-1.74
62	beta-Elemene	204.19	5.84	0	0	1	-1.15
63	beta-Eudesmol	222.2	4.37	1	1	0	-0.6
64	beta-Farnesene	204.19	6.26	0	0	1	-1.45
65	beta-Himachalene	204.19	5.44	0	0	1	-1.34
66	beta-Patchoulene	204.19	4.43	0	0	0	0
67	beta-Pinene	136.13	4.14	0	0	0	-1.39
68	beta-Sitosterol	414.39	8.45	1	1	1	0.78
69	Bisabola-3,10-diene-2-one	220.18	4.96	1	0	0	0.22
70	Bisabolane	210.23	6.86	0	0	1	-1.18
71	Bisacumol	218.17	4.63	1	1	0	-0.36
72	Bisacurone	252.17	2.65	3	2	0	-0.9
73	Bisdemethoxycurcumin	308.1	2.93	4	2	0	-1.04
74	Butylated hydroxytoluene	220.18	4.78	1	1	0	-1.5
75	Campesterol	400.37	7.87	1	1	1	0.59
76	Camphene	136.13	4.1	0	0	0	-1.32
77	Camphene hydrate	154.14	3.4	1	1	0	-0.43
78	Camphor	152.12	2.34	1	0	0	0.11
79	Carvacrol	150.1	3.44	1	1	0	-0.35
80	Carvone	150.1	2.99	1	0	0	-1.4
81	Caryophyllene oxide	220.18	3.97	1	0	0	-1.5
82	Cedrelanol	222.2	4.27	1	1	0	-0.43
83	Cinnamaldehyde	132.06	2.1	1	0	0	-1.54
84	Cinnamyl cinnamate	264.12	4.92	2	0	0	-1.45
85	Blatteralkohol	100.09	1.53	1	1	0	-1.15

86	3-Hexenylacetate	142.1	2.24	2	0	0	-1.07
87	cis-alpha-Bergamotene	204.19	5.63	0	0	1	-0.54
88	cis-beta-Farnesene	204.19	6.26	0	0	1	-1.45
89	cis-Carvotanacetol	154.14	3.03	1	1	0	-0.81
90	cis-Nerolidol	222.2	5.14	1	1	1	-1.03
91	Citral	152.12	3.47	1	0	0	-1.15
92	Curcumenone	234.16	2.73	2	0	0	-0.49
93	Curcumol	236.18	3.69	2	1	0	-1.44
94	Curcuphenol	218.17	5.24	1	1	1	0.28
95	Curlone	218.17	4.4	1	0	0	-1.03
96	Curzerene	218.17	4.74	1	0	0	-0.93
97	Curzerenone	230.13	3.91	2	0	0	-0.32
98	Cyclocurcumin	368.13	2.93	6	2	0	0.44
99	cymene-9-ol	150.1	2.79	1	1	0	-0.89
100	d-Borneol	154.14	3	1	1	0	-0.51
101	Decanoic acid	172.15	3.6	2	1	0	-0.54
102	Dehydrocurdione	234.16	3.91	2	0	0	-1.39
103	Dehydro-p-cymene	132.09	3.68	0	0	0	-2.12
104	delta-Curcumene	204.19	5.97	0	0	1	-0.6
105	delta-Elemene	204.19	5.51	0	0	1	-1.19
106	Demethoxycurcumin	338.12	2.88	5	2	0	-0.66
107	Elemicin	208.11	2.71	3	0	0	-1.37
108	Epiprocurcumenol	234.16	3.32	2	1	0	-0.15
109	Eucalyptol	154.14	2.61	1	0	0	-1.04
110	Eugenol	164.08	2.21	2	1	0	-0.74
111	Farnesol	222.2	5.53	1	1	1	-1.17
112	Furanodienon	230.13	4.55	2	0	0	-0.34
113	gamma-Elemene	204.19	5.54	0	0	1	-0.69
114	gamma-Terpinene	136.13	4.46	0	0	0	-1.64
115	Geraniol	154.14	3.46	1	1	0	-1.17
116	Geranyl acetate	196.15	4.07	2	0	0	-1.13
117	Geranyl butyrate	224.18	5.09	2	0	1	-1.01
118	Geranyl formate	182.13	3.68	2	0	0	-0.94
119	Geranyl hexanoate	252.21	6.06	2	0	1	-0.71
120	Germacr-1(10)-ene-5,8-dione	236.18	3.83	2	0	0	-1.45
121	Germacrene B	204.19	6.49	0	0	1	-1.6
122	Germacrone	218.17	5.40	1	0	1	-1.55

