CHAPTER 6

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LIST OF PUBLICATIONS

Research Papers : 07


Review Articles : 04


Standardization of Fruit of *Tribulus terrestris* Linn.

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Different parts of *Tribulus terrestris* Linn. are highly prized remedy amongst the people of India. Since ancient period the fruit is used as demulcent, diuretic, antispasmodic and aphrodisiac. Fruits have been identified by their macroscopic and microscopic characters, cell contents, behaviour of powdered drug with different reagents and preliminary phytochemical analysis.

Key Words: *Tribulus terrestris* Linn.

INTRODUCTION

*Tribulus terrestris* Linn. (Gokharu) is a herbaceous plant belonging to the family Zygophyllaceae. Different parts of the plant, viz., root, leaf and fruit are extensively used in the Indian system of medicine since ancient period. An infusion prepared from fresh leaf and stem is a highly prized remedy amongst the people of Southern India in gonorrhoea and dysuria. The juice of the fruit is an emmenagogue.\(^1\)–\(^5\)

Pharmacognostic reports on the root and fruit of the plant are very few and fragmentary.\(^6\)–\(^7\). As pharmacognostic screening of the crude drug is essential for identification of the commercial sample, the same has been undertaken to establish the identifying characters for prevention of admixtures and adulterants in the preparation of Ayurvedic formulation. *T. terrestris* is identified as the smaller variety while a large variety equated with *Pedaliun murex* Linn. (Pedaliaceae) is often used as a substitute for the drug.

EXPERIMENTAL

The plant is widely distributed throughout India up to 11000 ft. *T. terrestris* fruits were procured locally from Modinagar market and identified by Dr. H.B. Naithani, Botanist and Scientist, Forest Tree Seed Laboratory, Silviculture Division, Forest Research Institute, Dehradun.

Macroscopic and microscopic studies were made from free hand. Cell structures of the hard tissues were made by macerating the tissues in conc. HNO\(_3\).
Microscopic Characters: In differentiated tissues as studies from the pericarp, the pericarp is differentiated into epicarp, mesocarp, and endocarp. The epicarp is surrounded by non-glandular epidermis which is 2–3 layers thick which embeds the mesocarp. The mesocarp and endocarp is 3–4 layers thick which embeds non-glandular epidermis and crystals of calcium oxalate. In the mesocarp region some vessels show helical arrangement with tapered ends (Figs. 2 and 3).
Fig. 3. Microscopical characters of fruit of *T. terrestris* Linn.: (A) Epidermal cells and glands, (B) Bundles of fibres, (C) Cells of outer integument, (D) Cells of inner integument, (E) Endosperm cells with oil drops, (F) Part of sclerenchyma fibres, (G) Reticulated fibres
Thin-layer chromatography was performed for 1 h with 50 mL chloroform, 50 mL methanol and finally by distillation under vacuum. 50 mL of 2 N HCl and sodium carbonate was added in successive quantities of 20 mL. The extract was washed with water and evaporated to dryness and dissolved in 2 mL of chloroform.

Test solution and reference solutions were applied on silica gel G plates and the spots were visualized by spraying with anisaldehyde and heated at 120°C for 10 min.

A yellowish green spot (Rf 0.14) identified as both test and reference solution of 0.84, prominent violet spot (Rf 0.14) were also observed.
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Substituted indoles are a class of derivatives of indole, a CNS depressant, anticonvulsant, and analgesic. The S-cyclopropyl moiety is known to potentially increase the anticonvulsant property of fused indole moieties are likely to be effective.

Melting points were taken with a hot stage microscope and were recorded on Shimadzu. Infrared spectra were recorded on Bruker 300 MHz spectrometer. Elemental analysis was performed by a Thermo Finnigan system. The purity of synthesized compounds was confirmed by thin-layer chromatography.

Synthesis of 3-chloro sulfone

Equimolar proportions of 3-amino-3-chloro-2-propenoic acid and added drop by drop and it was stirred for two hours. After the reaction, the mixture was filtered and washed with water. The crude solid was recrystallized from ethanol to get a pure product.

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The air dried, pulverized fruits of *T. terrestris* were exhaustively extracted with ethanol (50%) and petroleum ether (60–80°C) using Soxhlet extractor and concentrated under reduced pressure. The concentrated ethanol extract and petroleum extract were dissolved in dimethyl sulfoxide (DMSO), an inert solvent which was also used as control and found inert against all the tested micro-organisms.

