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A REVIEW OF NON-STEROIDAL PHYTOCONSTITUENTS OF *TRIBULUS TERRESTRIS*

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ABSTRACT: The genus *Tribulus* belongs to family Zygophyllaceae comprises approximately 25 species which grow as prostrate hairy herbs in tropical and warm regions. In this review, the literature data on phytochemical investigations of the *Tribulus terrestris* are compiled. The well-recognized groups of secondary metabolites were sterols, alkaloids, flavonoids, and steroidal saponins.

INTRODUCTION: The genus *Tribulus* belongs to family Zygophyllaceae comprises approximately 25 species which grow as prostrate hairy herbs in tropical and warm regions. The fruit resembling a club-shaped crest with sharp spines (each fruit breaking into five triangular-shaped segments, each with two large spines at the tip and several smaller spines). *Tribulus terrestris* L. (Zygophyllaceae), is commonly known as devil's thorn, cat head, puncture vine, goat head and caltrop. It is a herbaceous, annual, prostrate or semierect, diffusely branched herb; native in dry and sandy districts in South Europe to Central Asia and in tropical and South Africa , growing in India, other warm countries such as Ceylon, desert plains, waste ground, weed of cultivation and Mediterranean region. [1-5]

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It is used in folk medicine to increase spermatogenesis, for treatment of eye troubles, edema, abdominal distension, leucorrhea and impotence, as aphrodisiac, galactagogue, anti-inflammatory, antidiarrheal and diuretic.[6]

Chemical Constituents:

The chemical constituents of *Tribulus terrestris* include steroidal saponins, flavonoids, alkaloids, coumarins, amino and organic acids and sterols. Their structures, 1 – 48 are shown below, and their names and the corresponding plant sources are collected in the **Table 1** and **Fig. 1.** As can been seen, steroidal saponins are the predominant constituents of *T. terrestris.* This review focus on non-steroidal phytoconstituents of *T. terrestris.*

1. Sterols: Four phytosterols**,** campesterol (1), stigmasterol (2), β-sitosterol (3) and β-sitosterol glucoside (4) have been isolated from *T. terrestris*.[6-9, 11, 13]

2. Alkaloids: Sixteen alkaloids, (5-20), were obtained from the plant. [6, 9, 10, 13-17]

3. Flavonoids: Nineteen flavonoids (21-39), were found in *T. terrestris.* [18, 19] Kaempferol, quercetin and isorhamnetin and their glycosides are the most common flavonols isolated from this plant.

4. Amino acids: Four amino acids (40-43), were isolated from this plant.[20]

5. Organis acids: Two organic acids (44, 45), were obtained from the plant.[10]

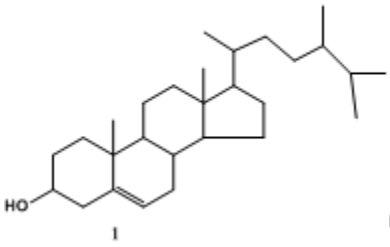
6. Indanone: Only one indanone (48) was obtained from the plant.[9]

7. Coumarins: Only one coumarin; scoparon (49), was isolated from *T. terrestris*.[7]

8. Other Constituents: D-(+)-pinitol (50) was obtained from *T. terrestris*.[7]

TABLE 1: A LIST OF ISOLATED COMPOUNDS FROM *TRIBULUS TERRESTRIS* LINN.:

No	Item	Ref.
I-	**Sterols:**	
1	Campesterol	[6], [7]
2	Stigmasterol	[6], [7], [8]
3	β-Sitosterol	[6], [7], [9], [11]
4	β-Sitosterol glucoside	[13]
II-	**Alkaloids:**	
5	Harmine	[6], [12]
6	Harmol	[6],[13]
7	Harman	[12], [13]
8	Harmaline	[6]
9	Harmalol	[6]
10	Tribulusterine	[9], [10]
11	Aurantiamide acetate	[10]
12	Terrestribisamide	[10]
13	Tribulusamide A	[14]
14	Tribulusamide B	[14], [15]
15	Grossamide	[14]
16	Terrestriamide	[10], [14], [16]
17	N-Trans-feruloyl tyramine	[14], [16]
18	N-Trans-coumaroyl tyramine	[10], [14], [16]
19	Tribulusimide C	[16]
20	Tribulusamide C	[17]
III-	**Flavonoids:**	
21	Kaempferol	[18], [19]
22	Kaempferol 3-*O*-glucoside	[19]
23	Kaempferol 3-*O*-gentiobioside	[18]
24	Kaempferol 3-*O*-rutinoside	[18]
25	Kaempferol 3-*O*-*P*-coumaroyl glucoside	[18]
26	Kaempferol 3-*O*-gentiobioside- 7-*O*-glucoside	[18]
27	Quercetin 3-*O*-glucoside	[18]
28	Quercetin 3-*O*-gentiobioside	[18]
29	Quercetin 3-*O*-rutinoside	[18]
30	Quercetin 3-*O*-gentiotrioside	[18]
31	Quercetin 3-*O*-rhamnogentiobioside	[18]
32	Quercetin 3-*O*-gentiobioside- 7-*O*-glucoside	[18]
33	Isorhamnetin-3-*O*-glucoside	[18]
34	Isorhamnetin 3-*O*-gentiobioside	[18]
35	Isorhamnetin 3-*O*-rutinoside	[18]
36	Isorhamnetin 3-*O*-P-coumaroyl glucoside	[18]
37	Isorhamnetin 3-*O*-gentiotrioside	[18]
38	Isorhamnetin 3,7-di-*O*-glucoside 7- *O*-glucoside	[18]
39	Isorhamnetin 3-*O*-gentiobioside- 7-*O*-glucoside	[18]
IV-	**Amino acids:**	
40	Glutamic acid	[20]
41	Glutamine	[20]
42	Aspartic acid	[20]
43	Asparagine	[20]
V-	**Organic acids:**	
44	Ferulic acid	[10]
45	*p*-Hydroxybenzoic acid	[10]
VI-	**Indanone:**	
46	7-Methyl hydroindanone	[9]
VII-	**Coumarin**	
47	Scoparon	[7]
VIII-	**Others**	[7]
48	D-(+)-Pinitol	



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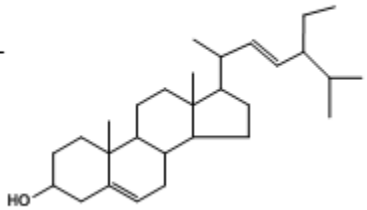

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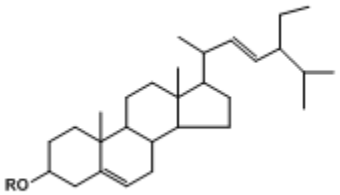
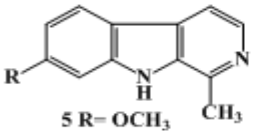
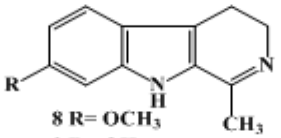


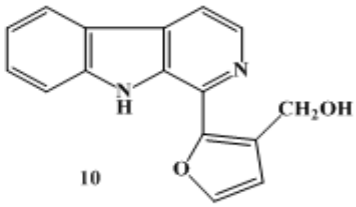
3 R=H
4 R=Glc



5 R= OCH_3
6 R= OH
7 R= H



8 R= OCH_3
9 R= OH



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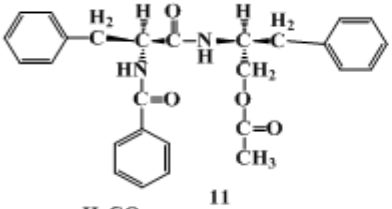

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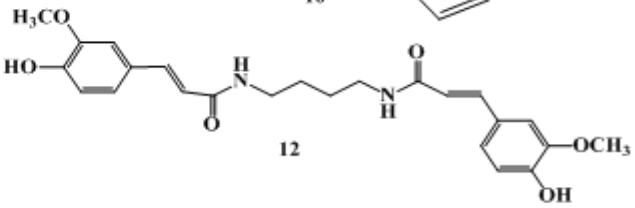

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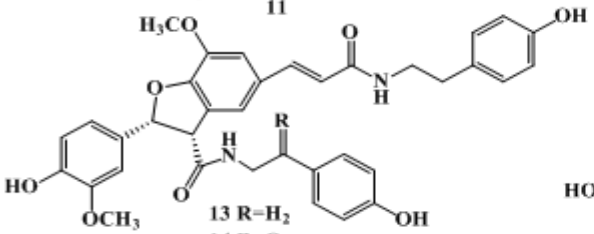
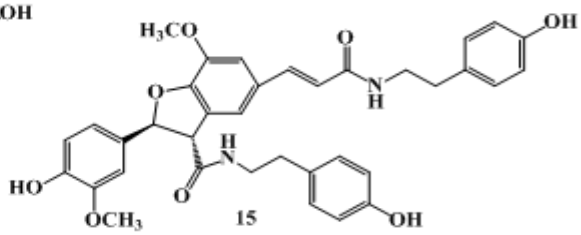