123	Heptyl salicylate	236.14	5.63	3	1	1	0.34
124	Humuladienone	220.18	4.81	1	0	0	-1.45
125	Humulene	204.19	6.23	0	0	1	-1.42
126	Humulene epoxide II	220.18	4.72	1	0	0	-1.64
127	Isobornyl acetate	196.15	3.36	2	0	0	-0.04
128	Isogermacrene D	204.19	5.84	0	0	1	-1.69
129	Isoledene	204.19	4.42	0	0	0	-1.21
130	Isoprocurcumenol	234.16	3.25	2	1	0	-0.73
131	Letestuianin B	370.14	2.58	6	2	0	-0.64
132	Levomenol	222.2	5.08	1	1	1	0.07
133	Limonene	136.13	4.53	0	0	0	-1.54
134	Linalool	154.14	3.07	1	1	0	-0.99
135	Linalyl acetate	196.15	3.7	2	0	0	-1.01
136	Linalyl isobutyrate	224.18	4.68	2	0	0	-1.14
137	Linalyl propionate	210.16	4.15	2	0	0	-1.01
138	Methyleugenol	178.1	2.59	2	0	0	-1.08
139	Myrcene	136.13	4.18	0	0	0	-1.38
140	Myrtenal	150.1	3.17	1	0	0	-1.55
141	Myrtenol	152.12	3.22	1	1	0	-1.3
142	Neral	152.12	3.47	1	0	0	-1.15
143	Nerolidol	222.2	5.14	1	1	1	-1.03
144	O-Cymene	134.11	3.72	0	0	0	-1.35
145	Oleoresin tumeric	1014.4	8.2	15	6	2	-0.66
146	p-Cymene	134.11	4.05	0	0	0	-1.65
147	Perilla ketone	166.1	2.92	2	0	0	-0.83
148	Piperine	285.14	3.47	3	0	0	-0.16
149	Piperitone	152.12	2.92	1	0	0	-0.5
150	p-Mentha-1,3,8-triene	134.11	3.75	0	0	0	-1.73
151	Procurcumadiol	250.16	2.19	3	2	0	-0.04
152	Procurcumenol	234.16	3.32	2	1	0	-0.15
153	Pulegone	152.12	3.08	1	0	0	-1.02
154	Sabinene	136.13	3.15	0	0	0	-0.87
155	Sabinyl acetate	194.13	2.38	2	0	0	-0.83
156	Safrole	162.07	2.94	2	0	0	-1.28
157	Sesquiphellandrene	204.19	5.72	0	0	1	-0.58
158	Sesquisabinene	204.19	4.95	0	0	0	-0.08
159	Stigmasterol	412.37	7.74	1	1	1	0.62

160	tau-Cadinol	222.2	4.27	1	1	0	-0.43
161	Terpinolene	136.13	4.42	0	0	0	-1.43
162	Tetradecane	198.23	7.86	0	0	1	-1.03
163	Tetrahydrobisdemethoxydiferuloylmethane	312.14	3.18	4	2	0	-1.23
164	Thymol	150.1	3.43	1	1	0	-0.54
165	Thymol acetate	192.12	3.61	2	0	0	0.07
166	Toluene	92.06	2.74	0	0	0	-1.69
167	trans-alpha-Bergamotene	204.19	5.63	0	0	1	-0.54
168	trans-Linalool oxide	170.13	2.47	2	1	0	-1.29
169	trans-Sesquisabinene hydrate	222.2	3.94	1	1	0	-0.28
170	Tricyclene	136.13	3.48	0	0	0	-1.15
171	Tridecane	184.22	7.36	0	0	1	-1.03
172	Turmerol	220.18	4.95	1	1	0	-0.75
173	Turmeronol A	232.15	3.86	2	1	0	0
174	Viridiflorol	222.2	4.16	1	1	0	-1.14
175	Vitamin E	430.38	10.08	2	1	1	0.48
176	Xanthorrhizol	218.17	5.17	1	1	1	0.52
177	Zingiberene	204.19	5.97	0	0	1	-0.6