The growth medium used for the test micro-organisms, viz., *Staphylococcus aureus* and *Escherichia coli*, was medium No. 1 (Hi-Media) and for *Candida albicans* Sabouraud dextrose agar (Hi-Media). The petri plates were pre-seeded with 10 mL of growth medium and 4 mL of inoculum in case of *E. coli* and *S. aureus* and 6.5 mL of inoculum in case of *C. albicans*. Paper discs of 6 mm diameter which absorb 0.1 mL of extract (ethanol/pet. ether) and known quantity of standard reference antibiotics were used for comparison of zone of inhibition.

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The morphological characters (colour, odour, size, shape, surface and taste) of the seeds were observed. Foreign organic matter, loss on drying, ash values, extractive values and other physical parameters were determined by pharmacopoeal methods. The behaviour of the powdered seeds with different chemical reagents and fluorescence characters of the alcoholic extract under UV radiation (254 and 366 nm) were also observed. The petroleum ether, ethanol and distilled water extracts were subjected to various chemical tests for the identification of phytoconstituents and ethanolic extract was subjected to thin layer chromatography.

Observation

Seeds are rough, oval in shape, bland in taste, odourless and light brown to pale brown in colour, having a size of about 3–4 mm long and 2–3 mm wide.

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pressure at low temperature (40–50°C). The extract was subjected to thin-layer chromatography using TLC aluminium sheets (Merck), previously activated by heating at 110°C for 30 min. Several solvent systems were tried. The best separation was achieved by the solvent system chloroform : methanol : formamide (80 : 19 : 1) for half an hour, drying in an oven at 110°C for 15 min, seen in UV light and then sprayed with Liebermann-Burchard reagent, Molisch’s reagent and with sulphuric acid, separately. Observations are given in Table-1.

Three spots (Rf 0.83, 0.86 and 0.90) gave positive Liebermann-Burchard test and other three spots having the Rf values 0.36, 0.05 and 0.00 showed pale blue, pale blue and green fluorescence, respectively in UV light, gave positive Molisch’s test.

The phytochemical tests indicated the presence of fixed oil and fat and sterols in petroleum ether extract; carbohydrates, sterols, tannins and proteins in ethanolic extract; and carbohydrates, tannins and proteins in distilled water extract. Chromatography study shows the presence of three different types of sterols and sugars in ethanolic extract.

(Received: 13 Nov 1990)
The seed powder (500 g) was extracted with petroleum ether (60–80°C) and ethanol (95%) successively in a Soxhlet extractor and the extracts were concentrated to dryness in vacuo. Antimicrobial activity of the extracts was determined using paper-disc diffusion method\(^5\) by measuring the zone of inhibition. The extracts at a concentration of 30 µg and 60 µg/disc were screened for their antimicrobial activity using *Bacillus subtilis*, *Staphylococcus aureus*, *Escherichia coli*, *Pseudomonas aeruginosa*, *Aspergillus niger*, *Aspergillus flavus*, *Candida albicans* and *Fusarium oxysporum* as test organisms.

Nutrient agar (Hi Media) and sabouraud dextrose agar (Hi Media) were used as media for bacteria and fungi respectively. Control experiment was carried out under similar condition by using ceftazidime and miconazole as a standard for antibacterial and antifungal activity, respectively. The petri dishes were incubated at 37°C for 48 h. The zones of inhibition are recorded in Table-1.

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EXPERIMENTAL

The seeds of *Dolichos biflorus* were procured locally from Modinagar market and identified by Dr. H.B. Naithani, Botanist and Scientist, Forest Tree Seed Laboratory, Silviculture Division, Forest Research Institute, Dehradun.

Macroscopic and microscopic studies were made from free hand. Seeds were powdered by crushing in electric grinder. Behaviour of powdered drugs was studied by treating with different chemical reagents. Foreign organic matter, loss on drying, ash values, extractive values and other physical parameters on seeds of *D. biflorus* Linn. were determined as per I.P. Methods. Preliminary investigations on fluorescence behaviour of ethanol extracts under long (365 nm) and short (257 nm) UV radiation were also studied.

RESULTS AND DISCUSSION

Macroscopic Characters: Fruits contain 5–7 seeds, compressed, hard, surface smooth, ellipsoid, flattened, 4–6 mm long and 4 mm wide, micropyle prominent, greyish to reddish brown in colour (Fig. 1).

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Fig. 2. Microscopic characters of A. (A) Thin section of the leaf, (B) Powder characteristics, showing parenchymatous cells and starch granules.
Preliminary phytochemical analysis

Qualitative examination of the various solvent extracts of seeds indicates the presence of fixed oil, carbohydrate, protein, fat and sterols\(^7\).