13 R=H_2
14 R=O



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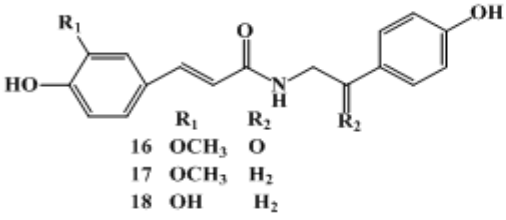
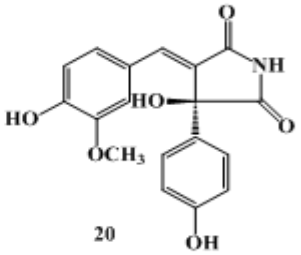


	R_1	R_2
16	OCH_3	O
17	OCH_3	H_2
18	OH	H_2
19	H	O



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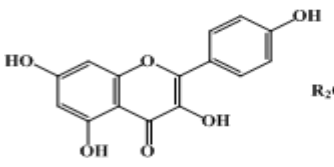
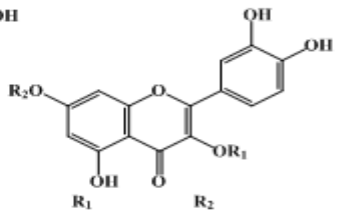
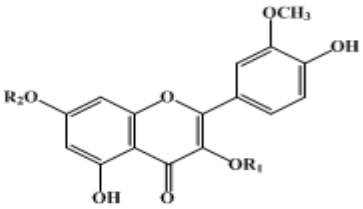


	R_1	R_2
21	H	H
22	Glc	H
23	Gent	H
24	Rut	H
25	*p*-coumaroyl	H
26	Gent	Glc



	R_1	R_2
27	Glc	H
28	Gent	H
29	Rut	H
30	Gentr	H
31	Rhamnogent	H
32	Gent	Glc



	R_1	R_2
33	Glc	H
34	Gent	H
35	Rut	H
36	*p*-coumaroylglc	H
37	Gentr	H
38	Glc	Glc
39	Gent	Glc

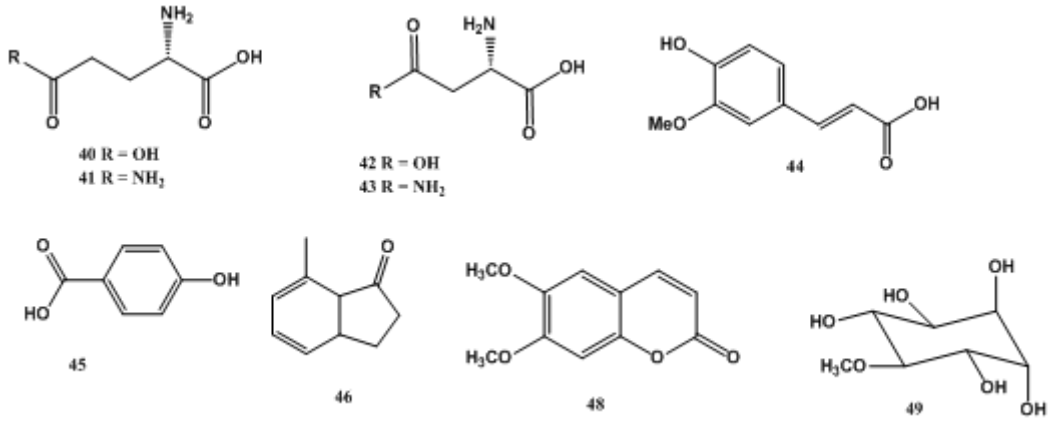


FIG. 1: STRUCTURES OF CONSTITUENTS OF *T. TERRESTRIS*

CONCLUSION: *Tribulus terrestris* is widespread all over the world, and have been used in traditional folk medicine. Phytochemical investigations of this species have revealed that many components exhibit significant biological and pharmacological activities. The typical constituents of this plant are steroidal saponins, flavonoids, alkaloids, coumarins, amino and organic acids and sterols. Further phytochemical and biological studies should be carried out on this species in order to elucidate their active principles and mechanisms of action of the active constituents.

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