Assessment of *Curcuma longa* Phytochemicals' Drug-Likeness Properties

The drug-likeness of *Curcuma longa* phytochemicals was evaluated using key physicochemical parameters influencing oral absorption and pharmacokinetics. The selected criteria included molecular weight (MW), cLog P, hydrogen bond acceptors (HBA), hydrogen bond donors (HBD), Lipinski's rule of five (RO5) violations, and drug-likeness score (DLS). These parameters help identify compounds with favorable characteristics for drug development.

Most of the analyzed compounds had molecular weights below 500 Da, indicating good potential for absorption and distribution. However, a few larger constituents, such as turmeric oleoresin, exceeded this limit and may show reduced bioavailability. cLog P values varied considerably; many compounds remained within the acceptable range (≤5), suggesting balanced lipophilicity and membrane permeability. In contrast, sterols and hydrocarbon-rich molecules exhibited higher cLog P values, which may reduce aqueous solubility.

Hydrogen bonding analysis showed that most compounds complied with recommended HBA (≤10) and HBD (≤5) limits, supporting suitable permeability and solubility. Lipinski screening further revealed that the majority of compounds had zero or one violation, indicating acceptable oral drug-likeness. Although several compounds displayed negative DLS values, which is common for natural products, some constituents such as ascorbic acid, vitamin E, stigmasterol, and β-sitosterol showed comparatively better scores. Overall, many turmeric phytochemicals possess promising drug-like properties, while some may require structural modification or formulation improvement for enhanced therapeutic application.

IV. DISCUSSION

The current study used Lipinski's rule of five and important physicochemical criteria to assess the drug-likeness of phytochemicals from *Curcuma longa*. The majority of compounds showed adequate hydrogen bonding properties and molecular weights around 500 Da, suggesting good absorption and permeability potential. Even though they supported membrane transport, a significant percentage of compounds had elevated cLog P values, indicating

strong lipophilicity, which may restrict water solubility. Although most phytochemicals met Lipinski`s requirements (≤1 violation), some compounds with greater molecular complexity or lipophilicity might have problems with bioavailability. The majority of natural substances had negative drug-likeness ratings; however, some phytochemicals, including ascorbic acid, β-sitosterol, stigmasterol, vitamin E, and xanthorrhizol, had comparatively higher values, suggesting more potential for drug development. Overall, the findings suggest that many *Curcuma longa* phytochemicals possess acceptable drug-like properties, but optimization strategies may be required for compounds with high lipophilicity or lower drug-likeness scores. To validate their therapeutic applicability, more experimental validation is required.

V. CONCLUSION

The present investigation highlights *Curcuma longa* as a valuable source of phytochemicals with promising drug-development potential. Most screened compounds satisfied essential criteria related to oral bioavailability, including molecular weight, hydrogen bonding capacity, and Lipinski's rule of five compliance. However, certain molecules showed high lipophilicity and lower drug-likeness scores, which may limit solubility and pharmacokinetic performance. Such limitations can be addressed through structural optimization or advanced formulation strategies. Notably, several constituents demonstrated superior profiles and deserve further exploration. Overall, this study confirms the usefulness of computational screening in identifying turmeric-derived candidates for future experimental and therapeutic research.

ABBREVIATIONS

CADD: Computer Aided Drug Design; DLS: Drug Likeness Score; MW: Molecular Weight; cLog P: Calculated Partition Coefficient; HBA: Hydrogen Bond Acceptor; HBD: Hydrogen Bond Donor; RO5: Rule of Five; ADME: Absorption, Distribution, Metabolism and Excretion; SMILES: Simplified Molecular Input Line Entry System; SDF: Structure Data File; QSAR: Quantitative Structure–Activity Relationship; TPSA: Topological Polar Surface Area; NF-κB: Nuclear Factor Kappa B; COX-2: Cyclooxygenase-2; EGFR: Epidermal Growth Factor Receptor; PubChem: Public Chemical Database; MolSoft: Molecular Software Platform.

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