Thin-layer chromatography

**Part I:** Seeds powder was defatted with petroleum ether (60–80°C) in soxhlet extractor. 1.0 g of defatted seed powder was warmed with 10 mL ethanol (70% v/v) for 30 min and centrifuged. The residue was re-extracted with ethanol and centrifuged. This process was repeated (8–9 times) till the supernatant was negative to ninhydrin test. All the supernatants were combined and evaporated to dryness *in vacuo*, dissolved in 0.5–1.0 mL distilled water and centrifuged. The clear supernatant was subjected to thin-layer chromatography by using TLC aluminium sheets (Merck). \(n\)-Butanol : acetic acid : water and 96% ethanol : water were used as mobile phase. The chromatograms were sprayed with ninhydrin (0.1% w/v) in butanol. Observations are given in Table-1.

(Received: 5 June 1992)
ANTIMICROBIAL ACTIVITY OF *DOLICHOS BIFLORUS* SEEDS

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ABSTRACT

The antimicrobial activity of the seeds of *Dolichos biflorus* has been studied using petroleum ether and ethanol extracts against various micro-organisms by disc diffusion method. The ethanol extract at a concentration of 25 and 50 µg/disc showed significant activity against the bacterial organisms investigated.

*Dolichos biflorus* Linn (Leguminosae) is also known as horse gram. Seed extract is useful for the patients suffering from urinary or kidney troubles, eye troubles, piles, enlargement of the spleen and pain in the liver\(^{1-7}\).

The seeds of *Dolichos biflorus* were procured locally from Modinagar market and identified by Dr H. B. Naithani, Botanist and Scientist, Forest Tree Seed Laboratory, Silviculture Division, Forest Research Institute, Dehradun.

Antimicrobial Activity

Seed powder (500 g) was successively extracted with petroleum ether (60-80 °C) and ethanol (95%) in a Soxhlet extractor. The extracts were concentrated to dryness *in vacuo*. The antimicrobial activity of the extracts was evaluated by disc diffusion method\(^4\). Both the extracts at a concentration of 25 µg and 50 µg were screened for their antimicrobial activity using *Bacillus subtilis*, *Staphylococcus aureus*, *Escherichia coli*, *Pseudomonas aeruginosa*, *Aspergillus niger* and *Candida albicans* as test organisms.

The Ceftazidime and Ketoconazole were used as standard for antibacterial and antifungal activity respectively. Nutrient agar (Hi Media) and Sabouraud dextrose agar (Hi Media) were used as media for bacteria and fungi respectively. The plates were incubated at 37 °C for 48 hrs. for bacteria and at 26 ± 1°C for 72 hrs. for fungi. The zone of inhibition was calculated by measuring the minimum dimension of the zone of no microbial growth around the disc.

The study reveals that the ethanol extract exhibited significant activity against all the tested bacterial organisms at the concentration of 25 µg and 50 µg. The petroleum ether extract at the concentration of 50 µg showed a slight antibacterial activity against *Escherichia coli* and *Pseudomonas aeruginosa*. None of the extracts were found active against the tested fungal organisms.

REFERENCES


* For correspondence

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PHYTOCHEMICAL AND PHARMACOLOGICAL STUDIES ON SEEDS OF SAPINDUS TRIFOLIATUS

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ABSTRACT
Physico-chemical characteristics of fixed oil and fatty acids of the seed kernels of Sapindus trifoliatus were determined. Three out of five fatty acids were indentified to be palmitic, stearic and oleic acids. One out of two unsaponifiable components was identified to be β-sitosterol. Unsaponifiable matter showed increase in force of contraction on frog's heart and slight protection against electro-shock induced convulsions.

INTRODUCTION
Different parts of the Sapindus trifoliatus Linn. (Sapindaceae), also known as Indian Soap-nut, are mentioned in indigenous systems of medicine because of their therapeutic values. Pessaries made out of the seed kernels are used in amenorrhoea and to stimulate the uterus facilitating childbirth1. The seed oil is employed medicinally as well as in the manufacture of soap2. Seed kernels contain 44.7% of a non-drying fatty oil comprising olein (61.5%), eicosanin (21.9%), stearin (8.5%), palmitin (5.6%) and lignocerin (2.5%). Various physico-chemical characteristics of phospholipid fraction of seed-oil have been reported35.

Considering these reports on the medical utility of the S. trifoliatus an attempt was made for systemic phytochemical and pharmacological investigations of its seeds.

EXPERIMENTAL

Proximate analysis and successive solvent extraction of the authenticated market seeds of S. trifoliatus leading to qualitative tests for various constituents was taken up. Fixed oil from seed kernels was extracted and studied for its physico-chemical characteristics. Unsaponifiable matter was studied for its pharmacological profile.

1. Proximate Analysis and Qualitative Examination of Seeds.

Proximate analysis of seed kernels was carried out to lay down

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Proximate Analysis of Seed Kernels of *Sapindus trifoliatus* Linn.

<table>
<thead>
<tr>
<th>Determination</th>
<th>% w/w</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture content</td>
<td>6.68</td>
</tr>
<tr>
<td>Total ash</td>
<td>4.00</td>
</tr>
<tr>
<td>Acid insoluble ash</td>
<td>0.298</td>
</tr>
<tr>
<td>Sulphated ash</td>
<td>45.88</td>
</tr>
<tr>
<td>Alcohol (95%) soluble extractive</td>
<td>9.77</td>
</tr>
<tr>
<td>Water soluble extractive</td>
<td>29.17</td>
</tr>
</tbody>
</table>

Table - II

Physico-chemical Characteristics of Seed Kernel Derived Fixed Oil of *Sapindus trifoliatus* Linn.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Refractive index (20°C)</td>
<td>1.4675</td>
</tr>
<tr>
<td>Specific gravity (25°C)</td>
<td>0.8964</td>
</tr>
<tr>
<td>Acid value</td>
<td>1.54</td>
</tr>
<tr>
<td>Saponification value</td>
<td>191.90</td>
</tr>
<tr>
<td>Iodine value</td>
<td>56.96</td>
</tr>
<tr>
<td>Acetyl value</td>
<td>NIL</td>
</tr>
<tr>
<td>Unsaponifiable matter</td>
<td>0.60 w/w</td>
</tr>
</tbody>
</table>

Table - III

Physico-chemical Characteristics of Fatty Acids and Their Fractions from Seed Kernels of *Sapindus trifoliatus* Linn.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Mixed fatty acids</th>
<th>Saturated fatty acids</th>
<th>Unsaturated fatty acids</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neutralisation number</td>
<td>159.1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Mean molecular weight</td>
<td>352.6</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Saponification value</td>
<td>231.3</td>
<td>223.8</td>
<td>234.7</td>
</tr>
<tr>
<td>Iodine value</td>
<td>69.2</td>
<td>0.45</td>
<td>89.1</td>
</tr>
</tbody>
</table>
Saturated and unsaturated fatty acids obtained from seed kernel oil were converted into neutral methyl esters \(^7,8\) and separated by thin layer chromatography\(^9,10\). The best separation was achieved by solvent system Pet. ether (60-80\(^\circ\)) - ethyl acetate (95 : 5). Co-TLC with authentic samples of esters of stearic, palmitic and oleic acids was performed.

Unsaponifiable matter (0.6%) obtained after saponification of fixed oil was tested for the presence of sterols by (a) Hesse's test (b) Libermann's test and (c) Libermann-Burchard's test. Co-TLC\(^12\) of isolated fractions of unsaponifiable matter using solvent system pet. ether (60-80\(^\circ\)) - ethyl acetate (95 : 5) with

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(C) Effect on Uterus

Addition of 2 to 20 mg) of organ bath (effect on isolated
virgin female

(D) Effect on Convulsions
## Table - III
Physico-chemical Characteristics of Fatty Acids and Their Fractions from Seed Kernels of *Sapindus trifoliatus* Linn.

<table>
<thead>
<tr>
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<tr>
<td>Iodine value</td>
<td>69.2</td>
<td>0.45</td>
<td>89.1</td>
</tr>
<tr>
<td>Solvent system</td>
<td>No. of spots</td>
<td>Esters of saturated fatty acids</td>
<td></td>
</tr>
<tr>
<td>---------------</td>
<td>-------------</td>
<td>---------------------------------</td>
<td></td>
</tr>
<tr>
<td>Pet. ether - Ethyl acetate (95:5)</td>
<td>3</td>
<td>0.85, 0.72, 0.63</td>
<td></td>
</tr>
<tr>
<td>-Do-</td>
<td>2</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>-Do-</td>
<td>2</td>
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</table>


Leaves opposite, abruptly pinnate, one of each pair usually smaller than the other, sometimes wanting altogether; Stipules lanceolate, hairy; leaflets 3-6 pairs, oblong, mucronate, villous on both the surfaces; base rounded oblique; petioles minute, hairy. Flowers axillary or leaf opposed, yellow, solitary, hairy; pedicels filiform. Sepals lanceolate, acute, hairy. Petals oblongobloid, claw short, hairy; stamens 10, inserted on the base of the disk, alternately longer and shorter, the latter with a small gland outside, filaments filiform, naked ovary sessile, hirsute, 5-12 lobed and celled; Style short; stigmas 5-12; ovules superposed. Fruit globose with 5-hairy woodycocci, each with 2 spines. Seeds many in each coccus, with transverse partitions.

PHYTOCHEMICAL STUDIES

Fruit contains an alkaloid in traces (0.001%); fixed oil 3.5% consisting mainly of unsaturated acids, essential oil in very small quantities, resins and fair amounts of nitrates. Harman occurs in the herb and harmine in seeds. The plant contains saponins which on hydrolysis yield steroidal sapogenins. Kaempferol, Keempferol-3-glucoside, Kaempferol-3-glucoside, Scabiosa, anemia and opthalmia.

The root is good stomachic and appetiser, diuretic and carminative.

The entire plant, but more particularly the fruits are used in medicines. It was given a good trial in Bright’s disease with dropsy. The diuretic property of the drug is due to the presence of large quantities of nitrates present as well as the essential oil which occurs in the seeds.

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rutinoside and a flavonoid tribuloside have been isolated from leaves and fruits.

Tribulus species cause the disease photosensitivity and geeldikkop in animals due to presence of an icterogenic principle in the plant was first studied by Henrici et al. and later by Brockmann, et al.

Diosgenin, Ruscogenin, Gitogenin and 25-D-Spirosta-3, 5-Diene obtained by hydrolysis of crude saponin isolated from T. terrestris.

Dried fruits of T. terrestris L. contains 5% of semidrying oil, peroxides, diastase, traces of glucosides, resins, protein and a large amount of inorganic matters. Shah et al. reported the presence of vit. C in the whole plant (78.00-141.66 mg/100 gm).

Nath, et al. reported crude protein 12.06%, ether extract 2.61%; crude fibre 27.7%; nitrogen free extract 40.83%; total carbohydrates 68.61%; total ash 16.72%; calcium 4.21% and phosphorus 0.24%.

Three steroidal sapogenins, diosgenin, gitogenin and chologenin were isolated by Gheorghiu et al. Out of 10 steroidal substances 3 saponins C, F & G (Fig. 1) were isolated from overground part of T. terrestris, with the help of repeated column chromatography and thin-layer chromatography by Tomowa et al. Saponin F proved to be a new product: tigogenin-3-diglucorhamnoside, named by them terrestroside F, the partial structure of which was determined on the basis of the hydrolytic products: aglycon tigogenin (identified by m.p., mixed m.p.; I.R. and mass spectrum; acetyl derivative) and an oligosaccharide part rhamnose: glucose (2:1). The saponins C and G proved to be a mixture of two tigogenin and diosgenin glycosides each. The mixture of aglycones was separated by column chromatography on silica gel containing silver nitrate and identified by the above mentioned indices as tigogenin and diosgenin. In the hydrolysates the sugars glucose and rhamnose were proved. A flavonoid was also isolated which was identified as astragaline (caemferol-3-glucoside).

Purushothaman, et al. isolated two steroid sapogenins hecogenin (3-$\beta$-hydroxy-5$x$-spirostan 12-one) and neotigogenin $5\alpha$: 22 55s-spirostan-3$\beta$-01) with the help of chromatography over silica gel from the chloroform extract of whole plant of T. terrestris, compound A, C27 H44 O3 m.p. 199-201°C, $\lambda$max 3500 cm$^{-1}$. Its monoacetate C27 H46 O4, m.p. 170°C ($\lambda$max 1725 and 1240 cm$^{-1}$). Compound B, C27 H42 O4, m.p. 243°C, contains a hydroxyl group (3460 cm$^{-1}$) and a six membered ring ketone (1710 cm$^{-1}$) and its monoacetate, C27 H48 O5, m.p. 240°C. Hecogenin was also reported by Tomowa, et al.

Tomowa et al. established the structure of isolated glycoside from the over ground part of T. terrestris L. as furostanol bisglycoside protodioscin (Fig. - 2) which upon acid hydrolysis yield the spirostanol diosgenin, tigogenin, glucose and rhamnose. Mahato et al. analysed for diosgenin content from four samples of T. terrestris L. growing under different climate condition. The highest yield of diosgenin was 0.21% and the lowest yield was 0.06%. Other steroid constituents characterised were $\beta$-sitosterol, stigmasterol and neotigogenin.

Altogether 22 amino acids were identified in the root nodules of T. terrestris L. and qualitatively analysed by Ather, et al. Glutamic acid, Glutamine, Aspartic acid and Asparagine being the major amino acids. Other amino acids are cystine, cysteine, Tryptophan, serine, proline, Glycine, Alanine, Valine, Methionine, Leucine, Isoleucine, Tyrosine, Phenylalanine, y-Amino butyric acid, Ornithine, Lysine, Histidine and Arginine.

Chakravarti, et al. isolated Diosgenin from the weeds of T. terrestris L. Seth, et al., reported the Sodium, potassium, and Calcium contents in the fruits of T. terrestris L. Arti Duhan, et al. reported a rich source of calcium in the leaves of T. terrestris L.
Afria\textsuperscript{20} showed that young leaves possessed the maximum concentration of protein (92.5 mg/gm dry wt.) and most of the individual free amino acids\textsuperscript{15}, as compared with mature leaves and immature fruits.

Saleh et al\textsuperscript{21}. detected 25 flavonoid glycosides in *T. terrestris* L. The glycosides belong to the common flavonols, kaempferol, quercetin and isorhamnetin with the 3-gentiobiosides as the major glycosides. Singh et al\textsuperscript{22} isolated Diosgenin and Tigogenin from over ground part of *T. terrestris* L.

Prakash, et al\textsuperscript{23} confirmed 4 alkaloids harmine, harmaline, harman and tetrahydroharmine in the plant *T. terrestris*. Bourke et al\textsuperscript{24} extracted 5 compounds in the alkaloid mixture of *T. terrestris* L., only 2 were present in large amount and identifiable as the structurally related beta-carboline indoleamines harmame and norharmame.

Zafar, R. et al\textsuperscript{25}., isolated diosgenin, hecogenin, ruscogenin, spirosa-3,5-diene from flowers of *T. terrestris* L. Two compounds of cinnamic amide derivative named terrestriamide and 7-methylhydroindaneone-1, were isolated from *T. terrestris* L for the first time\textsuperscript{26}.

**PHARMACOLOGICAL SCREENING**

Pharmacological study of *T. terrestris* L have been carried out by Bose et al\textsuperscript{27}. The minor alkaloidal fraction did not affect the blood pressure of the dog, but depressed the frog heart in *situ*. It produced inhibition of acetyl choline induced contraction of isolated intestine of rats and also of frog rectus muscle and had moderate diuretic effect. The aqueous fraction induced mild hypotension, showed anti-acetylcholine like action on the rat intestine. The seeds of the *T. terrestris* was found to be toxic to the liver of rats\textsuperscript{28}. No toxic symptoms were observed by Sastry\textsuperscript{29}. Seth et al\textsuperscript{30}., reported that water soluble extract of *T. terrestris* L had a potent stimulant effect on the isolated heart muscle in hypodynamic state. Chakraborty et al\textsuperscript{31}., studied the various pharmacological action and reported that an alcoholic extract of the plant produced a sharp vasodepression in anaesthetised dogs mediated through cholinergic mechanism. It also possessed some characteristic changes in C.N.S. and in carbohydrate metabolism. Prakash et al\textsuperscript{23}., reported marked C.N.S. stimulant activity in adult albino mice in *T. terrestris* L. Bourke et al\textsuperscript{32}., reported locomotor disorders with the *T. terrestris* L. due to beta carboline alkaloid.

Bourke et al\textsuperscript{24} administered harmame and norharmame from alkaloid extract of *T. terrestris* L to normal sheep and showed that both compounds were able to cause locomotor effects. Antiurolithiatic activity in the alcoholic extract of *T. terrestris* was studied by Anand, R et al\textsuperscript{33}. Singh et al\textsuperscript{34}., evaluated the diuretic action with minimal side effects of *T. terrestris* L on the albino rat.

Administration of the fractions of ethanolic extract of *T. terrestris* fruits by Anand R. et al\textsuperscript{35} resulted in a varying degree of reduction in deposition of stone as compared to the untreated control animals.

Sangeeta et al\textsuperscript{36}., observed the effect of an aqueous extract of *T. terrestris* on the metabolism of oxalate in male rats fed sodium glycolate, that lowering hyperoxaluria seemed to be mainly mediated through its inhibitory action on GAO and GAD, and its enhanced production of glyoxylate. Vijaya S. et al\textsuperscript{37}., examined in vitro that aqueous extract of *T. terrestris* L. inhibited Amylase and activated Lipase digestive enzyme.

**ANTI MICROBIAL SCREENING**

George, et al\textsuperscript{38}., reported that alcoholic and aqueous extracts of plant or leaf are effective against *S. aureus* and *E. Coli* whereas the aqueous extract of seeds was only effective against *S. aureus*. Joshi et al\textsuperscript{39}., studied the antibacterial activity of 0.9% saline solution extract of fruit material, against the *S. aureus* and *E. Coli*. Dhar, et al\textsuperscript{40}., reported the antimicrobial activity of 50% ethanolic extract of the seed and
aerial parts of *T. terrestris* against the *B. Subtilis*, *S. Typhi*, *A. tumefaciens*, *E. Coli* and *M. tuberculosis*.

Singh, et al\(^4\) reported that the ethanolic extract (95%) of *T. terrestris* (fruits) is completely active against *E. coli*.

Ikram, M. et al\(^2\) studied the antimicrobial activity of ethanolic extract (95%) of *T. terrestris* (stem & leaf) against *B. Subtilis* by hole-plate diffusion method. Surinder Jit et al\(^3\) reported maximum activity in ether and 50% ethanolic (1:1) extract of *T. terrestris* shoot against *S. aureus*.

Tewaj, H.A.A. et al\(^4\) found the molluscidal activity at 50-100 ppm and most toxic at 100-200 ppm concentration against *Bulinus truncatus* in the aqueous extract of *T. terrestris* L.

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Review on Phytochemical and Pharmacological Aspects of *Cichorium intybus* Linn.

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*Cichorium intybus* Linn. (Compositae) is an important medicinal plant which finds use in Ayurveda and Unani systems of medicine, especially in inflammations. It is useful in thirst, headache, ophthalmia, throat inflammation, enlargement of the spleen, fever, vomiting and diarrhoea etc. An attempt has been made to review the phytochemical and pharmacological work done on *Cichorium intybus* Linn.

Key Words: Review, *Cichorium intybus* Linn., Phytochemical and pharmacological properties.

INTRODUCTION

*Cichorium* is a genus of thirteen species belonging to the family Compositae. Two species, viz., *C. endivia* and *C. intybus*, are of common occurrence in N.W. India up to 6,000 ft., Waziristan, Baluchistan, W. Asia and Europe. *C. intybus* Linn. has been described to be of great medicinal value. *C. intybus* is a perennial herb, 1–3 ft. high, with fleshy tap root up to $2^{1/2}$ ft. in length. The plant is commonly known in Hindi: Kasni; Punjabi: Hand; English: Chicory†.

Morphology

An erect, usually rough and more or less glandular, perennial herb; stems 0.3–0.9 m. angled or grooved; branches tough, rigid, spreading; radical and lower leaves 7.5–15 cm. pinnatifid lobes toothed, pointing downwards; upper leaves alternate, small, entire, heads ligulate, 2.5–3.8 cm diam.; flowers bright blue; pappus of 1 or 2 series of short, blunt erect scales; ligules very long, spreading, 5-toothed; style-arms long; achenes smooth, angled, crowned with the ring of pappus scales.

The plant is a good tonic, cooling, useful in thirst, headache, ophthalmia, throat inflammation, enlargement of the spleen, fever, vomiting and diarrhoea. The root is stomachic and diuretic; enriches and purifies the blood; lessens inflammation and pain in the joints. The seeds are tonic to the brain, alexiteric, appetiser; useful in ophthalmia, biliousness, lumbago, troubles of the spleen and asthma. The leaves are applied topically to lessen pain in the joints and have also hypoglycaemic effect. The flowers are used in liver disorders.

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The anthocyanins identified as delphinidin 3-O-glucoside, delphinidin 3-O-(6-O-malonyl glucoside), and the known compounds were delphinidin 3-O-(6-O-acetyl glucoside) 3, and delphinidin 3-O-(6-O-glucosyl arabinoside). In addition, 3-O-p-coumaryl glycoside was also detected.
Balbaa et al. observed quinidine like action on isolated toads's heart in roots of each of eight varieties of C. intybus L. Prakash et al. observed 84% resorptive activity at a dose of 200 mg/kg body weight in 50% ethanolic extract of C. intybus L.

Panday observed bradycardia in normal and hypodynamic heart of frog and a fall in B.P. with a corresponding increase in respiratory rates in dog treated with alcoholic extract of seeds of C. intybus L. Handa et al. reported cholagogue activity in alcoholic extract of the C. intybus L.

A significant decrease in the triglyceride level of liver, plasma and heart coupled with decreased cholesterol level in plasma was observed in rats, fed with high level of saturated fat supplemented with 5% roots of C. intybus L. as compared to high fat fed group, by Kaur et al. Misra, et al. found antimalarial activity against erythrocytic stages of Plasmodium berghei only in vitro in alcoholic extract of seeds of C. intybus L.

Gadgoli et al. found hepatoprotective activity against carbon tetrachloride and paracetamol induced toxicity in rats, treated each with chloroform, methanol and water extract of seeds of Cichorium intybus L.
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(Received: 2)
D. priuriens (Cow hedge) and D. soja (Soya bean) are extensively cultivated and its seeds are used as food and leaves and stem as fodder. The seeds have been used in the indigenous system of medicine for a long time as astringent, anthelmintic, nerve tonic, diuretic, aphrodisiac and antipyretic etc. The plant is commonly known in Hindi: Kulthi; Sanskrit: Kulastha; Bengali: Kulti, Kurti-kalai; Marathi: Kulith, Kulthi; Gujarati: Kulti; Malayalam: Kullu, Kollu; Telugu: Vlavalu; Tamil: Kollu.

Morphology

Stems: Very wide climbing slender, slightly pubescent, oblong blunt, sub-glabrescent leaflets on a petiole, lateral ones very unequal sided, stipullae minute and linear.

Flowers: 1–3 on very short pedicels in the axils of the leaves. Calyx slightly downy with upper teeth quite connate, the side lanceolate and the lowest one linear. Corolla yellow.

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bacteria, along with compounds such as oestrogens, L. Ingham et al.\textsuperscript{10} isolated
5-neohesperidoside isoflavone from the bacteria treated by D. biflorus L.
Mitra et al.\textsuperscript{12} isolated 3-oxosteroid: stigmastenedoic acid.
L. Akihisa, et al.\textsuperscript{13} isolated 3-oxosteroid: stigmastenedoic acid.
Dube\textsuperscript{14} identified L-ascorbic acid along with citric and aspartic acid from seeds.

**Pharmacological Screening**

The seeds are diuretic; tonic for kidney; cure hiccough, eye related problems, leucorrhoea and menstruation. They also have anti-implantation activity and are used as a cure for the petroleum ether, alcohol extract.

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When the package comes into contact with the food, the mass is transferred from the food into the packaging material. This transfer can be affected by many physical factors.

Recently, numerous studies have been conducted to understand how mass is transferred through migration of components. Modeling studies try to simulate this process. In these studies, packaging material is a fundamental component, and possible contamination is a result of the transfer. Quantitative aspects of these processes, such as the mass of the packaging material, are another variable of interest. The work of Brown et al. extracted certain parameters, and the work of Begley et al. tested nylon packing material. Their results described possible migrants were studied.

Along with the main parameters, the laboratory evaluated the polymer used to improve the performance.
Morphology
Leaves are 7.5-10 cm long, rachis grooved, more or less pubescent with a conical gland axis of the leaves, the upper crowded, common peduncle in fruit not exceeding 4 cm long; pedicels in fruit rarely exceeding 8 mm long. Calyx glabrous, divided to the base; segments 5 mm long, ovate, acute, spreading. Petals 5, pale yellow, subequal, 8 by 2.5 mm, oblong, obtuse, spreading, the upper petal 2-lobed, the others entire. Stamens 10, the 3 upper reduced to minute staminodes, the remaining 7 perfect and subequal.

Pods 12.5-20 cm by 4.5 mm, subtetragonal, much curved when young, obliquely septe, not reticulate and sutures are very broad. Seeds 25-30, rhombohedral, with the long axis in the direction of the pod
gentiobioside and a new anthraquinone chrysophanol-1-β- gentiobioside from etanol extract of seeds of *C. torra* L.. Niranjan *et al* (9) isolated proteins from seeds of *C. torra* L.. Singh *et al* (10) identified, glucose, galactose, xylose and raffinose from defatted seeds of *C. torra* Linn using T.L.C. method. Further Katoch *et al* (11) reported that immature seeds of the plant had higher level of crude protein (26.60 %) than the mature seeds (22.62%). Chakrabarty *et al* (12,13) reported 3,5,8,3', 4',5'-hexahydroxyflavone, hydroxy coumarin, aurapertol, euphol, basseol, emodin, rhein, palmitic acid, isostearic acid, behenic acid, ethyl arachidate and β-sitosterol in stem bark and ethyl arachidate, β-sitosterol, behenic acid, palmitic acid, marginic acid, euphol and 3,5,8,3',4',5'-isolated from *C. torra* L. along with 5-lysolalatemin and 3-hydroxy-1,2,5,6-tetrol.

The crude extract of *C. torra* L. was given to mice in an intravenous dose of 200 mg/ Kg while saline was administered as a control.

The extract exhibited a significant anti-tumoral activity in the culture of tetrachloridemicarcinoma cells as the pyrone group was found to be significant. The extract significantly inhibited galactosam
inhibitory concentration between 1.56 mg/ ml to 12.5 mg/ ml of the water – methanol – chloroform- and diethyl ether/ ethanol-extract of C. tora L. against E. coli, Staphylococcus aureus, Pseudomonas aeruginosa and Candida albicans, using both cup plate and disc diffusion method.

Mukherjee et al (28) found antifungal activity of the dealcoholized extract of the leaves of Cassia tora Linn.

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